

# **NORTH EAST VICTORIA**

# **COMPREHENSIVE REGIONAL**

# **ASSESSMENT REPORT**

**August 1998**

**Prepared by officials to support the North East Regional Forest Agreement Process**

Published by the joint Commonwealth and Victorian Regional Forest Agreement (RFA) Steering Committee.

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## FOREWORD

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This report describes the Comprehensive Regional Assessment (CRA) that has been undertaken in Victoria's North East Regional Forest Agreement (RFA) region.

The CRA has examined the natural, cultural, social, resource and economic values in the forests of the North East. This involved detailed assessments of biodiversity, old-growth forest, national estate, wilderness, world heritage, social values, forest resources and the forest based industries and ecologically sustainable forest management.

Following the release of this CRA report, meetings with the local community and interest groups will be held to discuss the documentation and its implications, and to consider the issues that will need to be addressed in the RFA. Following consultation with the local community and interested groups, this assessment will provide a basis for the Victorian and Commonwealth Governments to develop a Regional Forest Agreement for the North East region.

The RFA will define the commitments made by both Governments to forest conservation, forest use and development, and the development of those industries based on the forest resources of the region. The RFA is intended to operate for 20 years.

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# **1. BACKGROUND TO THE RFA PROCESS**

## **1.1 INTRODUCTION**

For over two decades the competing demands of conservation and industry on our forests have been an area of debate and controversy. The National Forest Policy Statement (NFPS), agreed by the Commonwealth, State and Territory Governments, provides the framework for the resolution of this issue.

The NFPS sets out how the Commonwealth and States will jointly aim to achieve ecologically sustainable management of forests through comprehensive assessments of the natural, cultural, economic, and social values of Australia's forests and negotiated Regional Forest Agreements that will:

- establish and manage forest reserve systems which are comprehensive, adequate and representative (CAR reserve system);
- establish ecologically sustainable management of forests; and
- develop an efficient, internationally competitive timber industry.

A central aim in the RFA process is to take account of the full range of forest values and consider both benefits and costs in making policy or resource use decisions. RFAs also recognise the range of economic and environmental obligations of each tier of government in managing and protecting forest values.

The detailed information required to negotiate each RFA is drawn together through a comprehensive regional assessment (CRA) of forest values for the regions agreed by the Commonwealth and each State. In Victoria, East Gippsland became the first region in Australia for which a CRA was completed followed by an RFA. Subsequently, CRAs and RFAs have been completed for Tasmania and the Central Highlands region of Victoria. The major steps in the RFA process are shown in Figure 1.1 and are described in more detail in the next section.

RFAs are intended to provide stability through the establishment of a sustainable resource base for industry, while at the same time ensuring the protection of Australia's biodiversity, old growth and wilderness through a CAR reserve system and complementary off-reserve management.

## **1.2 LEGISLATIVE AND POLICY FRAMEWORK FOR THE RFA PROCESS**

The following is a discussion of Commonwealth and State legislation and policies which are the framework for the RFA process.

### **The National Forest Policy Statement**

The NFPS sets out the vision of the Commonwealth and State Governments for Australia's forests and forest industries based on the principles of ecologically sustainable forest management. The elements of that vision are described in the NFPS and comprise:

- forest conservation;
- wood production and industry development;
- integrated decision making and management;
- private native forests;
- plantations;
- water supply and catchment management;
- tourism and other economic and social opportunities;
- employment, workforce education and training;
- public awareness, education and involvement;
- research and development; and
- international responsibilities.

The RFA process implements key elements of the NFPS.

## **National Reserve Criteria**

In accordance with the NFPS, the Joint Australian and New Zealand Environment and Conservation Council (ANZECC) and the Ministerial Council on Forestry, Fisheries and Aquaculture (MCFFA) NFPS Implementation Sub-committee - known as JANIS - agreed on national criteria for establishing a CAR reserve system (JANIS 1997).

The National Reserve Criteria include provision for the protection of biodiversity, old growth and wilderness, as well as recognising the role of off-reserve management in meeting conservation objectives. Further details of the criteria are provided in the biodiversity, old growth and wilderness chapters of this report.

## **Commonwealth Legislation**

The Commonwealth's principal involvement in forest issues derives from the *Export Control Act 1982* which regulates the export of woodchips and unprocessed wood. In assessing applications for export under this Act, the relevant Minister is required to ensure that a range of Commonwealth obligations are met. The major legislation includes:

- *Australian Heritage Commission Act 1975*
- *Endangered Species Protection Act 1992*
- *Environment Protection (Impact of Proposals) Act 1974*
- *World Heritage Properties Conservation Act 1983.*

## **Victorian Legislation**

The States and Territories have enacted legislation to fulfil their responsibilities for the protection and management of values and resources in public and private forests. The major Victorian legislation includes:

- *Archaeological and Aboriginal Relics Preservation Act 1972*
- *Catchment and Land Protection Act 1994*
- *Conservation, Forests and Lands Act 1987*
- *Crown Land (Reserves) Act 1978*
- *Country Fire Authority Act 1958*
- *Environment Conservation Council Act 1997*
- *Environment Effects Act 1978*
- *Environment Protection Act 1970*
- *Extractive Industries Development Act 1995*
- *Fisheries Act 1995*
- *Flora and Fauna Guarantee Act 1988*
- *Forests Act 1958*
- *Heritage Act 1995*
- *Heritage Rivers Act 1992*
- *Land Act 1958*
- *Land Conservation (Vehicle Control) Act 1972*
- *Mineral Resources Development Act 1990*
- *National Parks Act 1975*
- *Planning and Environment Act 1987*
- *Reference Areas Act 1978*
- *Victorian Conservation Trust Act 1972*
- *Victorian Plantations Corporation Act 1993*
- *Water Act 1989*
- *Wildlife Act 1975.*

Further details on the scope and operation of the legislation in relation to the RFA process is provided in Appendix 1.

## **Indigenous Issues**

The RFA process addresses indigenous issues in two distinct ways: consultation on the outcomes and process in general (as part of the wider consultation process); and cultural heritage, through the National Estate assessment.

As with all communities and stakeholder groups with an interest in the North East RFA, Aboriginal communities in the region and appropriate representative bodies are already involved and will continue to be consulted throughout the RFA process.

The *Native Title Act 1993* recognises and protects native title rights and interests. In recognition of this Act:

- where any Government action to implement an RFA could affect native title, the action will be taken in accordance with the Native Title Act; and
- an RFA is not intended to influence in any way native title claims that may arise.

## **Accreditation**

To the maximum extent possible Governments will accredit existing data sets and processes used in the RFA process under the provisions of the Intergovernmental Agreement on the Environment (IGAE) (Commonwealth of Australia 1992a). Under these provisions, the Commonwealth or Victoria will endorse a process used by the other's jurisdiction as having accommodated part or all of the interests of the accrediting government.

The data sets and processes used in the assessments described in this report have been accredited for the North East RFA.

## **1.3 THE RFA PROCESS IN VICTORIA**

### **Background**

During 1995 the Commonwealth and the States of Victoria, Tasmania, New South Wales and Western Australia identified interim (or deferred) forest areas which may be required for a CAR reserve system and should be protected pending the completion of RFAs. In January 1996 the Commonwealth and Victoria signed an Interim Forest Agreement (IFA) which makes provision for the protection of such areas.

The Prime Minister and Premier also signed a Scoping Agreement committing Governments to arrangements and timetables for the completion of the RFAs.

The RFA process is managed by a Joint Commonwealth-Victoria Steering Committee, supported by a Technical Committee. The membership of these committees is listed in Appendix 2.

### **Victorian RFA Regions**

Victoria has a land area of 22.7 million ha, of which some 40 per cent is publicly owned. Of the public land, 42 per cent (3.8 million ha) is reserved for conservation purposes, including 2.5 million ha of forests. A further 3.5 million ha of public land is also forested, of which about 1.2 million ha is available for timber harvesting.

Victoria has five RFA regions:

- East Gippsland,
- Central Highlands,
- North East,
- Gippsland, and
- West.

On 3 February 1997, the Prime Minister and the Premier of Victoria signed the RFA for the East Gippsland region and the Central Highlands region RFA was signed on 27 March 1998. The North East is the third region in Victoria in which an RFA is to be developed.

### **Stages in the RFA process**

The major stages in the RFA process are depicted in Figure 1.1 and outlined below.

#### ***Comprehensive Regional Assessment (CRA)***

The CRA that has been undertaken for the North East region is described in this report. It consists of the following assessments:

- biodiversity
- world heritage
- old-growth forest
- social
- wilderness
- resource
- economic

National Estate assessment is continuing and will be the subject of a separate report.

The CRA draws on a wide range of studies conducted in recent years. Relevant technical papers are referenced in the report.

The CRA provides a synthesis of the information on which the RFA can be developed and agreed between the Victorian and Commonwealth Governments. It makes no judgements or interpretations of information where this might pre-empt the development of the RFA. Furthermore, both Governments are committed to consultation with the community and other interested stakeholder groups, within the context of the NFPS.

#### ***RFA Directions Report***

The Directions Report builds upon information contained in the CRA report and the results of consultations with the community. The Directions Report will address:

- how the proposed CAR reserve system addresses the national forest reserve criteria;
- the elements of ecologically sustainable forest management (ESFM) which are part of the RFA;
- industry development opportunities; and
- the links between the RFA process and other statutory processes, particularly environmental impact assessment, World Heritage, National Estate and endangered species.

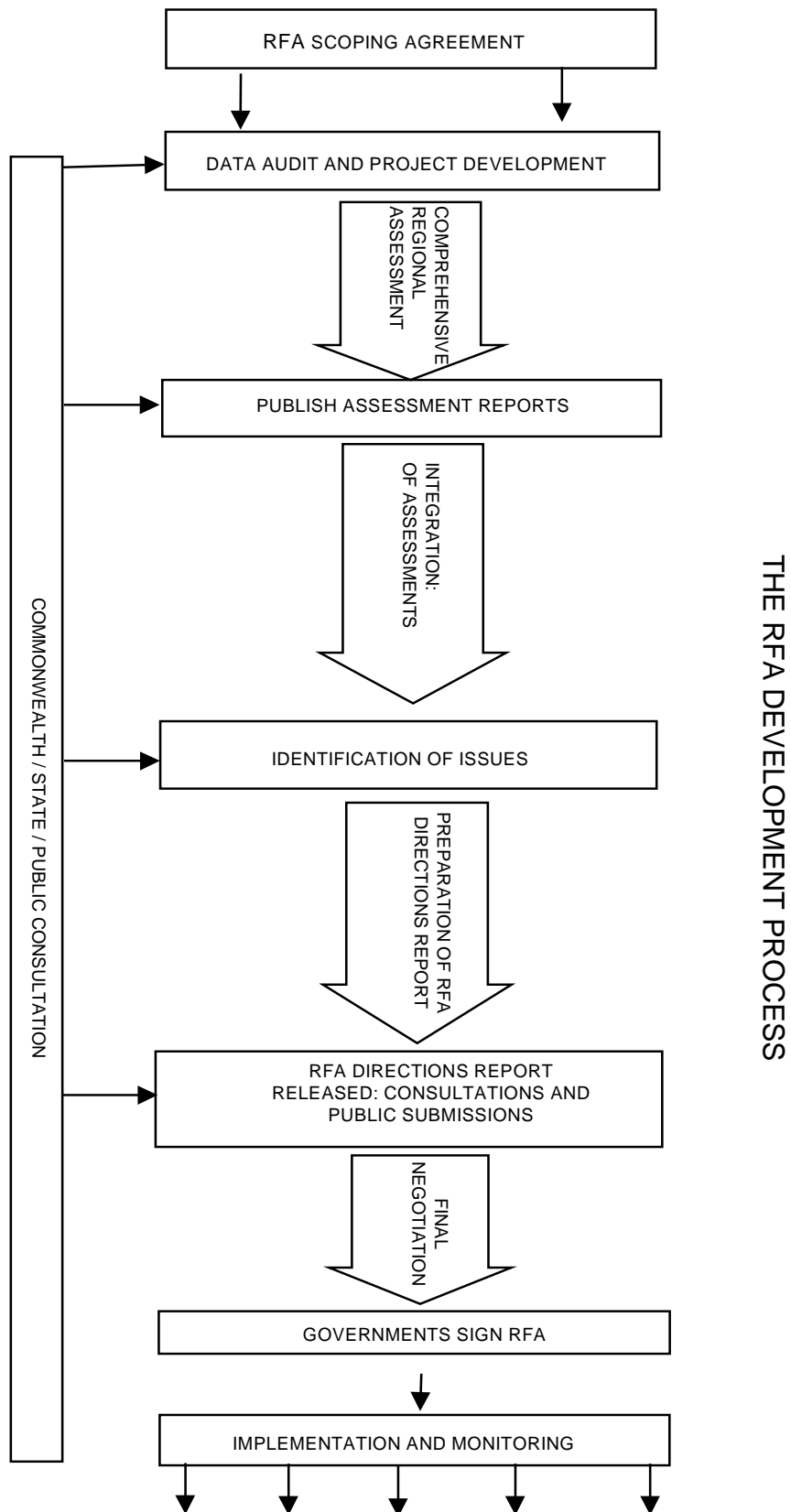
The North East RFA Directions Report will be released later in 1998.

The community and stakeholder groups will be consulted both during the development of the Directions Report and following its release through a series of workshops held in the North East and Melbourne over the next few months. These consultations will focus on the issues that need to be addressed in the RFA. The first workshops will be held shortly after the release of the CRA report and will familiarise stakeholders with the information which it contains. Any deficiencies in the data or methods identified at that stage can be taken into account in the development of the Directions Report.

#### ***RFA finalisation***

Following the release and consultation on the Directions Report, the Commonwealth and State Governments will negotiate the Regional Forest Agreement. The RFA is scheduled to be completed in late 1998.

**Figure 1.1: Major Stages in the RFA Process**







## **2. NORTH EAST REGION**

### **2.1 LOCATION**

The RFA region covers over 2 million hectares in the north east of Victoria. Its boundaries include the Murray River to the east and north, and the Hume Highway Freeway north of Seymour to the west, and the Great Dividing Range to the south. The North East region includes the Rural City of Wodonga and parts of the Towong, East Gippsland, Indigo, Alpine, Wangaratta, Delatite, Strathbogie, Murrindindi and Mitchell Shires.

The North East Forest Management Plan, currently in preparation, will have the same boundaries as the RFA region.

### **2.2 LANDSCAPE AND CLIMATE**

The Great Dividing Range is the dominant landform feature in the region. It has a significant influence on weather patterns and this in turn affects vegetation distribution and fire risk conditions. Interaction with topographic features of the Alps modifies prevailing conditions and this results in a diversity of climate within short distances (LCC 1982). Dry 'rainshadow' valleys contrast with adjacent mountains that are characterised by wet montane forests and, at higher elevations, sub-alpine woodlands and alpine herbfields.

The alpine area is characterised by high precipitation, with much of this falling as snow. Rainfall in the higher elevations is generally greater than 1200 mm, with an average of 2000 mm being recorded on the Bogong uplands (LCC 1982). At lower elevations, rainfall varies between 600 and 1200 mm (LCC 1984). Rainshadow areas occur in the Lake Nillahcootie area, near Eskdale in the Mitta Mitta valley and around Corryong. Summer thunderstorms are common.

Location and topography also strongly influence temperatures. In summer, temperatures on the plains average 30° C although temperatures of over 40° C have been recorded. In contrast, temperatures at higher elevations average around 15° C in the summer (LCC 1982). In winter, the average maximum temperatures range between 10° C and 16° C in the flatter country but are closer to zero in the mountains. Minimum temperatures in the colder months average 4° C, although temperatures of -4° C are common in the Alps (LCC 1982; LCC 1984). The North East is one of few parts of Australia to have permanent snow over winter.

### **2.3 SIZE AND TENURE**

The North East region covers approximately 2.3 million hectares or 10 per cent of the total area of Victoria. Private land comprises 1 057 300 ha, or 46 per cent of the region, and is mostly cleared and used for a range of agricultural pursuits. In general, private land is located in the west of the region and along major river valleys.

Public land comprises 1 260 700 ha, or 54 per cent of the area, and is covered mostly by native forest. The region is known for its mountain landscapes, diverse range of flora and fauna, timber resources, tourism and recreational opportunities and the high quality of water in its rivers and streams.

State forest occupies 718 700 ha; more than half of the total public land. Conservation reserves, which include for example National Parks, State Parks and Flora and Fauna Reserves, occupy 31 per cent of the public land, or about 392 000 ha. The remaining public land in the North East, as shown in Table 2.1, includes other public land, plantations and water bodies. Three of Victoria's major water storages, Lakes Hume, Dartmouth and Eildon, are totally or partially in the North East.

**Table 2.1: Land Tenure in the North East**

<b>Land Tenure</b>	<b>Area (ha)</b>	<b>Proportion of all land (%)</b>	<b>Proportion of public land (%)</b>
State Forest	718 700	31	57
Conservation reserves	392 000	17	31
Other public land	56 200	2	5
Plantation	65 400	3	5
Water bodies	28 400	1	2
<b>Public land total</b>	<b>1 260 700</b>	<b>54</b>	
<b>Private Land</b>	<b>1 057 300</b>	<b>46</b>	

Source: NRE unpublished data (1998)

## 2.4 POPULATION

In 1996, the total population of the North East region was 174 378. In recent years, the North East has experienced stable growth with an annual growth rate of 1.3 per cent, slightly above the 0.75 per cent growth rate for regional Victoria.

There are no major cities in the North East region. Wodonga, with a population of approximately 26 239 people, is the largest town in the region followed by Wangaratta with 15 527 people. Benalla (8 582 people) and Mansfield (2 526 people) are the largest towns in the south of the region. Other towns in the region include: Corryong (1 215 people), Myrtleford (2 705 people), Chiltern (1 080 people), Beechworth (2 953 people) and Yackandandah (592 people) (Department of Infrastructure 1997). More detailed demographic information is provided in Chapter 11, Social Assessment.

## 2.5 REGIONAL ECONOMY OF THE NORTH EAST REGION

Victoria's gross State product (GSP) by industry is shown in Table 2.2. Access to native forest resources provides at least part of the base for several industry classifications including agriculture, forestry and fishing; mining; accommodation, cafes and restaurants; and cultural and recreational services. These industries accounted for about 10 per cent of GSP in 1995-96. However, only a small proportion of the GSP associated with these broad industry groupings can be attributed directly to forest based industries. Other sectors rely in part, on native forest resources, for example the manufacturing category includes output from the wood processing industries.

Industry classifications which provided a higher share of employment for residents of the region in 1995-96 included community services (19.4 per cent); wholesale and retail trade (18.2 per cent); manufacturing (15.7 per cent); agriculture, forestry and fishing (9.9 per cent) and recreational, personal and other services (8.8 per cent). It is apparent from Table 2.3 that employment in the forestry and logging sector and wood and paper products sector increased between 1991 and 1996. The trend in total employment in the North East region between 1991 and 1996 was an increase of 3.5 per cent. Employment in the tourism related sector, recreation personal and other services also increased, however residents employed in mining decreased between 1991 and 1996. Due to the aggregated nature of the available data, the composition of the growth in employment over this period is not clear.

**Table 2.2: Industry contribution to Victorian gross State product (in 1995-96 dollars)**

	<b>1990-91</b>	<b>1995-96</b>	<b>Share %<sup>a</sup></b>
	<b>\$m</b>	<b>\$m</b>	
Agriculture, forestry and fishing	2 472	3 725	3.3
Mining	3 600	3 150	2.8
Manufacturing	16 460	19 880	18.0
Electricity, gas and water	3 550	3 642	3.3
Construction	6 152	6 149	5.5
Wholesale trade	6 100	7 135	6.4
Retail trade	6 388	8 085	7.3
Accommodation, cafes and restaurants	1 454	2 111	1.9
Transport and storage	4 034	5 011	4.5
Communication	2 537	3 738	3.3
Finance and insurance	2 715	4 684	4.2
Property and business services	8 397	10 890	9.8
Government administration and defence	3 012	3 216	2.9
Education	4 560	5 643	5.1
Health and community services	5 606	7 137	6.4
Cultural and recreational services	1 215	2 105	1.9
Personal and other services	1 650	2 354	2.1
Ownership of dwellings	8 586	9 761	8.8
General government	1 620	1 816	1.6
<b>Total</b>	<b>90 108</b>	<b>110 232</b>	<b>100</b>

<sup>a</sup> a Share of Victorian GSP. *Source:* Australian Bureau of Statistics (1996).

The North East region accounts for a small proportion of total Victorian production and employment. The region is estimated to have accounted for 2.4 per cent of total employment in Victoria in 1996 (Table 2.3).

Forest related industries both directly employ people living in the North East region, and indirectly support employment in other sectors of the economy. Employment attributable to the wood resources of the North East region extends beyond the North East RFA boundary and is not included in these statistics. An example of this would be timber processors located outside the region which source wood from the North East region. Timber processing linkages with wood resources derived from the native forests of the North East region are discussed in more detail in Chapter 5 on the Timber Industry.

**Table 2.3: Number of residents employed in the North East Victoria and Victoria, by industry<sup>a</sup>**

	North East			Victoria		
	1991	1996	Share <sup>b</sup>	1991 <sup>c</sup>	1996 <sup>c</sup>	Share <sup>d</sup>
	no.	no.	%	no.	no.	%
Agriculture, forestry and fishing	4 794	4 440	9.9	71 759	74 178	3.9
<i>Forestry and logging<sup>e</sup></i>	174	219	0.5	1 409	1 833	0.1
Mining	98	63	0.1	5 697	5 626	0.2
Manufacturing	5 563	7 008	15.7	298 007	308 677	16.2
<i>Wood and paper products<sup>e</sup></i>	774	1 005	2.2	25 832	28 032	1.4
Electricity, gas, water	591	477	1.1	25 882	13 497	0.7
Construction	2 368	2 525	5.7	97 526	111 471	5.8
Wholesale and retail trade	7 339	8 129	18.2	348 676	381 489	20.1
Transport and storage	1 276	1 383	3.1	76 430	74 857	3.9
Communication	592	589	1.3	34 508	43 119	2.2
Finance, property and business services	2 350	2 963	6.6	200 300	244 789	12.8
Government administration & defence	4 251	3 227	7.2	94 386	71 416	3.7
Community services	7 722	8 690	19.4	323 280	365 381	19.2
Recreational, personal and other services	3 330	3 926	8.8	112 253	142 905	7.5
Not stated or classifiable	2 959	1 347	3.0	6 852	60 554	3.1
Total	43 233	44 767	100	1 820 173	1 897 959	100
Share of Victorian employment ( per cent)	2.4	2.4		100	100	

<sup>a</sup> Estimates from 1991 and 1996 census data based on statistical local areas (SLAs). Parts of some SLAs included here do not lie completely within the North East RFA boundary and some SLAs that lie only partly within the North East RFA region have not been included. <sup>b</sup> Share of North East employment in 1995-96. <sup>c</sup> As at May 1991 and 1996 respectively. <sup>d</sup> Share of Victorian employment in 1995-96. <sup>e</sup> Subcategory of major category above (major category estimate includes subcategory). Totals may not add up to 100 per cent due to rounding. *Source:* Australian Bureau of Statistics (1997a and 1997b).

## 2.6 HISTORY OF THE NORTH EAST FORESTS

Victoria's North East is the traditional land of several Aboriginal communities - the Minjambuta, Jaitmathang, Ngarigo, Taungarong, and Braiakaulung. These communities lived most of the year in the valleys flanking the mountains, with many entering the alpine region during summer in search of the Bogong Moth. The culture of Aboriginal communities was based on an intimate and dynamic relationship with the environment through activities such as gathering and hunting, and through association of places with religious beliefs and obligations.

Aborigines shaped the North East environment through their activities. Timber and bark were used to make shelters, weapons and tools. Fire was used to encourage regeneration, particularly of edible plant foods, and exposed edible roots.

By the early 1800s, while there had been little physical contact with Europeans, the introduction of new diseases had already begun to seriously affect local Aboriginal populations. It threatened their traditional social and subsistence base. By 1877, the population of Aborigines in the North East had declined to less than 25 (LCC 1984).

A Central Board for the Protection of Aborigines was appointed to oversee the interests of the Aborigines in the Colony of Victoria. Five major stations and reserves, where remaining Aborigines were encouraged to settle, were established in the North East. Tangambalanga Reserve was gazetted in 1862 (LCC 1984). These reserves were revoked and sold by 1873, with some people being moved to other reserves in Victoria.

European activity in the North East began in 1824, when explorers Hume and Hovell crossed the Murray River on the first overland trip from New South Wales to Port Phillip.

Squatters quickly followed the explorers into the North East. In 1835, Bonegilla was established at the junction of the Kiewa and Mitta Mitta Rivers. Initially the valleys of these rivers were favoured, but by 1838, the Ovens and King River valleys were occupied. Squatters' runs were established near Euroa, Benalla and Mansfield. By 1847, squatters had claimed all but the most inaccessible land.

In the aftermath of the bushfires of Black Thursday 1851, alpine grazing commenced in the North East. Fires had denuded the countryside of grass, forcing many squatters to search for forage for their cattle. Good grassland was discovered on the Bogong and Cobungra plains. By the 1860s, a regular pattern of high country grazing had developed around the Dargo High Plains, the Bogong High Plains, and Gibbo - Pinnibar. Graziers introduced new fire regimes to the high plains: to encourage a 'green pick' and for protection from wildfire. Regular use of fire and grazing led to changes in the composition of indigenous flora.

The discovery of alluvial gold near Beechworth in 1852 brought new settlers into the North East. Further discoveries were made at Yackandandah Creek, Pennyweight Flat, Madman's Gully and Woolshed Creek. Miners followed the Ovens River south towards the Alps and Mount Buffalo. In 1853, diggers rushed the Buckland River. Miners from Gippsland used the track cut by stockmen to reach the Buckland and Harrierville goldfields. By 1856, the miners had opened the Upper Ovens goldfield around Morses' Creek (Bright) and Growler's Creek (Wandiligong).

Other metals were mined in the North East. Alluvial tin was mined on the Koetong, Dry Forest, Burrowye and Cudgewa Creeks from the 1870s. Tin was mined at Mt Wills from 1888, prompting the development of a township, Glen Wills. It was also mined north of Beechworth, and at Eskdale on the Mitta Mitta goldfield. Other metals mined in the North East included molybdenum at Stanley and Everton, tungsten at Barnawartha and Koetong, and copper at Tawonga and Bethanga.

Mining methods included sluicing, dredging, quartz reefing and deep lead mines. These resulted in significant and widespread disturbance to forests and streams. Deep lead mining required powerful

pumping machinery and relied on heavy timbers for underground workings. Forests were cleared to supply the timber that lined the shafts and fuelled steam boilers, while prospectors burned the heavily timbered spurs to make visible surface quartz deposits. Around Chiltern and Rutherglen, the ironbark forests were almost cleared by the late 1880s.

Government assistance for track construction was a significant stimulus for mining activity in the region, particularly in the mountainous regions of the Great Dividing Range. During the 1880s and 1890s, mining tracks were constructed throughout the region. Improved access encouraged prospecting. However, few additional tracks were constructed after 1909 and tracks were cleared and maintained by the Mines Department until 1925.

New towns were established to service the large goldfields population. A township was surveyed at Beechworth in 1853. Three years later, it was the regional capital of North Eastern Victoria, reaching a population of approximately 20 000 at its peak. Other townships were established at Yackandandah, Chiltern, Myrtleford, Bright and Harrietville.

Agricultural clearing commenced during the 1840s in response to the growth of townships. New land regulations in 1854 attracted farmers to the North East as land was released for auction in selected parishes close to the goldfields. Six agricultural districts were established between 1855 and 1860 - Beechworth, Belvoir (Wodonga), Benalla, Euroa, Mansfield and Ovens. The Beechworth district, located between the Kiewa and Ovens Rivers, was the first agricultural district to be established, but was soon overshadowed by the Belvoir and Ovens districts.

During the 1860s, four major Land Acts transformed the region from a grazing to an agricultural economy. Land was made available to selectors in established agricultural districts and adjacent parishes. These 'free selection' Acts encouraged new settlers and reduced the squatters' runs. In 1869, the entire North East was opened for selection. Selection prompted a shift in population to the western plains; hastened by the completion of the North Eastern Railway in 1874.

The Department of Crown Lands and Survey persevered with its attempts to encourage the clearing of forested land for agricultural purposes. In forested districts, selection blocks were typically 120 to 160 acres, often remote and poorly served by roads. Despite the best efforts of selectors, many were abandoned after only three or four years. Selections that were abandoned were reclaimed by the Crown.

Wildfire occurred frequently in the North East due in part to the settlers' use of fire. The first notorious and perhaps most devastating fire documented was the 'Black Thursday' fires of 1851. In 1939, fires burnt much of the Great Dividing Range of eastern Victoria and into the foothills and close to towns including Mansfield, Whitfield, Bright, Mt Beauty, Mitta Mitta and Corryong. Areas of Alpine Ash also burnt along the upper reaches of the Ovens, Kiewa and Mitta Mitta Rivers. Fires in 1952 burnt much of the Upper Murray district that was left unburnt in 1939. Other major wildfires in the region occurred in 1898, 1911, 1944, 1968, 1972, 1978, and 1985.

During the nineteenth century, settlers in the North East were dependent on native forest as a source of timber, oil and resin. Graziers, miners and selectors felled large quantities of bush timber. Government authorities used hardwood species for railway sleepers, piles for piers and docks and electricity poles and timber companies processed a range of forest products, including eucalyptus oil and wattle-bark.

During the gold rushes, the number of sawmills operating in Victoria increased dramatically. In the 1870s, sawmills were operating at Porepunkah in the Ovens River region. Traditionally, these mills were erected on Crown land in return for payment of an annual licence fee. The timber was felled by axe and cross cut saw, then sawn into manageable sections for transportation to the mill by horse and bullock teams or timber tramway. The first sawmills were located close to their log supply. Power was supplied by steam using stationary engines.

In the last quarter of the nineteenth century, following the decline in mining activity, harvesting was limited to small quantities of timber for fencing and farm buildings. Nevertheless, splitters continued to work in the forests, with no restrictions being placed on species, size or quantity of timber.

The first legislation enabling the government to reserve forested areas for the protection of timber resources was granted under the Land Act of 1862. This legislation however brought no effective measures for the conservation of forests. A series of reports from the 1870s recorded details of huge waste in the timber industry and irresponsible and ineffective management of the forest resource. Forestry Bills were introduced to Parliament between 1879 and 1892 but none were enacted.

A Royal Commission on Forests which sat from 1897 to 1901 led to the *Forests Act 1907* which established the Department of Forests. This legislation was strengthened by the *Forests Act 1918* which established the Forests Commission of Victoria. The 1918 Act gave the Commission the revenue to protect, conserve and develop the indigenous forest and maintain an adequate area of softwood plantations. In the North East, Forest Districts were established at Benalla, Beechworth, Tallangatta, Mansfield, Myrtleford, Corryong and Bright. This development of forest management coincided with the early years of intensive commercial sawmilling in the eastern forests.

During this period, sawlog production in the North East was small in comparison with East Gippsland. Alpine Ash was regarded as a good substitute for the preferred Mountain Ash, but it was not expected to take a leading role. Nevertheless, several firms operated in the region. In 1918, McCashney & Harper Pty. Ltd. opened a mill at Toombullup and in the 1920s, two firms: Carter's of Benalla and George Bell, built mills near Tatong.

Significant sawlog harvesting commenced in the 1930s, when operations commenced near Mt Baldhead, Mirrimbah and Mt Wills. In 1935, P V Christenson established a mill at Mirrimbah.

The need to salvage fire-killed ash timber after the bushfires of 1939 served to concentrate milling activity in the Eastern and Central Highlands. However, with salvage operations completed, loggers turned their attention to the Alpine Ash forests around Mt Stirling for high quality building and joinery timber. Significant demands for timber resulted from post-war migration, the housing boom, and restrictions on the importation of timber.

Following the Second World War, the North East saw renewed timber harvesting activities. In Mansfield, mills were constructed in 1947 and 1948, with timber supplies being drawn from the forests of the King, Howqua and Jamieson watersheds. Alpine Ash forests near Mt Wills and Mt Pinnibar were opened for harvesting in the 1950s.

The Forests Commission was able to directly influence the location of timber extraction and sawmilling through its log allocation system. Annual licences were granted to remove specified volumes of timber from defined areas of State forest. The Commission's roading program also assisted the expansion of the timber industry.

The Royal Commission, following the 1939 bushfires, directed that sawmills should no longer be sited in the forest. This required the improvement of the road system for hauling logs to urban centres. Licensees became responsible for the construction of the roads in their area. The improvement in roads, and an advance in technology after World War II, encouraged the increased mechanisation of logging operations.

Changes in cutting and sawmilling technology led to a dramatic increase in the volume of timber harvested in Victoria. Tractors for snigging and motor vehicles for hauling logs and sawn timber replaced bullock teams and timber tramways. Diesel and electric power replaced steam at the mills. Crawler tractors fitted with dozer blades facilitated road-making, which gave access to previously inaccessible areas, and bulldozers with winches snigged logs from deep gullies. Chainsaws also revolutionised cutting practices in the forests.

Residents of the North East also used the forests for recreation. Organised bushwalking tours which began in the late 1890s had become well established by the 1920s and boomed in the 1930s. After the Second World War walking clubs offered a range of associated activities including camping, orienteering, rock-climbing and cross-country skiing. The popularity of these activities and others such as four-wheeled driving, trail bike and mountain bike riding has steadily increased.

Alpine recreation on an organised basis began in the late 1880s at locations like Mount Buffalo. The Mount Buffalo Chalet opened in 1910. Bright served as centre for alpine activities and the Bright Alpine Club made the first winter ascent of Mount Feathertop in 1889. Lobbying by this club saw the main scenic features of Mt Buffalo reserved for a national park in 1898, which was gazetted in 1848.

Use of the Bogong High Plains and nearby mountains for cross-country and downhill skiing began in the early 1920s. Increased popularity in downhill skiing during the 1940s led to the development of Mount Buller, Mount Hotham and Falls Creek alpine resorts. The resort at Falls Creek benefited from the roads built to service the Kiewa hydro-electric scheme on the Bogong High Plains.

During the 1970s and 80s, the Land Conservation Council (LCC) conducted a number of land use reviews which led to the creation of new and enlarged National, State and Regional Parks and reserves, and identified forests which would be available for timber production and other land uses. LCC reviews have shaped the character of the North East through the creation of the Alpine National Park, which links Victoria's alpine area with the Kosciusko National Park in New South Wales, and other investigations related to softwood plantation establishment.

## **2.7 LAND CLASSIFICATION**

### **Conservation Reserves**

The North East has an extensive system of National Parks and other conservation reserves. The system has been established to protect a range of significant natural and cultural values and to provide opportunities for recreation, tourism and education.

The reserve system occupies approximately 392 000 ha, or 31 per cent of public land in the region. It includes part of the Alpine National Park, the newly proclaimed Chiltern Box-Ironbark National Park and Mount Buffalo, one of Victoria's oldest national parks. The biodiversity, old-growth and national estate assessments provide information on the reserve system and the values it contains. Map 1 shows the location of the reserve system.

### **State Forest**

State forests are managed for both conservation and sustainable resource utilisation. Within State forest provision is made for:

- water supply;
- catchment and stream protection;
- hardwood timber production;
- conservation of natural and cultural values;
- recreation and tourism;
- mineral exploration and mining; and
- other forest uses, such as honey production and grazing.

State forest also has an important role in complementing the management of parks and reserves for conservation, recreation and eco-tourism. Forest management plans direct the management of State forest for the protection of environmental values while providing for the sustainable management of the natural resources.



A management plan for State forest in the North East is currently in preparation. The management plan will provide a strategic landuse framework in State forest and be based on three 'management zones' which set priorities and specify permitted activities for different parts of the forest. The three management zones are:

- The **Special Protection Zone (SPZ)** - managed for conservation with no timber harvesting permitted. This zone is designed to link and complement established conservation reserves.
- The **Special Management Zone (SMZ)** - managed to conserve specific features where timber harvesting is still permitted under certain conditions.
- The **General Management Zone (GMZ)** - managed for a number of uses where timber production is the main priority.

## 2.8 MANAGEMENT ARRANGEMENTS

Land management arrangements, central to the achievement of Ecologically Sustainable Forest Management (ESFM), vary according to tenure and the objectives of management on each tenure. Legislation and policies define the broad management arrangements applicable to different lands. Implementation of such arrangements is achieved through planning processes, management plans, codes of practice, guidelines and environmental prescriptions that are applied at a strategic and operational level.



### 3. FOREST MANAGEMENT AND RESOURCE UTILISATION

Forest management on public land aims for the conservation of natural and cultural values whilst providing resources for the community's economic benefit.

This chapter briefly outlines the processes of State forest planning and management in the North East region. Further information about the forest management planning process is provided in the Ecologically Sustainable Forest Management (ESFM) reports (VicRFASC 1996b and VicRFASC 1997a).

#### 3.1 STATE FOREST MANAGEMENT

The principles for State forest management in Victoria are set down in the Timber Industry Strategy (Victorian Government 1986). This document states that forest management will be:

- economically viable;
- environmentally sensitive;
- sustainable for all forest values; and
- assisted by public participation in planning.

A number of acts of Parliament, such as the *Forests Act 1958*, the *Conservation, Forests and Lands Act 1987* and the *Flora and Fauna Guarantee Act 1988*, as well as Government and Departmental policies, guide forest management planning in Victoria.

Implementation of many principles in the Timber Industry Strategy is provided through the development of the Code of Forest Practices for Timber Production, Forest Management Plans, wood utilisation plans, coupe plans and forest operator licensing provisions.

##### Code of Forest Practices for Timber Production

The Victorian Parliament ratified the Code of Forest Practices for Timber Production (the Code) in May 1989 in accordance with Section 55 of the *Conservation, Forests and Lands Act 1987*. The Code's purpose is to ensure that commercial timber growing and harvesting activities are carried out in such a way that an internationally competitive timber industry is promoted while being compatible with the conservation of a wide range of environmental values, and promoting ESFM.

To this end, the Code provides Statewide goals, guidelines and minimum standards to be applied to timber production operations both by NRE and forest operators. These goals and guidelines apply to timber harvesting, timber extraction roading, regeneration and reforestation, and are to be used during the formulation of detailed plans and prescriptions which include:

- Forest Management Plans which address the management of environmental, cultural and resource values in a Forest Management Area;
- Wood Utilisation Plans which detail the type and quality of wood to be produced over the duration of the plan, together with a plan for the allocation of wood to processors. Plans are generally produced to cover a three year period and are updated annually;
- Forest Coupe Plans which identify the areas to be harvested and a schedule which incorporates the specifications and conditions under which each operation is to be administered and controlled.

The Code will be reviewed at least every ten years to take account of new research information and field experience. Since its implementation in 1989, several reviews of aspects of the Code have been undertaken (Victoria Auditor-General 1993, CNR 1995a; CNR 1995b; CNR 1995c; O'Shaughnessy 1995a). A second version of the Code, developed by NRE using a process of scientific review and community consultation, was ratified by Parliament in 1996.

In general, the Code is implemented at a local level in association with a set of regional prescriptions. The detailed prescriptions take account of local conditions such as climate, forest type, topography,

elevation, soil type, and various management activities. They must be consistent with the Code, based on relevant scientific input, and reviewed periodically. In the North East, regional management prescriptions were reviewed during 1997 to incorporate the requirements of the revised Code (NRE 1997a).

Compliance with the Code on public land is required under the conditions of licences issued in accordance with the provisions of the *Conservation, Forests and Lands Act 1987* and the *Forests Act 1958*. The *Timber Harvesting Regulations 1989* require all forest operators to be licensed to carry out timber harvesting operations. Breaches of particular terms or conditions of Forest Operator Licences can result in the accumulation of penalty points and may lead to the suspension or cancellation of the licence.

In 1993, Amendment S13 under the *Planning and Environment Act 1987* extended the application of the Code to cover commercial forestry operations on private land. This provides a sound environmental basis for timber production on private land. Local government authorities are responsible for monitoring the application of the Code on private land.

### **Forest Management Plans**

The Timber Industry Strategy divided Victoria into 15 Forest Management Areas (FMAs) for the purpose of preparing and implementing Forest Management Plans. These plans direct the use and care of forests for planning periods of ten years, with provision for more frequent review if circumstances warrant. The planning process provides opportunities for public consultation and participation in resource use and protection.

These plans must be in accord with requirements of relevant Victorian Government Acts and policies, including the *Flora and Fauna Guarantee Act 1988*, the *Catchment and Land Protection Act 1994* and the *Forests Act 1958*, and the National Forest Policy Statement 1992. Accordingly, plans are required to give consideration to:

- ecologically sustainable management, including the maintenance of environmental values and the sustainable use of natural resources;
- the contribution of conservation reserves and the impact of private land activities on, the determination of appropriate protection levels for environmental values in State forest;
- Catchment Management Strategies, and requirements of Special Area Plans made under the *Catchment and Land Protection Act 1994*;
- protection of all flora and fauna listed as threatened under the *Flora and Fauna Guarantee Act 1988*;
- protection of regional biodiversity;
- continuing opportunities for recreation, scientific study and education;
- public participation in plan development; and
- monitoring and review of management performance.

To meet these requirements, the planning process sub-divides the State forest into zones, as discussed in Section 2.7, which identify where environmental, cultural and timber resource values are to be given priority. Combined with land scheduled under the *National Parks Act 1975* and other conservation reserves, these forest management zones provide for an integrated reserve network and a framework for sustainable forest use.

A Forest Management Plan covering State forests in the North East RFA region is currently in preparation. The plan covers three Forest Management Areas, including all of the Benalla-Mansfield and Wangaratta FMAs, and the majority of the Wodonga FMA. State forest outside the North East RFA region, but within Wodonga FMA, will be considered as part of the Gippsland RFA and covered by the forest management plan for that region. An Advisory Committee made up of people with a range of interests from communities across the region is guiding preparation of the plan.

The North East Forest Management Plan will apply to 718 700 hectares of State forest, representing 31 per cent of the North East RFA region. This area of State forest has been determined from detailed land use studies by the former Land Conservation Council (LCC). The Alpine and the North Eastern 1 - 5 LCC study areas cover the North East RFA region. The more recent LCC reviews in the region are the North Eastern Victoria (Ovens Softwood Plantation Zone) Special Investigation (1981), the Alpine Special Review (1983) and the North Eastern (Benalla-Upper Murray) Areas 1, 2 and 4 Review (1984). Other reviews which cover the North East include special investigations of rivers and streams, and wilderness.

### **Wood Utilisation and Coupe Planning**

Forest Management Areas are subdivided into a hierarchy of blocks, compartments and coupes for recording and management purposes. Of these, compartments are the smallest permanent forest planning unit.

Coupes are selected for harvesting to supply the required quantities and mix of wood products to meet annual wood supply commitments. A three-year schedule of coupes, and associated access roading, forms part of a Wood Utilisation Plan (WUP) which is prepared for each FMA annually. Its preparation involves specialist expertise, uses sound silvicultural practices and ensures environmental care. These plans are made available for public comment prior to finalisation. Special plans may be prepared and approved to carry out salvage of timber or regeneration of stands following fire, storm or other events.

Timber harvesting operations are based on a Forest Coupe Plan which has been prepared with reference to the WUP and other regional plans. This plan provides a detailed description of the coupe, including a map identifying the area to be harvested and conditions to apply to all operations. Prior to harvesting, coupe boundaries must be identified in the field. Boundaries may be determined by natural features, such as ridges, or other prominent features. Requirements for coupe planning and harvesting are detailed in the Code of Forest Practice for Timber Production (NRE 1996a). Regional prescriptions, as discussed earlier, provide operational guidelines for coupe marking and harvesting.

## **3.2 SILVICULTURE**

Silviculture is the theory and practice for managing forest establishment, species composition and growth to achieve specific forest management objectives. Silvicultural treatments can include harvesting, site preparation, seeding, planting and tending operations such as thinning and fertilising. A review of the theory and practice of silviculture was provided in the East Gippsland Resource and Economics Report (VicRFASC 1996c) and is also relevant to the North East region. Further details on eucalypt silviculture are available in Florence (1996). A summary of silvicultural techniques used in the North East, including an outline of current NRE policy, management practices and research in silviculture, is provided in the following section.

State forest in the North East area is dominated by mixed species eucalypt forests and to a lesser extent by ash-type forests. These forest types differ in their ecological responses to disturbance, particularly their effects on regeneration. For example Ash type stands are killed by all but low intensity fires, whereas the mixed species stands can withstand fires of higher intensity. As a result, a range of silvicultural techniques may be appropriate, depending on the ecological characteristics of each forest type, plus environmental, economic and social factors.

### **Ash Forests**

Ash forests in the North East are predominantly *Eucalyptus delegatensis* (Alpine Ash) with *E. regnans* (Mountain Ash) found only in the Mt Sunday area, south of Mansfield. These species are normally found in pure, even-aged stands at altitudes ranging between 300 and 1000m for *E. regnans*, and mostly over 1000m to 1500m for *E. delegatensis*. Where the two species occur in the same area, there is usually a fairly sharp transition from one to the other.

### **Regeneration systems**

Alpine Ash seeds have inherent dormancy (Grose 1963), which can only be broken by cool, moist conditions such as those under snow during winter. This knowledge has led to the current practice of sowing seeds in autumn following seedbed preparation. Germination occurs in spring after the snow has melted and the dormancy broken.

In contrast, Mountain Ash seeds have no general dormancy (Cunningham 1960), and will therefore germinate when soil moisture and temperature conditions are suitable - being either in autumn or spring.

Through operational experience, the clearfelling regeneration system is consistently able to provide for adequate regeneration and optimal growth in ash type forests (Campbell *et al.* 1984). Debris remaining after harvest is burnt and the site is artificially sown. Burning produces a high quality seedbed, which assists in early regeneration. Where burning is not appropriate, or conditions have resulted in burning at lower intensities (which are not as effective), mechanical disturbance of the soil is required for adequate regeneration. It is common practice to regenerate by sowing seed; however, when seed availability is restricted, or seed has failed to germinate, seedlings are planted to achieve prescribed stocking levels.

The seed tree system is occasionally used where seed crops on standing trees are considered sufficient to meet specified seedfall targets. Seed trees may be removed two to three years later, or retained as habitat.

Regeneration success rates in both Alpine Ash and Mountain Ash forests in the North East have been excellent, with no failures reported following harvesting and regeneration in the period July 1989 to June 1993 (Murphy and Fagg 1996).

### **Regrowth management**

Clearfelling and high intensity wildfire often result in dense regeneration leading to competition for light and nutrients between individual stems. The result is that some stems become dominant and grow strongly, while others are suppressed. Although eucalypt forests naturally self-thin as they mature, artificial thinning of *E. regnans* regrowth leads to increased growth in diameter and basal area (and thus, volume) in the retained trees, thereby contributing to increased sawlog production (Webb 1966, in Jeremiah and Roob 1992). Similar responses occur in *E. delegatensis* regrowth. However, to date there has been no commercial thinning of Ash forests in North East Victoria.

### **Mixed Species Forests**

The mix of eucalypt species can be an indicator of site productivity. Across the North East, sites of higher quality can contain mixtures that include: *E. viminalis* (Manna Gum), *E. globulus* (Blue Gum), *E. obliqua* (Messmate), *E. robertsonii* (Narrow-leaved Peppermint), *E. dalrympleana* (Mountain Gum) and *E. mannifera* (Brittle Gum); ash species may occur at the upper edge of the mixed species range. Low quality sites usually contain *E. dives* (Broad-leaved Peppermint) and *E. macrorhyncha* (Red Stringybark). Higher quality stands provide the majority of the North East's mixed species timber supply (Ryan 1997).

### **Regeneration systems**

Across the North East, mixed species forests are either even-aged or uneven-aged. Even-aged stands are predominantly all one age, and tend to occupy higher quality mixed species sites (Ryan 1997). Uneven-aged stands may have two or more age classes. Stand structure may be the result of fire or past harvesting practices.

Stand structure has the greatest influence on the choice of silvicultural techniques in the North East. In the high quality mixed species and even-aged stands, seedtree and clearfelling systems are used.

Low quality mixed species and uneven-aged stands lend themselves to selection silviculture, thinning from below or overwood removal to reduce competition from poorer quality stems and stimulate the growth of retained trees.

Site preparation and establishment may occur through burning or mechanical disturbance, followed by artificial or natural seeding, or coppice. Where fire is not used for site preparation, poisoning or ringbarking of seed trees may be necessary to induce seed fall. In practice, the choice of regeneration technique is strongly influenced by the method of harvesting and the species/structure characteristics of the stand. Silvicultural systems which retain a greater basal area after harvest, for example in uneven-aged stands, may need less site preparation and establishment effort compared to even aged stands. The coupes in uneven aged stands may still require a low intensity burn or mechanical disturbance followed by supplementary artificial seeding for regeneration.

Regeneration success rates in the mixed species forests where even-aged silviculture has been practiced, have also been excellent in the period 1989 to 1993 (Murphy and Fagg 1996).

### ***Regrowth management***

Thinning of stands can also be undertaken in mixed species forest to increase the merchantable wood yield by concentrating growth on a smaller number of retained stems. If funds and markets are available, suitable stands of mixed species forest will be thinned, where appropriate, to lead to increased productivity and stand quality. Such operations are required to follow the NRE Guideline on Thinning of Mixed Species Regrowth (NRE 1997b).

### **Silvicultural Policy and Management**

Whilst the application of silviculture is usually based on the ecological characteristics of the forest type - such as the need for high site disturbance in Ash type forests - other considerations are also taken into account. The range of ecological, environmental, social and economic considerations for silviculture is contained in the Code of Forest Practices for Timber Production. These are implemented through Forest Management Plans, regional prescriptions, Wood Utilisation Plans, and Coupe Harvesting Plans.

The Code of Forest Practices for Timber Production provides a series of goals and guidelines for the establishment and tending of timber stands on public land which address:

- management of regeneration and reforestation;
- establishment, including tree species and seed sources;
- stocking and early growth;
- tending; and
- maintaining forest health.

In accordance with the Code, harvesting and regeneration systems in the North East are managed to:

- provide for adequate regeneration of the original species mix;
- obtain the desired growth;
- maximise sawlog yield;
- minimise environmental impact;
- incorporate social and economic considerations; and
- protect regeneration from excessive damage.

Silvicultural systems are also applied to both ash-type and mixed species forests to maintain a non-declining yield of sawlogs. This is currently achieved through:

- harvesting ash forest using clearfelling systems on a nominal 80 year rotation; and
- choosing the most appropriate silvicultural system in mixed species forest based on stand structure.

As discussed by Dore (1994) and Ryan (1997), no single silvicultural treatment can be applied across the mixed species forests of the North East. Instead, a range of treatments is available, and used, depending on numerous factors including:

- stand conditions, including age structure, species composition, seed availability and site quality;
- site conditions, such as elevation, aspect and rainfall;
- operational constraints, such as rock and steep slopes;
- markets for residual roundwood or specialty timbers;
- non-wood values, including flora and fauna, landscape and recreation.

The North Eastern Mixed Species Silviculture (NEMSS) Project identified several possible silvicultural systems through consideration of age structure, species composition and seed availability (Ryan 1997). Systems range from clearfelling to overwood removal.

### **Silvicultural Research**

An intensive program of silvicultural research into Alpine Ash was undertaken by Grose in the late 1950's and early 1960's, largely based in the Mansfield - Connors Plain areas (Grose 1957, 1963). Current knowledge of regeneration requirements of Alpine Ash is based on this work in which several harvesting and regeneration systems were trialed, including retaining group, strip and single seed-tree sources. Operational difficulties, however, led to the adoption of the current clearfelling system, using high intensity burning and artificial sowing.

Departmental and CSIRO research into thinning of ash eucalypts has occurred over many years. Results have indicated that, given suitable machinery and sites with low levels of old log debris, thinning can be commercially viable and can have other benefits in the longer term (Webb 1966, Kerruish and Rawlins 1991). A collaborative program involving CSIRO, University of Melbourne and the Australian Logging Council - the Forest Technology Program - is setting out to investigate ways of minimising site soil disturbance in Victorian and Tasmanian forests using appropriate machine technology and integrated harvesting and site preparation.

With the completion of the North East Mixed Species Silviculture System project, the North East Research and Development Action Group (NERDAG) was formed. This NRE group exists to improve silvicultural management in Mixed Species and Alpine Ash forest in the North East (Fagg and Flinn 1997). Its responsibilities include production of review, discussion and operational papers which provide further knowledge of silviculture in these forest types, and assist the efficient application of silviculture systems. Reports produced to date by the NEMSS Project and NERDAG include a review of current silvicultural practices (Dore 1994), a discussion of regeneration techniques and their success (Dore 1995), a trial of the use of poisoning to induce seedfall (Ryan 1997), and guidelines for silviculture in mixed species forests (Ryan 1997). Current projects being undertaken by NERDAG are monitoring the effects of pre-harvest site preparation, shelterwood systems and alternative sowing techniques on regeneration in mixed species forests.

### **3.3 FIRE PLANNING AND MANAGEMENT**

Fire is an integral part of the ecology of forests. It is a disturbance to which most of the native flora and fauna are generally well adapted. The wildfire hazard in the North East is as potentially severe as anywhere in Australia.

The Department of Natural Resources and Environment is responsible for the prevention and suppression of fires in State forests, National parks and other protected public lands. The Department also has responsibility for fire prevention on private land within 1.5 kilometres of State forests, National parks and protected public land which has not been excised by legislation. By definition under the *Forests Act 1958*, these lands are referred to as the 'Fire Protected Area'.



The Country Fire Authority (CFA) is responsible for fire prevention and suppression in the 'Country Area of Victoria', which excludes the metropolitan fire district and most public land.

The Code of Practice for Fire Management on Public Land (CNR 1995d) provides a framework for fire management on Public land in Victoria. As a requirement of this Code, regional fire protection plans must be prepared and provide strategies for fire prevention, preparedness, suppression and recovery. The North East and Benalla-Mansfield Regional Fire Protection Plans apply in the North East RFA region.

Regional fire protection plans are developed after extensive consultation with municipal and regional fire prevention committees and other interested parties, including agency specialists in flora, fauna, parks, forestry, fire management, land and water protection, the Country Fire Authority and the community. They are reviewed every five to seven years.

Fire prevention, based on the general principle of minimising the incidence of preventable wildfire, includes strategies for education, enforcement and operations such as fuel management. In accordance with the Code of Practice for Fire Management on Public Land, regional fire protection plans include a fuel management strategy for fire prevention and preparedness, which aims to reduce the rate of wildfire spread and improve the prospects for controlling wildfire close to assets and in strategically located regional corridors.

The fuel management strategy primarily includes fuel management burning based on five zones:

- Zone 1 : asset protection (especially adjacent to private property)
- Zone 2 : strategic fuel reduced corridors
- Zone 3 : broad area fuel reduced mosaic
- Zone 4 : specific flora and fauna management
- Zone 5 : exclusion of prescribed burning

Fuel reduction burns are undertaken in only three of the strategically located zones to maintain fuel to defined levels. Areas containing significant biological, cultural or economic values which can be damaged by fire are generally located in Zone 5 where prescribed burning is excluded, or Zone 4 where the ecological requirements of an area are given priority. Before fuel reduction burning is undertaken on Public land, the Code of Practice for Fire Management on Public Land and regional fire protection plans require that each burn must be the subject of an approved plan.

The selection of sites and frequency of burning depend on the priority for fuel reduction, the rate of fine fuel accumulation, and biological values in accordance with the priority zones (CNR 1995d).

The fuel management strategy zoning takes into account natural values and principles of environmental care. The development of fire suppression and rehabilitation strategies also includes consideration of values at risk from wildfire or suppression activities. Where necessary, NRE prepares a rehabilitation plan which details activities required to assist the recovery of infra-structure, other assets and environmental values from the impact of wildfire and fire suppression.

### **3.4 FOREST RESEARCH**

Much research has been undertaken in the forests of Victoria and the North East. The Compendium of Forest Research (VicRFASC 1998d) contains an annotated bibliography of research and other scientific literature, and a synopsis of research in progress. The compendium addresses forest research relating to sustainability indicators, silviculture, forest hydrology, fire effects studies, forest flora and fauna, soils and nutrition, plantation establishment and management, pests and plant diseases, forest entomology and tree breeding genetic development and seed supply. The Compendium is available on request.

### **3.5 MONITORING AND REVIEW**

The Department of Natural Resources and Environment has a number of procedures established to monitor and review implementation of the plans and policies described in this chapter. These processes are considered further in the Statewide ESFM report (VicRFASC 1997a). Review of Codes and management plans are required every ten years, public participation is required in planning processes, and procedures are monitored and independently audited. These reviews provide the basis for adaptation of plans, ensuring they remain relevant.

Regular audits of harvesting operations on State forest are also undertaken to review the implementation of the Code of Forest Practices. Independent assessors from within NRE compare operations to the requirements of codes and prescriptions. These assessors are actively involved in the day to day implementation of the Code and are stationed outside the FMA being audited. In the East Gippsland RFA, Victoria committed to publish future reports of internal audits of compliance with the Code of Forest Practices for Timber Production. The 1996/1997 Statewide Code audit results have been published (NRE 1997c).

## 4. MANAGING FOR TIMBER PRODUCTION

This chapter describes and evaluates the past, present and future arrangements used by NRE for inventory, data handling and yield forecasting for sawlogs and residual logs in the North East region.

### 4.1 FOREST TYPE, EXTENT AND MERCHANTABILITY

The classification and description of forest types for commercial purposes is based on the predominant commercial species, and the quality and quantity that will provide sawlog material. Subject to a number of constraints, including tenure and zoning, forests in the North East are considered to be commercial if potential stand height exceeds 28m.

For timber production purposes, the commercial forests of the North East have been classified into three forest types:

- Ash,
- Mountain mixed species,
- Foothill mixed species.

The Ash forest type consists of stands dominated by Alpine Ash (*E. delegatensis*) at the higher elevations (up to 1500 m) and is sometimes associated with Mountain Gum (*E. dalrympleana*). Small scattered stands of Mountain Ash (*E. regnans*) occur below 1000 m in the southern part of the region. Mountain mixed species forests occupy the higher elevation slopes and include Mountain Ash, Alpine Ash, Messmate (*E. obliqua*) and Mountain Gum (*E. dalrympleana*). These forests are generally of high quality. The foothill mixed species forest generally occur on the lower slopes and comprise Messmate (*E. obliqua*), Narrow-leaf Peppermint (*E. robertsonii*), Mountain Grey Gum (*E. cypellocarpa*), Blue Gum (*E. globulus*) and Manna Gum (*E. viminalis*) as characteristic species.

Forests are also classified by age or maturity:

- Regrowth - 0-60 years of age,
- Advanced regrowth - 61-80 years,
- Mature (M) - greater than 80 years, and
- Overmature (OM) - greater than 120 years, with evidence of senescing crowns.

Map 6 describes the spatial location and extent of the commercial forest types in the North East region.

**Table 4.1: Net productive area (ha) for commercial forest types in the North East Region**

Forest Type	Benalla/Mansfield FMA			Wangaratta FMA			Wodonga FMA			TOTAL
	M/OM	Regrowth	Un stocked	M/OM	Regrowth	Un stocked	M/OM	Regrowth	Un stocked	
AlpineAsh	250	7 580		1 140	5 400		11 340	13 840	30	39 580
Mountain Ash	10	280								290
Mountain Mixed Species	930						20 630	800		22 360
Foothill Mixed Species	22 290	4 190	10	20 440	620		10 170	60	40	57 820
<b>TOTAL</b>	<b>23 480</b>	<b>12 050</b>	<b>10</b>	<b>21 580</b>	<b>6 020</b>		<b>42 140</b>	<b>14 700</b>	<b>70</b>	<b>120 050</b>

Source: DNRE Hardwood Area Resource Information System

The net productive area for commercial forest types in the North East region (Table 4.1) is based on information in the NRE Hardwood Area Resource Information System (HARIS) database. This data is current to 1992/1993, which is the date of the last HARIS update for the North East. Net productive area will be updated on the completion of the State-wide Forest Resource Inventory (SFRI) in the North East.

HARIS provides a standing volume for sawlog and residual roundwood for the mature and overmature (M/OM) forest types. The broad forest age class strata contained in HARIS in the North East are:

- Pre 1900 (Mature and Over-Mature, or M/OM);
- Decades after 1900 to 1991 (Regrowth, Advanced Regrowth and Mature).

HARIS is also used to provide net areas for the M/OM and regrowth forests. It is not used to provide data for standing volumes of regrowth ash, as this can be forecast using growth estimates, age class and area statements. The HARIS database was described and appraised by the University of Melbourne for the East Gippsland CRA Report (VicRFASC 1996c).

SFRI data will update and improve spatial information and estimates of standing volume for forest stands in the North East. New inventory design and reporting standards will, however, make direct comparison with HARIS data difficult. In general, previous inventories collected resource data using classical inventory techniques and existing sawlog and pulpwood standards. Volume estimates could not be readily recalculated when forest product standards changed or new products were developed. The SFRI will provide strategic level forest resource estimates independent of forest product standards. It is discussed in more detail in Sections 4.3 and 4.5.

It should be noted that the North East RFA region does not correspond exactly to the Benalla/Mansfield, Wangaratta and Wodonga FMAs. The North East region includes all of the Benalla/Mansfield and Wangaratta FMAs and parts of the Central and Wodonga FMAs. No State forest in Central FMA is within the North East region. The 17 per cent of Wodonga FMA that is outside the North East region includes State forest and produces hardwood sawlog. However, legislation requires that sustainable yield figures are provided on an FMA basis.

### **Sawlog Classification**

Sawlogs are graded according to their quality, and sometimes by their species. The actual grading is regulated by sawlog grading instructions, and a grade from A (highest quality) to D (lowest quality) is assigned to all sawlogs. When discussing sawlog allocations, it is usual to refer to a minimum allocation grade, such as C+ or D+. The term C+ denotes C grade and better sawlogs, whilst D+ denotes D grade or better - in effect all sawlogs are D+. The basis for licence allocations and yield predictions has changed from C+ sawlogs to D+ sawlogs to align the standards used for licensed sawlog allocations with the legislation governing sustainable yield. Logs not meeting the D grade requirements are termed residual logs.

### **Residual Log Classification**

Victorian Government policy for native forest timber production is geared towards sawlog production and value-adding. The Timber Industry Strategy (Victoria Government 1986) sets the context for Departmental policy regarding the production of residual logs. Residual logs are those that are either too small or too defective to meet current sawlog specifications, but may be salvaged mainly for non-sawlog end-uses such as firewood, craftwood or wood-fibre products. Residual logs are produced as a by-product of harvesting for sawlogs, or from silvicultural activities such as thinning or overwood removal which are designed to enhance future sawlog production. Specifications for sawlog and residual logs are given in Appendix 3.

### **Timber Resource**

The most productive forests in the North East are the ash type forests occupying 39 870 ha (33 per cent) of the total net productive area for the FMAs in the North East region. Due to the

relatively young age and small tree size, the regrowth ash resource currently contributes only a small percentage of the regions timber supply. Most of the current supply is derived from the mature ash resource.

The mixed species forests in the North East are also important for timber production and occupy 80 180 ha (67 per cent) of the net productive area.

In 1996-97, approximately 74 900 m<sup>3</sup> (net) of sawlog was harvested in the FMAs in the North East. Of this, some 58 100 m<sup>3</sup> (78 per cent) was derived from ash type forests while the remaining 16 800 m<sup>3</sup> (22 per cent) was derived from mixed species forests.

Growth rates used in the forecast of sustainable yield are usually derived from surveys or inventories of forest plots in representative forest types (see Table 4.3).

Data pertaining to Ash type forests in the North East were derived from regional assessments and various Forest Inventory Reports (FCV 1982a, 1982b, 1982c, 1982d).

Data relating to the mixed species forests are not as reliable as data for the ash resource because the mixed species forests have not been surveyed thoroughly. An assessment was carried out in the Strathbogie and Toombullup State forests (DCE 1991), but this was only of a low intensity.

The impact of errors resulting from using these estimates of net productive area and growth rates to forecast sustainable yield should be relatively small, given the low growth rates applied. The State-wide Forest Resource Inventory (SFRI) project, described later in this chapter, will result in a marked improvement in estimates of net productive area and estimates of growth and yield.

### **Regrowth**

Regrowth forest accounts for 27 100 ha (68 per cent) of the net productive area in Ash, and 5 700 ha (7 per cent) of the net productive area of the Mixed species forests in the region. The regrowth ash forests will provide the greater part of the future timber volume due to its higher growth rates and higher proportion of high quality sawlog. Data for regrowth volumes and growth rates are very important as these will determine the future availability of sawlog for industry.

## **4.2 LEGISLATIVE, POLICY AND PLANNING FRAMEWORK FOR SUSTAINABLE YIELD**

Sustainable yield, as the term applies in Victoria, is the estimated annual rate of hardwood sawlog production that can be achieved from the forest, taking into account the structure and condition of the forest, without impairing the long-term productivity of the land.

Sustainable yield is forecast on the basis of sawlog production, as timber harvesting in Victoria is sawlog-driven with residual logs produced as a by-product of sawlog operations. The availability of residual logs is therefore determined by the sustainable production of sawlogs. Nevertheless, as part of the management strategy to supply sawlogs, commitments can be made to supply regular levels of residual logs so that silvicultural regimes can be implemented and waste is minimised.

The *Forests Act 1958* (as amended in 1990) defines the legislative requirements for the determination of sustainable yield for sawlogs and the relationship with hardwood supply levels, that is the volume of sawlogs made available to industry. The Act specifies that the total hardwood supply level in a Forest Management Area (FMA) must equal or be within a permitted margin of the sustainable yield rate forecast over a 15 year Timber Supply Period. The short-term (annual) hardwood sawlog supply level is more flexible. In determining the short-term supply level, the factors which are considered include the long-term sawlog supply level; planning and socio-economic factors; bushfire and other natural disasters; and agreements or decisions by the Commonwealth (*Forests Act 1958*, Sections 52A and 52B).

The *Forests Act 1958* also specifies that the sustainable yield rates for the harvesting of hardwood sawlogs are to be reviewed in each five year period from 1 July 1991 to determine whether they are still appropriate. The Minister is required to review sustainable yield as soon as possible outside the specified five yearly timetable if 'the Minister considers that there has been a significant variation in the hardwood sawlog resources in any State forest available to be exploited commercially'. The Minister may also review sustainable yield at any time 'if he or she thinks it is appropriate to do so.' (*Forests Act 1958* Sections 52D. (Sub-sections 2&3)). On completion of the review, the Minister may decide that sustainable yield rates should remain the same, or may recommend to the Governor in Council new sustainable yield rates, given significant changes in the available sawlog resource, for all or any of the State's 15 designated forest management areas.

The major objectives associated with the forecast of sustainable yield are to:

- provide a non-declining supply of grade D+ sawlogs;
- provide the highest yield available (on a sustainable basis) at any given point in time; and
- eventually achieve a balanced age class distribution throughout the forest and approach the maximum potential productivity of the forest (the long term sustainable yield) (NRE 1996d).

For each forest type, the forecast of sustainable yield requires data for:

- net productive area of mature/overmature forest;
- standing volume of grade D+ sawlogs for the mature/overmature forest;
- net productive area of regrowth forest;
- age (year of origin) of the regrowth and an average minimum harvesting age;
- growth rates (MAI) of the regrowth; and
- allowances for known risks (for example wildfire) or other factors.

From the available data, sustainable yield is forecast using an integrated process that considers wood production in the context of other forest values.

### 4.3 SUSTAINABLE YIELD IN THE NORTH EAST

#### Current Sustainable Yield

The current legislated Sustainable Yields for the Benalla/Mansfield, Wangaratta and Wodonga FMAs are provided in Table 4.2.

**Table 4.2: Legislated Sustainable Yields of Sawlogs (m<sup>3</sup>/year)**

Forest management Area	Volume (D+ m <sup>3</sup> /yr)
Benalla/Mansfield FMA	13 500
Wangaratta FMA	25 000
Wodonga FMA	28 000
<b>Total</b>	<b>66 500</b>

Source: NRE 1997e

Currently, about 22 000 m<sup>3</sup> gross of residual logs generated from harvesting activities in the North East are sold into residual log markets. Additional volumes could be supplied from the region if markets expanded in the future. Residual logs are a by-product of normal sawlog harvesting operations. Improved estimates of residual log availability will be produced when the sustainable yield for sawlog is reviewed using new data from the State-wide Forest Resources Inventory.

### Historical Development of Sustainable Yield Forecasts

The following discussion outlines the major factors that have influenced the development of the sustainable yield forecasts that apply to the Forest Management Areas (FMAs) within the North East.

Prior to the sustainable yield forecasting established following the Timber Industry Inquiry, the area available for timber harvesting had been reduced as a result of previous Government decisions to expand the area of parks and reserves in the North East, including the establishment of the Alpine National Park.

#### 1984/85 Inquiry into the Timber Industry

The Timber Industry Inquiry (Ferguson 1985) established by the Victorian Government was required to investigate and report on all aspects of the timber industry in Victoria. Sustainable yields were forecast for forest districts and groupings of forest districts. The departmental (Forests Commission) Hardwood Resources Information System (HARIS) database was updated across the State for the Inquiry.

Forecasts were determined using manual spreadsheet techniques and data extracted from the HARIS database. These forecasts were based on assumptions and the prevailing management strategies and included a conservative approach that sought to allow for a number of environmental issues that had not been formally addressed prior to the Inquiry. As a result, a 25 per cent reduction factor was applied to the forecast figure to account for the unquantified potential loss in available area and volume associated with protection of arboreal mammal habitats, rainforest and sites of high recreation and landscape value. The forecasts were submitted to the Inquiry and the Chairman, Professor Ferguson, concluded at the time that the forecasts were adequate but recommended that more advanced planning methods and forecasting be used in future (Ferguson 1985).

Since the Timber Industry Inquiry, various factors have resulted in changes to timber resource availability in the region. The following is a synopsis of these changes and the relative implications for sustainable yield forecasts.

#### 1986 Timber Industry Strategy

The Timber Industry Strategy (TIS) (Victoria Government 1986) established the basis for the application of regional sustainable yield to the harvesting of sawlogs from State forest in Victoria in response to the Timber Industry Inquiry. The regions established for this purpose are called Forest Management Areas (FMAs) and are based on areas of native forest supplying sawlogs, the location of major conversion centres and consolidation of supply commitments to individual sawmills.

In addition to defining FMAs, the Timber Industry Strategy established the processes and methodology for forecasting sustainable yield. Sustainable sawlog yield rates for each FMA were based on available resource data, management plans and existing sawlog utilisation standards. Forecast estimates in TIS were made to 2014/15. The growth rates used to estimate the forecasts are given below (Table 4.3).

**Table 4.3: C+ net MAI, by Forest Management Area (m<sup>3</sup>/ha/yr)**

Forest Type	Benalla/Mansfield FMA	Wangaratta FMA	Wodonga FMA
Mountain Ash	2.0	N/A	N/A
Mountain Mixed Species	1.1	1.0	1.0
Foothill Mixed Species	1.0	1.0	1.0

Note: N/A - not applicable

The TIS concluded that there was insufficient hardwood resource to sustain sawmilling operations in the Benalla/Mansfield FMA, as these operations had been predominantly supplied by the mature ash resource. Subsequently, a review of resources indicated that a harvest level of 2 500 m<sup>3</sup>/year could be sustained by the foothill mixed species resource. This revised estimate formed the basis for the sustainable yield rate adopted for Benalla/Mansfield in the 1990 legislation.

Following the TIS, estimates of sawlog resource availability were revised for Wodonga FMA when it was recognised that errors were present in the 1984 HARIS database. A revised area statement was produced and this formed the basis for the sustainable yield rate of 23 000 m<sup>3</sup>/year adopted for Wodonga in the 1990 legislation.

Table 4.4 lists the sustainable yield rates adopted in 1990 for Benalla/Mansfield, Wangaratta and Wodonga FMAs.

**Table 4.4: 1990 Legislated Sustainable Yields of Sawlogs (m<sup>3</sup>/year)**

Forest Management Area	Volume (C+ m <sup>3</sup> /yr)
Benalla/Mansfield FMA	2 500
Wangaratta FMA	21 000
Wodonga FMA	23 000
<b>Total</b>	<b>46 500</b>

Source: Forests (Timber Harvesting) Act 1990

### 1988 Uniform Log Grading Rules

New State-wide sawlog grading standards were introduced in 1988. Four grades of sawlog were established, based on the relative quality of logs for sawmilling. These grades (A, B, C and D) were applied to all native hardwood species except the durable species including Red Gum, Box and Ironbark.

The lowest grade (grade D) sets the minimum standard for sawlogs from non-durable species forests across the State.

The new grades replaced local sawlog standards, which varied considerably across the State, and between forests of differing age and type. The significance of this change was that, in some parts of the State, more timber was defined as sawlog. In the North East, sawlogs equated to grades A, B and C (C+). The new grading effectively represented the formalisation of a classification of sawlog that was previously purchased outside of the C+ allocation arrangements. Given that this was essentially an administrative amendment, this change did not affect the sustainable yield forecast from the North East for C+ sawlogs.

### 1989 Long-term Licences

Long-term (15 year) licences were first issued in 1989 to provide the timber industry with a secure supply of resource, and to encourage investment in value-adding. The licences that were subsequently issued generally specified grade D and better (D+) sawlogs. Only a limited number of purchasers who were already adding value to a substantial proportion of their output were issued with licences for grade C and better (C+) sawlogs.

The long term licences were set in accordance with the sustainable yield forecasts for Benalla/Mansfield, Wangaratta and Wodonga FMAs taking into account negotiations between the department and industry.



A number of licences in the North East were due for renewal in 1996/97. Five 3-year licences have been issued based on their current annual license allocations in the interim until improved resource information from the SFRI is available. Renewal of long-term (15 year) licences will be considered following completion of the North East forest management plan and forecasting of sustainable yield using the updated SFRI data.

### **Code of Forest Practices for Timber Production**

The Code was first produced in 1989 (CFL 1989) to formalise the large number of regional harvesting and regeneration prescriptions into a single State-wide document. It was adopted by the Victorian Parliament in 1989, and was independently reviewed by the CSIRO in 1996 (NRE 1996b). A revised Code was adopted by the Victorian Parliament in early 1997. Given that regional prescriptions were already in place it was judged that the introduction of the Code had a minimal impact on resource availability in the North East.

### **1990 Sustainable Yield Legislation**

In 1990, as part of the implementation of the TIS, the *Forests Act 1958* was amended to provide for a legislated sustainable yield rate for each FMA. The forecasts are specified in a schedule to the Act and are periodically reviewed according to legislative requirements.

The 1990 legislation adopted the sustainable yield rates for Benalla/Mansfield, Wangaratta and Wodonga FMAs as shown in Table 4.4.

### **1991 Land Conservation Council (LCC) Rivers and Streams investigation and LCC Wilderness investigation**

Following the final recommendations of the Land Conservation Council (LCC) State-wide investigation of Rivers and Streams, two Heritage Rivers and eight Essentially Natural Catchments in the North East region were designated. For these areas, the LCC estimated the reduction to the sustainable yield forecast up to the year 2000/1 would be: 0.4 per cent for the Wodonga FMA, 0.2 per cent for Benalla-Mansfield FMA and 0.1 per cent for the Wangaratta FMA. (LCC 1991a)

The final recommendations for the LCC's State-wide investigation of wilderness were published in 1991 (LCC 1991b). In the North East region, each of the Wilderness Areas and Other Areas with Remote and Natural Attributes were in National Parks except the Wabba Wilderness Area and the Dandongadale and Wongungarra catchments both identified as Other Areas with Remote and Natural Attributes.

The Wabba Wilderness Area includes sawlog resources corresponding to approximately 0.3 per cent of the regional sustainable yield of the Wodonga Forest Management Area; this excludes the 0.1 per cent which is included in the above figures for the Rivers and Streams Special Investigation recommendations.

The recommendation for the Other Areas with Remote and Natural Attributes in the Dandongadale catchment does not preclude the use of the timber resources in this area. The Remote and Natural Area in the Wongungarra catchment would have only a minor impact on timber supplies.

### **1994/95 State-wide Forest Resources Inventory (SFRI)**

The State-wide Forest Resources Inventory (SFRI) commenced in Victoria in 1994/95 (NRE 1996e). The SFRI will map around 3.5 million hectares of State forest, with sampling of productive regrowth, mature and over-mature forests to determine the standing volume of D+ sawlog. The program will also provide the necessary base data to enable development of new growth models for a significant number of forest types, thereby enhancing the capacity to forecast future timber yields from both M/OM and regrowth stands. Specifically the new inventory will:

- update the State's timber resource data, replacing data collected primarily in the 1960s, 1970s and 1980s;

- be the State's first complete forest resource inventory based on a single inventory design and standard;
- enable new growth and yield models to be developed for many of the State's native forests;
- enable resource estimates to be made to a uniform standard of utilisation;
- have the capacity to adjust to new utilisation standards; and
- provide a basis for resource estimates, sustainable yield forecasts and management planning well into the next century.

Data from the SFRI for the FMAs located in the North East region will become available in mid-1998.

### **1996 State-wide Review of Sustainable Yield**

The *Forest Act 1958* requires the Minister to review all sustainable yield rates every five years. This follows an amendment to the Act in 1990 and the relevant provisions commenced in 1991. The first review was conducted in 1996.

At the time of the review, the SFRI project had commenced in the North East, but SFRI data were not available to update existing information. In addition, with a number of planning processes underway, including the development of the Proposed North East Forest Management Plan and the RFA process about to commence, it was decided to defer a formal review of sustainable yield until completion of these. Consequently recent changes, including the impact of LCC recommendations, were not considered in the 1996 review of the Wodonga and Wangaratta FMAs because it was considered that they could be accommodated without impacting the sustainable yield rates given the conservatism of the original forecast.

Following a review of the regrowth Ash resource in 1992, a revised sustainable yield rate was determined for Benalla/Mansfield FMA. The revised rate was incorporated in the 1996 review (NRE 1997e).

One change made for all FMAs as part of the 1996 sustainable yield review was the conversion of sustainable yield rates from C+ to D+ log grade, based on the proportion of each sawlog grade sold in the 1995/96 financial year for each FMA. A log grade audit, conducted in 1996, was used to adjust these figures. This was judged to be the most robust and transparent method of conversion, in the absence of new resource information. The 1996 sustainable yield rates for D+ sawlogs are given in Table 4.2.

## **4.4 APPRAISAL OF SUSTAINABLE YIELD METHODOLOGY**

The Timber Industry Inquiry established the need for improved estimates of sustainable yield (Ferguson 1985) and this is being implemented through the Timber Industry Strategy which established Forest Management Areas and an improved process and methodology for forecasting sustainable yield. As a result, sustainable yield rates in the North East region have been based on the Timber Industry Strategy and subsequent new resource estimates.

As outlined in section 4.5, the Sustainable Yield Spreadsheet (SYSS) methodology for forecasting sustainable yield has been externally reviewed and accredited through the CRA/RFA process, and the HARIS data collection process was reviewed for the East Gippsland RFA and was considered adequate.

The availability of the SFRI data and use of the Integrated Forest Planning System (IFPS) will enable improved forecast estimates to be made in the development of the North East Forest Management Plan. The IFPS methodology has been reviewed and approved by an external consultant.

Confidence in the sustainable yield forecasts can be enhanced through formal documentation of the methodology used to determine resource availability for the preparation of the proposed Plan,

including stated assumptions, and exposure to risk using sensitivity analysis, as well as formal documentation of actual versus predicted yields.

#### **4.5 STRATEGIC FORECAST OF SUSTAINABLE SAWLOG YIELD**

Strategic forecasts of sustainable yield for FMAs in the North East region will be based on the North East Forest Management Plan, State-wide Forest Resource Inventory (SFRI) and Integrated Forest Planning System (IFPS) as outlined below.

##### **North East Forest Management Plan**

The TIS identified the need for a comprehensive forest management planning process to develop plans for each FMA in Victoria. The plans provide for sustainable timber production, plus the protection of environmental values in State forests, and incorporate input from the community. Each plan includes a management strategy and a zoning scheme that defines areas that are to be managed to meet particular objectives, including timber and a range of biodiversity and other forest values. The zoning scheme will therefore allow for the requirements of sustainable yield under the *Forests Act 1958*. The proposed North East Forest Management Plan, covering State forest in the North East RFA region, is due to be released in 1998.

During development of the zoning scheme in the proposed plan, analysis of the impact of the plan on timber resource availability will be carried out. The analysis will be based on the net productive area as provided by SFRI and availability as defined by the forest management zones. Revised growth and yield estimates derived from SFRI analyses will also be used.

The general reduction factor applied to earlier estimates will not be applied as available areas are quantified as part of the process of developing forest management zones.

Management guidelines developed as part of the Forest Management Plan will determine the availability of the resource, through definition of forest management zones, and establishment of guidelines for the timing of timber harvesting.

The analysis of implications of the proposed Plan on sustainable yield will be carried out using the SYSS module of the Integrated Forest Planning System (IFPS). Following publication of the final Plan a formal review of sustainable yield will be made using the full version of the IFPS.

##### **SFRI**

The forecast of sustainable yield, to be prepared following the release of the North East Forest Management Plan, will be based on new inventory data provided from the State-wide Forest Resource Inventory. This data will include improved estimates of standing volumes, areas and growth. It will be spatially referenced and stored in a GIS database. Aerial photograph interpretation for the North East component of SFRI was completed in late 1997. The completion of the transfer to GIS and integration of the mapping with logging history records and the plot inventory work is scheduled for completion in mid 1998.

SFRI data will update and improve spatial information and estimates of standing volume for ash and mixed species stands.

An estimate of net productive area, which is the area of forest capable of producing merchantable timber, will be produced by the SFRI. The net available productive area is the actual area from which sawlogs can be harvested under current management prescriptions as defined by the Code of Forest Practices (NRE 1996a). This area excludes productive forest located in streamside buffers and on steep slopes. Areas deemed to be unmerchantable due to accessibility constraints are also excluded.

## **IFPS**

The analysis methodology applied to sustainable yield forecasts has progressed from a manual spreadsheet approach through various stages of computerised spreadsheets known as the Sustainable Yield Spreadsheet (SYSS). SYSS is one component of the Integrated Forest Planning System (IFPS). It is used to test management strategies using aggregated data. Other components of the IFPS include GIS, growth and yield, optimisation and monitoring modules (Lau *et al.* 1996). Specifically, the IFPS interactively links Arc/Info, FORPLAN/ SPECTRUM, Lindo, SIR DBMS (Scientific Information Retrieval Data Base Management System), ERMapper, and an array of smaller components.

The concept behind the integration of such a diverse array of tools is to create a link between the forecast of sustainable timber flow and spatially locating the timber contributing to this flow.

The IFPS offers forest planners a structured, well organised approach to forest management issues. It provides scientifically based estimates of the sustainable yield of forest resources and a means of monitoring change in the forest. It also enables alternatives to be considered and answers “What If?” questions related to management options. This enables the objectives of ecologically sustainable forest management to be met.

IFPS models are run many times with different constraints to investigate alternative strategies and to determine the impact that forestry activities will have in both the short and long term. The IFPS attempts to find an optimal solution, within the constraints imposed, which achieves a balance between the social, economic and environmental aspects of forest use.

The ability to visualise results spatially, in context with maps and remotely sensed data, allows feasibility testing to be conducted. This important process may significantly alter the final forecast of the sustainable yield. However, it usually results in a modified set of prescriptions. Testing options continues in an iterative manner until feasible results are achieved.

The Midlands sustainable yield review (CNR 1995e) is an example of the use of the IFPS to incorporate detailed harvesting prescriptions for specific areas.

## **Monitoring and Auditing**

NRE is currently undertaking a comparison of the area and volume predicted to be harvested, the actual area and volume harvested, and the licensed volumes for each FMA for the period 1991/92 to 1995/96. This will form part of the on-going reconciliation of sustainable yield with licensed sawlog levels as required in the Forests Act.

## **Review of SFRI and IFPS**

In a review of the SFRI, both inventory and yield data collection and analysis techniques were seen to be effective and useful methodologies that should result in statistically valid and unbiased estimates of volume and yield appropriate for strategic level planning (Brack and Turner 1995). Brack and Turner also identified the need for sensitivity and jackknife analyses to estimate the effects of SFRI sub-models on the overall reliability of the model estimates.

In the absence of growth data from permanent plots, it is proposed to use stem analysis to develop growth and yield models. This process was considered to be sound by the consultants, and will be used to develop appropriate models.

The HARIS data collection process was reviewed in the CRA/RFA for the East Gippsland FMA, and was considered adequate, (VicRFASC 1996c). The SYSS methodology has been externally reviewed and accredited through the CRA/RFA process (VicRFASC 1996c).

The IFPS methodology was reviewed and approved by external consultants (Turner and Church 1995) for its application in the Midlands FMA. The use of this methodology in conjunction with good quality GIS-based inventory data was considered to be consistent with best international practices.

#### **4.6 RESIDUAL LOGS**

As previously discussed, residual logs are those that are either too small or too defective to meet current sawlog specifications (Appendix 3), but may be salvaged mainly for non-sawlog end-uses such as firewood, craftwood or wood-fibre products. Victorian Government policy for native forest timber production is geared towards sawlog production and value-adding. The Timber Industry Strategy (Victoria Government 1986) sets the context for Departmental policy regarding the production of residual logs. Residual logs are produced as a by-product of harvesting for sawlogs, or from silvicultural activities such as thinning or overwood removal which are designed to enhance future sawlog production.

## 5. TIMBER INDUSTRY – CURRENT POSITION AND OUTLOOK

### 5.1 TIMBER INDUSTRY — CURRENT POSITION AND OUTLOOK

#### State forest log production and value

The North East region accounted for around 8 per cent of total State sawlog production and 1.3 per cent of total State residual log production in 1996-97 (Table 5.1). In 1996-97, the region produced 64 275 cubic metres of sawlog, and 13 601 cubic metres of residual log.

**Table 5.1: Gross volume of logs harvested from North East region, 1996-97 <sup>a</sup> (cubic metres)**

Non-ash species								
Log grade <sup>b</sup>	Total							Total
	A	B	C	D	D+	R	Other	
Benalla/Mansfield	9	1370	3370	2803	7552	2536	0	10088
Wangaratta	0	598	1412	1699	3709	528	0	4237
Wodonga	3	599	4631	1138	6371	227	0	6598
North East	12	2567	9413	5640	17632	3291	0	20923
Total Victoria	796	34245	276452	108847	420340	453390	24518	898248
North East <sup>c</sup> (%)	1.5	7.5	3.4	5.2	4.2	0.7	0.0	2.3
Ash species								
Log grade <sup>b</sup>	Total							Total
	A	B	C	D	D+	R	Other	
Benalla/Mansfield	75	4526	2140	1832	8573	6667	0	15240
Wangaratta	608	5031	3964	2685	12288	2899	0	15187
Wodonga	146	3664	14880	7092	25782	744	0	26526
North East	829	13221	20984	11609	46643	10310	0	56953
Total Victoria	4184	139736	178328	56729	378977	580622	0	959599
North East <sup>c</sup> (%)	19.8	9.5	11.8	20.5	12.3	1.8	0	5.9
Total ash and non-ash								
Log grade <sup>b</sup>	Total							Total
	A	B	C	D	D+	R	Other	
North East	841	15788	30397	17249	64275	13601	0	77876
Total Victoria	4980	173981	454780	165576	799317	1034012	24518	1857847
North East <sup>c</sup> (%)	16.9	9.1	6.7	10.4	8.0	1.3	0.0	4.2

<sup>a</sup> The North East region includes all State forest areas in the Benalla/Mansfield and Wangaratta FMAs and 83 per cent of the Wodonga FMA. The totals presented here are the sum of the volumes for Benalla/Mansfield and Wangaratta FMAs and that part of the Wodonga FMA included in the region (hence, totals here may not correspond to those presented in chapter 4). <sup>b</sup> Log grades A to D represent sawlogs of diminishing log quality respectively. Log grade R represents residual or pulplog. Other includes all ungraded sawlog, such as specialty logs. <sup>c</sup> North East share of Victorian total. Source: Department of Natural Resources and Environment, 1998.

The North East region contributed around \$1.90m in log royalties in 1996-97 (including the Timber Promotion Council component and roading charges), or 5.4 per cent of total State forest log royalties received in that year. In 1996-97, total sawlog royalties received from the region were \$1.80m, while total residual log royalties were approximately \$97 000.

The native ash forests of the North East region have a high commercial value, because of their relatively rapid rates of growth and the characteristic long straight bole, making them highly suitable for milling into sawntimber products. Although the ash forests (comprising alpine ash and mountain ash) account for a relatively small proportion of the total net productive forest area in the region (33 per cent, Table 4.1), they provide a substantial share of higher grade logs.

Residual logs sourced from ash forests are also regarded as a cost effective input into the manufacture of pulp and paper products, because of the lower quantity of black tannins produced during the paper manufacturing process. This makes the processing of ash logs less costly than other species which contain higher quantities of black tannins, such as the mixed species hardwood forests.

The North East region is a source of ash logs for the domestic sawmilling and pulp and paper based industries, accounting for around 5.9 per cent of total ash type logs produced from Victorian State forests in 1996-97 and the majority of sawlogs produced in the North East region. The region produced 46 643 cubic metres of ash type sawlog in 1996-97, with a total royalty value of approximately \$1.32 million, and around 10 310 cubic metres of ash type residual log in 1996-97, with a total royalty value of around \$67 500.

The North East region also produced 17 632 cubic metres of non-ash (mixed species) hardwood sawlog in 1996-97, which had a total royalty value of \$477 499, and 3 291 cubic metres of non-ash residual log, with a total royalty value of around \$29 500, was extracted from the region. The North East accounted for 2.3 per cent of Victoria's total non-ash log production in 1996-97, with only a small proportion (0.7 per cent) being lower value residual logs. Around 3.5 per cent of the royalties received in Victoria for non-ash logs are from the North East region. In addition to royalty payments, in 1996-97 sawmill licence fees for the North East region were around \$0.17 million.

### **Log pricing and allocation arrangements**

Hardwood sawlogs harvested in the North East region are classified according to their size and quality (the potential for processing beyond the green sawntimber stage) and sometimes by their species, using a system of log grades in diminishing order of sawlog quality from A through to D (Red Gum, Box and Ironbark are termed durables and are not graded from A to D). Logs which do not achieve the D sawlog classification are called 'residual' logs. These are generally logs which are either too small or defective to meet current sawlog specifications, but which may be utilised to produce other wood products.

Royalty rates are determined using the 'royalty equation system'. In principle, royalty rates are set so that the sum of royalty rates and the transport costs involved in sending a base grade of sawn timber to a defined key market will be the same for all operations accessible to that market. There may be adjustments to account for variations in timber quality from the base grade, provision of access roads, or other factors. Details of the 'royalty equation system' are contained in the Victorian Timber Industry Strategy (Victorian Government 1986).

Fifteen year sawlog licences were introduced in 1987 and specified the volumes and grades of sawlogs to be supplied. Long term licences were introduced to provide a greater degree of certainty regarding the supply of wood resources for the timber industry and to promote further investment in value adding. The volume of logs allocated to a mill is often covered by more than one licence.

Sawlog licence allocations may be specified in net or in gross volume terms. Allocations specified in gross terms include the percentage of defective material in the log which is unsuitable for sawmilling, while allocations specified in net terms exclude defective material. Sustainable yield forecasts are

calculated in net volume terms. Sawlogs sourced from State forests in the North East region are currently sold at the stump. That is, royalties are charged on the sawlog before any processing occurs. Licences include the right to take timber.

Provision has been made in the licence arrangements for licencees to elect to receive logs above or below their annual allocation by up to 30 per cent in any one year, thus making provision for fluctuations in market conditions. Allocations must not be exceeded over the licence period, with no more than 110 per cent of the annual allocation being obtained in any five year period.

The proportion of sawlog grades which are allocated to licencees are negotiated on the basis of the degree of further processing being undertaken. If licencees are engaging in further processing they will be allocated a higher proportion of higher grade logs. However, the total allocation of D+ logs does not vary through this process.

### **Log harvesting and transport arrangements**

At present, two types of log harvesting and hauling arrangements exist for sawmills in the North East region:

- contractors are engaged by sawmill owners/managers or logging syndicates to harvest and transport logs from the forest to one or more mills; or,
- employees of sawmills harvest and haul logs.

Hardwood harvesting crews in the North East region are generally comprised of a faller, a 'snigger' (person who uses a skidder or dozer to place the fallen tree on a log dump), a log sorter/grader and a loader operator, and one or more log truck drivers depending on the distance the logs must be hauled to the mill for processing. A harvesting and hauling crew of four to five people could fall, snig, grade, load and haul an average of 12 000 to 15 000 cubic metres of logs in a harvesting season in the North East region. The harvesting season in the North East region is concentrated over a period of five to six months from late spring to early autumn. This is due to the fact that 70 per cent of the total volume of logs produced in the region are Alpine Ash which grow at high elevations throughout the region, much of which is inaccessible during winter.

In 1996-97, it is estimated that employment attributable to hardwood logging and hauling in the North East region is 30 people. It should be noted that this estimate differs from that provided in the social assessment, which includes total logging and hauling employment in the region such as integrated hardwood and softwood operators and both full-time and part-time operators.

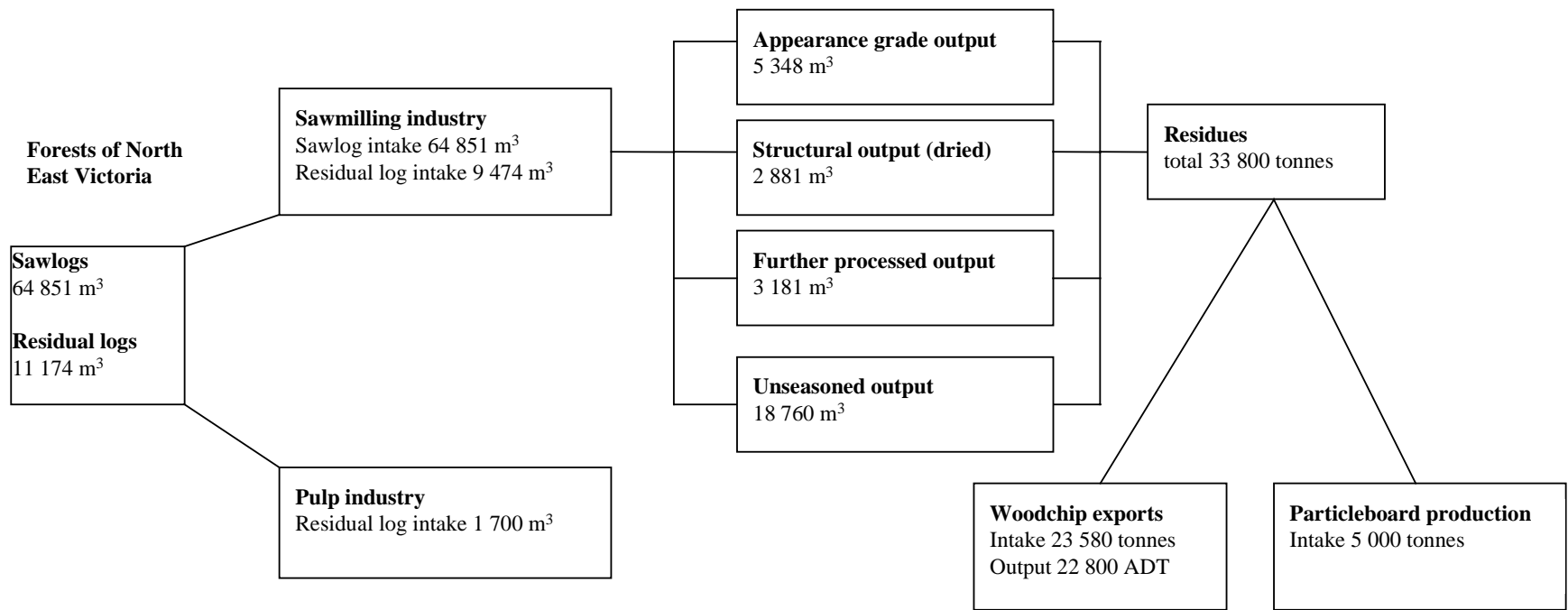
## **5.2 STRUCTURE AND VALUE OF THE HARDWOOD BASED INDUSTRIES**

In 1996-97 there were 9 hardwood sawmills receiving sawlogs from native forests in the region, a further 4 sawmills received residual logs only. In addition, three pulpwood processors received residual logs from the region or sawmill residues from sawmills utilising logs from the North East. Since 1996-97, one of the mills processing sawlogs has closed. The location of State forests in the North East region and sawmills and residual log processing facilities utilising wood resources from these forests is shown in Figure 5.1 (located in sleeve).

The hardwood sawmills processing logs from the native forests of the North East are involved in a range of sawntimber processing activities, including a high proportion of further processed products such as kiln dried and appearance grade products for both domestic and export markets. The quality and volume of available sawlog resources, the scale of sawmill operations and further processing capacity largely determine the range of products produced at each mill. The log input capacities of the sawmills processing hardwood sawlog resources from the North East region in 1996-97 is shown in Table 5.2. In addition, there were a further 4 sawmills that processed residual logs (and no sawlogs) from the North East in 1996-97. In total these mills processed 3100 cubic metres of residual logs in 1996-97 with the major products being pallets, palings and a small amount of scantling.



Figure 5.2: Structure of the hardwood industry in the North East region, 1996-97<sup>a</sup>



<sup>a</sup> Estimates are totals for the sawmilling industry based on the percentage of log intake from the North East RFA region.

A variety of pulp-based products are also manufactured using hardwood residual logs and sawmill residues sourced from the North East. In 1996-97, residual logs from the region were processed into pulp for use in tissue manufacture and woodchips for export. In addition, a small volume of sawmill residues (sawdust) was used in the production of particleboard within the region. The current structure of the hardwood based industry in the North East region is shown in Figure 5.2.

**Table 5.2: Capacity for sawmills processing sawlogs sourced in the North East region, 1996-97**

<b>Log input</b> (cubic metres)	<b>Number of sawmills</b>
<b>0 - 10 000</b>	3
<b>10 000 - 20 000</b>	4
<b>20 000 - 30 000</b>	0
<b>30 000 - 60 000</b>	1
<b>60 000 - 90 000</b>	1

The commercial forestry, sawmilling and residual log processing based industries using wood sourced from the North East region presently account for an estimated 212 direct wood based industry jobs (located within and outside the North East region), with an estimated gross value of production of \$20.6 million (Table 5.3). Estimates of gross value and employment from the sawmilling and residual log processing industries were calculated on a pro-rata basis, by multiplying the percentage of total wood intake that is sourced from the North East region for these industries by the relevant total employment or gross value of production figures. On this basis, it is apparent that the native wood based industries are an important part of the local economy of the North East region.

**Table 5.3: Key economic features of the hardwood based industries, North East region, 1996-97**

<b>Total gross value of wood based industries (product value)<sup>a</sup></b>	<b>\$ million</b>
Residual log based industries	3.2
Sawmilling industry	18.1
Total	20.6 <sup>b</sup>
<b>Total forestry and wood based industry employment</b>	<b>no. persons</b>
Forest management	15 <sup>c</sup>
Residual log based industry	9 <sup>a</sup>
Sawmilling industry	158 <sup>a, d</sup>
Logging and haulage	30
Total	212
<b>Total log intake</b>	<b>m<sup>3</sup></b>
Total sawlogs intake	64 851
Total residual log intake	11 174
Total	76 025
<b>Total State forest royalties received</b>	<b>\$ million</b>
Total sawlog royalties received	1.80
Total residual log royalties received	0.10
Total sawmill licence fees received	0.17
Total	2.07

a Calculated by multiplying the percentage of total intake sourced from the North East by the relevant total employment, production or gross value of production figures. These facilities are not located in the North East. b This estimate has been adjusted to prevent doublecounting of sawmill residues in the total gross value of production. c Department of Natural Resources and Environment, 1998. This figure includes NRE staff directly associated with commercial wood production and does not include permanent or part time forest works crews or NRE staff who spend part of their time on commercial forest activities. d Full time equivalent.

The flow-on effects to the State economy from the wood based industries using wood sourced from the North East region may be broadly estimated using appropriate input-output and employment multipliers. Drawing on available multipliers for the wood based industries in the Victorian economy, it is estimated that the value of turnover from the sawmilling and pulpwood processing industries receiving hardwood resources from the North East contribute around \$34 million and \$7 million respectively to State output. These estimates are based on a State output multiplier of 1.87 for the sawmilling sector and 2.14 for the paper products sector (National Institute of Economic and Industry Research, 1985).

The sawmilling and residual log processing industries receiving hardwood resources from the North East region contribute 363 and 28 jobs respectively to the Victorian economy. These estimates are based on a State employment multiplier of 2.3 for the sawmilling sector (with 158 direct jobs) and 3.1 for the paper products sector (with 9 direct jobs). It is also estimated that the commercial forest management sector (with 15 direct jobs) and logging and haulage sectors (with 30 direct jobs) from the North East region contribute 94 jobs to the Victorian economy, using a State employment multiplier of 2.1 for the forestry sector. The total level of employment attributable to hardwood resources sourced from the North East region from the forestry, logging and haulage, sawmilling and pulpwood processing industries is therefore estimated to contribute around 485 jobs to the Victorian economy.

The native hardwood resources sourced from the region also contribute to a range of further solid wood manufacturing based activities, such as furniture manufacturing, joinery and craft wood industries. In 1996 there were 585 persons employed in the furniture and joinery based industries who were resident in the Statistical Local Areas comprising the North East region (Australian Bureau of Statistics 1997b). These industries included the categories: timber resawing and dressing; furniture manufacturing; wooden structural component manufacturing; plywood and veneer manufacturing and fabrication; wood product manufacturing; and wooden furniture, upholstered seat manufacturing and furniture. It is important to note, however, that at least some of these manufacturing activities are likely to have been based on wood resources from a range of sources; hardwood native forests, plantation softwood forests and imports. In addition, some further processing industries utilising hardwood timber from the North East region may be located outside the region.

In Table 5.4, estimates are provided for forestry and wood based industry employment by major industry category for people who were resident in the Statistical Local Areas comprising the North East region. Based on these figures, the wood based industries (including both hardwood and softwood) accounted for around 1 224 direct jobs, or around 1.9 per cent of total regional employment. However, it is important to note that these figures do not take account of indirect employment or wood based industry jobs that are linked to hardwood resources sourced from the North East region but are not located within the RFA boundary. An example would be the Midway processing facility at Geelong, which receives a small volume of eucalypt wood resources from the North East region and is located outside the RFA boundary.

### **Sawmilling industry survey**

In order to provide an accurate assessment of the economic circumstances underlying the competitiveness and value of the hardwood sawmilling industry, an economic survey of sawmills receiving logs from the North East region was conducted.

Information derived from the survey has been used in conjunction with other market based information to estimate the total gross and net economic value of the North East hardwood sawmilling industry. The method used to derive estimates for the North East sawmilling industry is outlined in box 1.

**Table 5.4: Total direct forestry and wood based industry employment resident in the North East region, 1996<sup>a</sup>**

<b>Industry</b>	<b>Employment 1996 no.</b>
<b>Forestry and Logging</b>	
Forestry and Services to forestry	77
Logging	142
Total	219
<b>Wood and paper products manufacturing</b>	
Log sawmilling and timber dressing undefined	114
Log sawmilling	185
Timber resawing and dressing	9
Plywood and veneer manufacturing and fabrication	356
Wooden structural component manufacturing	60
Prefabricated building manufacturing NEC	6
Wood product manufacturing NEC	54
Wood chipping	3
Furniture manufacturing	28
Wooden furniture, upholstered seat manufacturing and furniture	78
Paper and paper products manufacturing undefined	3
Pulp, paper and paperboard manufacturing	69
Paper and sack manufacturing	0
Solid paperboard container manufacturing	0
Corrugated paperboard container manufacturing	0
Paper product manufacturing NEC	34
Wood and paper product manufacturing undefined and other wood	6
Printing and services to printing	0
Total	1 005
<b>Total forestry and wood based industries</b>	<b>1 224</b>

a Only SLAs that have a minimum of 50 per cent of their area falling within the North East region have been included in these estimates.  
Source: Australian Bureau of Statistics (1996b).

The survey contained a series of questions designed to assess the economic conditions underlying the long term competitiveness and value of the industry and was conducted over one week in December 1997. Face to face interviews were conducted with sawmill owners or managers, although information for sawmills previously covered in the sawmill survey for the Central Highlands RFA was updated via telephone interviews. All sawmill owners/managers were contacted as part of the economic survey. Questionnaires were completed for all of the hardwood sawmills receiving State forest logs from the North East region. In log intake terms, the survey responses accounted for 100 per cent of total State forest logs received by the North East region sawmilling industry in 1996-97.

**Box 1: Deriving total estimates for the sawmilling industry in the North East region**

One hundred per cent (9 out of 9) of hardwood sawmills receiving sawlogs from the North East region in 1996-97 responded to the survey. Information was also collected for the 4 sawmills that processed residual logs (but not sawlogs) from the region in 1996-97.

In some instances, only partial responses to the questionnaires were supplied. For omitted data, estimates calculated from average costs, prices and returns were used. As a number of mills also use logs sourced from outside the North East region, projections for key variables attributable to logs sourced from the North East region are provided. For each mill, the employment, gross value and net value of production attributable to the resources sourced from the North East region are calculated by multiplying the percentage of total intake sourced from the North East by the relevant total employment, gross value of production and net value of production estimates. For example, if a mill employing 50 people were to source 40 per cent of its logs in the North East region and the remainder in other RFA regions, total employment attributable to the North East region would be estimated as 20 people.

**5.3 THE HARDWOOD SAWNTIMBER INDUSTRY**

In 1996-97, there were 13 sawmills receiving logs from State forests located in the North East region. Nine of these mills received sawlogs while 4 mills received residual logs only. The following information presented on the hardwood sawmilling industry relates to the 1996-97 financial year, as this was the latest year for which complete records were available. Since the sawmill survey was conducted, one mill that received sawlogs in 1996-97 has closed.

For the 9 sawmills which processed sawlogs, around 34 per cent of total log intake came from State forests located within the North East region in 1996-97 (Table 5.5) (this volume may vary annually). The remaining sawlogs received were sourced from State forests located in other RFA regions in Victoria and a small amount was sourced from private forests within Victoria. Of the 4 mills that received only residual logs in 1996-97, logs from the North East accounted for all of the hardwood log intake at 3 of these mills but for less than one per cent of hardwood log intake at the other mill. Due to the high proportion of logs sourced from outside the region, discussion in the remainder of this chapter will focus on the hardwood sawmilling industry 'attributable to North East region resource' as discussed in box 1.

**Table 5.5: Intake by the North East region hardwood sawmilling industry, 1996-97 <sup>a</sup>**

	<b>Intake, m<sup>3</sup></b>	<b>Share of total intake, %</b>
North East region State forests	71 028	34.0
North East region private forest	200	0.1
Other than North East region	137 543	65.9
Raw wood material intake <sup>b</sup>	0	0.0
Total intake by sawmills	208 771	100.0

**a** Estimates based on sawmill survey for mills processing sawlogs. **b** Includes sawn and semiprocessed wood from other North East region sawmills.

The total value of turnover (or gross receipts) for the hardwood sawmilling industry in the North East is estimated at \$18.1 million in 1996-97 (Table 5.6). It is estimated that labour costs for the sawmilling industry totalled \$4.7 million in 1996-97, approximately 40 per cent of the estimated total operating costs of \$11.1 million. As such, the total net value of production (or net profits earned) for 1996-97 for the hardwood sawmilling industry in the region is estimated at around \$7.0 million.

**Table 5.6: Key financial features of the hardwood sawmilling industry by product North East region, 1996-97 <sup>a</sup>**

	Sawmill production	
	Total	Attributable to North East <sup>b</sup>
	\$m	\$m
Gross receipts from sawntimber and products	58.9	17.4
Gross receipts from sawmill residues (woodchips etc.)	2.9	0.7
Gross value of production	61.8	18.1
Labour costs (wages and salaries paid)	15.0	4.7
Total operating costs <sup>c</sup>	46.9	11.1
Capital investment by sawmills in 1995-96 <sup>d</sup>	4.9	na
Net value of production (GVP minus total operating costs)	14.9	7.0
Replacement value of fixed capital	24.4	na

**a** Estimates based on sawmill survey. **b** Estimates are totals for the sawmilling industry based on the percentage of log intake from the North East region. **c** Operating costs include labour costs, wood purchasing and delivery costs, repairs and maintenance, depreciation and interest payments. **d** Total for sawmills which process sawlogs. **na** Not applicable.

Seasoned sawntimber was produced at 6 of the 9 hardwood sawmills using sawlogs from the North East (five of these mills also produced unseasoned sawntimber). In total, 11 409 cubic metres of seasoned sawntimber was produced, accounting for 38 per cent of the total sawntimber production of 30 169 cubic metres in 1996-97. Almost all (99.5 per cent) of the estimated \$4.9 million of capital investment at mills sourcing sawlogs from the North East region in 1996-97 occurred at the 6 sawmills producing seasoned sawntimber.

It is estimated that the level of employment attributable to the North East resource at sawmills is 158 people, taking into account the proportion of total log intake sourced from the North East region. In total, these sawmills presently employ around 455 persons. Approximately 98 per cent of these employees are full time workers. Total individual mill employment at the 13 mills using wood resources from the North East region ranges from 1–2 people in the smallest mill to around 180 people at the largest mill.

### Major sawntimber products and markets

Approximately 62 per cent of the 30 169 cubic metres of hardwood sawntimber produced from logs sourced from the North East in 1996-97 was unseasoned sawntimber products such as scantling and palings (Table 5.7). The remaining 38 per cent was sold as appearance grade or seasoned structural timber. A small amount of veneer was also produced in 1996-97.

**Table 5.7: Production of the North East hardwood sawmilling industry, 1996-97 <sup>a</sup>**

	Attributable to North East <sup>b</sup>	Share of total	Total	Share of total
	m3	%	m3	%
<b>Seasoned sawntimber</b>				
Veneer	37	0.1	260	0.1
Appearance – select	3 473	5.3	16 293	6.7
Appearance – standard	1 837	2.8	7 586	3.1
Structural	2 881	4.4	12 320	5.1
Further processed	3 181	4.9	5 311	2.2
<b>Unseasoned timber</b>				
Scantling	13 363	20.6	20 584	8.4
Palings and pallets <sup>b</sup>	4 732	7.3	38 023	15.6
Other sawn	665	1.0	1 241	0.5
Total sawntimber	30 169	46.4	101 618	41.7
Woodchips	23 561	36.3	91 906	37.7
Other residues	11 241	17.3	50 234	20.6
Total residues	34 802	53.6	142 140	58.3
Total	64 971	100.0	243 758	100.0

a Preliminary estimates for industry based on sawmill survey. b Estimates are totals for the sawmilling industry based on the percentage of log intake from the North East region.

While only amounting to 38 per cent of total sawntimber production in 1996-97, seasoned sawntimber accounted for 65 per cent of the gross value of sawntimber production. The higher prices received for these products reflect the additional processing required.

Table 5.8 shows the mix of sawntimber products sold by the North East sawmill industry in 1996-97 and the anticipated product mix in 2006-07. It can be seen that sawmillers currently utilising sawlogs from the North East anticipate that the proportion of output sold as seasoned timber will increase to around 64 per cent of total output by 2006-07 (mills that only process residual logs have been excluded from this estimate).

The sawmillers anticipated a large increase in the production of further processed timber and further increases in the production of appearance grade and processed timber rather than unseasoned products.

The major markets for each product were also identified (Table 5.8). The unseasoned timber products were mainly distributed to Melbourne and regional Victoria. The bulk of seasoned timber production was also sold in Victorian markets with the exception of select appearance grade products where export markets predominated.

**Table 5.8: Current and anticipated sawntimber production in the North East region and major markets, 1996-97 and 2006-07 <sup>a</sup>**

Product	Production share		Major markets in 1996-97 <sup>b</sup>
	1996-97 %	2006-07 %	
<b>Seasoned sawntimber</b>	40.2	63.6	Melbourne, regional Victoria, Export
Appearance grade – select	12.4	14.3	Export, regional Victoria
Appearance grade – standard	6.5	13.8	Regional Victoria, New South Wales, Queensland
Dried structural grade	10.0	9.0	regional Victoria, Melbourne
Further processed	11.3	26.5	Melbourne and Export
<b>Unseasoned sawntimber</b>	59.8	36.4	Melbourne, regional Victoria
Scantling	47.0	28.2	Melbourne, New South Wales and Queensland
Palings and pallets	11.1	7.1	Melbourne, regional Victoria
Other sawntimber	1.7	1.1	Melbourne and regional Victoria
<b>Total</b>	100	100	

<sup>a</sup> Preliminary estimates for industry based on sawmill survey. These estimates exclude specialist recovery mills. <sup>b</sup> Markets recorded in order of importance.

## 5.4 THE HARDWOOD RESIDUAL LOG PROCESSING INDUSTRY

Hardwood residual logs and sawmill residues sourced from the North East are used in a number of downstream processing operations for production of woodchips for export and the production of pulp which is further processed into tissue. Sawdust sourced from sawmills in the North East is also used in particleboard manufacture. In Table 5.9 the total wood intakes of major downstream processors that utilise residual logs and sawmill residues from the North East region are shown and employment, production and the gross value of production attributable to North East region are estimated. It is important to note that the estimates of employment, production and gross value of production presented in Table 5.9 reflect the proportion of total fibre input sourced only from the North East.

A description of the major downstream processing operations using hardwood residual logs and sawmill residues from the North East region is provided below.

**Table 5.9: Uses of residual logs and sawmill residues from the North East region, 1996-97 <sup>a</sup>**

	Tissue	Particleboard	Export woodchips	Total Intake
Pulplogs (tonnes)	1 750	0	0	1 750
Residues (tonnes)	0	5 000	23 580	28 580
Total intake (tonnes)	1 750	5 000	23 580	30 330
Employment <sup>b</sup> (no)	4	4	2	10
Gross value of production <sup>b</sup> (\$m)		na	na	33.96

<sup>a</sup> Excludes sawmills. <sup>b</sup> Calculated by multiplying the percentage of total intake sourced from the North East region by the relevant total employment, production or gross value of production figures. na Not available.



### ***Carter Holt Harvey***

Carter Holt Harvey operates a pulp mill at Myrtleford which supplies a tissue plant in Melbourne. The Myrtleford pulp mill employs 31 full time staff and has a capacity of 15 000 air dried tonnes of eucalypt pulp a year and 20 000 air dried tonnes of softwood pulp. Of the eucalypt resource pulped at Myrtleford, approximately 1 750 tonnes was sourced from the North East region in 1996-97. Most of the eucalypt resources required by Carter Holt Harvey are sourced from the Central Highlands region, due to Carter Holt Harvey's preference for mountain ash regrowth.

Production at the tissue plant in Melbourne is around 63 000 tonnes a year. Approximately 645 people are employed (including some interstate). About one per cent of total tissue production is attributable to hardwood sourced from the North East. Carter Holt Harvey is also engaged in the production of a number of products using softwood resources.

### ***Midway Propriety Limited***

Midway operates an export oriented woodchip facility in Geelong. Hardwood residual logs, sawmill residues and softwood roundwood are chipped at this facility. The mill has a production capacity of around 500 000 tonnes a year. Twenty full time staff are employed at the mill handling the hardwood resource intake (additional staff are employed in plantation operations and handling the softwood intake). Of the hardwood resource intake, approximately 23 600 tonnes of sawmill residues were sourced from the North East in 1996-97 and accounted for around 8 per cent of the company's total hardwood intake.

More recently, Midway has sourced a relatively small volume (5 000 tonnes) of hardwood residual logs from the North East. This volume is determined on an annual basis through a competitive tendering process.

### ***D & R Henderson/Monsbent***

Monsbent source around 5 000 tonnes of hardwood sawmill residues (sawdust) from the North East to produce particleboard at its plant in Benalla. Monsbent employs 91 people in its particleboard operation to supply the furniture manufacturing and building industries (Monsbent also operates a softwood sawmill at its Benalla facility). Output is sold in export markets as well as in New South Wales, Victoria, Queensland and South Australia. The sawdust sourced from hardwood sawmills in the North East region accounts for around 4 per cent of the total fibre intake for production of particleboard (a significant volume of softwood roundwood are also sourced from the North East region).

## **5.5 THE SOFTWOOD PROCESSING INDUSTRY**

There are currently around 53 000 hectares of softwood plantations of various age classes in the region, the majority of which is radiata pine. The Victorian Plantations Corporation manages about 45 000 hectares with the remaining 8 000 hectares in private ownership (TIRES 1996).

Currently eight softwood mills operate using softwood resources sourced from the North East region. They are:

- a medium density fibreboard plant in Wangaratta, which has an annual capacity of 150 000 cubic metres;
- a complex in Myrtleford which comprises a sawmill, plymill and a pulpmill,
- a newsprint mill in Albury;
- three sawmills of various capacity which produce both green and dry sawntimber products;
- a particleboard plant in Benalla which also produces appearance grade softwood sawntimber products; and
- an exporter of peeler (or veneer) logs, sawlogs and pulplogs.

In total, industry intake of softwood sawlogs, pulplogs and residues from the North East region in 1996-97 exceeded 850 000 cubic metres.

Based on a survey of softwood mills it is estimated that the softwood sawmilling industry employs 706 people. A further 135 people are estimated to be employed in harvesting and hauling softwood from the North East region.

#### ***Australian Newsprint Mills***

Australian Newsprint Mills (ANM) operate a newsprint plant just outside Albury, New South Wales. The mill sources softwood pulplogs from public and private sources in the North East region and in New South Wales. Total softwood intake is around 260 000 tonnes, of which 23 per cent is sourced from the North East region. A significant proportion of the total fibre input is recycled fibre. Currently, the company employs 290 people and sells most of its newsprint in domestic markets.

#### ***Benalla Timber***

This company operates a timber preservation plant which produces lattice, posts and treated pine pulp using logs from (mainly) public and private sources in the North East region. Softwood intake is around 5 000 cubic metres per annum. Products are sold in regional markets throughout Victoria and New South Wales.

#### ***Boral Timber***

Boral Timber employs 162 people at its mill in Tumbarumba, New South Wales to produce green and kiln dried sawntimber products and woodchips. Approximately 37 per cent of the 200 000 cubic metres of logs used at the Tumbarumba mill are sourced in the North East region and are supplied by the Victorian Plantations Corporation. Melbourne and Sydney are currently the major markets for sawntimber produced by Boral. Woodchips are sent to Wagga as an input to laminex (particleboard) production.

#### ***Carter Holt Harvey***

In addition to the pulpmill (described earlier), Carter Holt Harvey operates a sawmill and plymill at Myrtleford. A broad range of structural and appearance grade products are manufactured at the sawmill, which sources approximately 260 000 cubic metres of softwood a year from the Victorian Plantations Corporation. The Victorian Plantations Corporation also supplies the plymill with about 50 000 cubic metres annually. While the larger proportion of softwood used is sourced in the North East, approximately 19 per cent of the softwood used by Carter Holt Harvey is sourced from State Forests New South Wales.

#### ***Dominance Industries***

Dominance Industries operates a Medium Density Fibreboard (MDF) plant, commissioned in 1997, to produce MDF for export markets (a small proportion of output is sold on the domestic market). Softwood pulplogs from the Victorian Plantations Corporation, currently 240 000 tonnes, and a small volume of sawmill residues are sourced in the North East. Currently the mill is operating below capacity but is capable of processing 280 000 tonnes of residual log annually to produce approximately 150 000 cubic metres of MDF. Private softwood resources are expected to supplement current log intakes once mill capacity is reached. Employment at the plant is also expected to increase to 100 people (from 86 people currently) as production expands.

#### ***GB Timber***

GB Timber operates a Copper-Chrome-Arsenate (CCA) preservation plant in Healesville which uses a small proportion of softwood logs (5 per cent) sourced in the North East region. The larger proportion of logs used at the mill are sourced in the Central FMA from public and private sources.

The mill employs 20 people and produces outdoor timber products such as fencing and a range of other value added timber outputs (moulded timber) for markets in Melbourne, Adelaide, Sydney and regional Victoria.

#### ***D & R Henderson/Monsbent***

A range of green and dried sawntimber products is produced by Monsbent at its sawmill and particleboard plant in Benalla. Approximately 75 per cent of the 170 000 tonnes of softwood logs used by Monsbent are sourced in the North East through the Victorian Plantations Corporation. The remainder are sourced privately. There are 100 people employed at the sawmill operation which produces around 45 000 cubic metres of structural timber, decoration mouldings and roughsawn timber a year. Output from the particleboard plant is around 96 000 cubic metres a year and 91 people are employed in this part of the operation.

#### ***Radiata Exports***

Radiata Exports sell softwood peeler logs, sawlogs and pulplogs to markets in South East Asia. Currently only a small proportion of the total volume of logs exported is sourced within the North East but is expected to increase significantly once regional infrastructure is established to support greater processing and storage of logs and the South East Asian economies recover from recent economic instability.

## **5.6 OUTLOOK FOR WOOD PRODUCT INDUSTRIES**

The discussion below is a broad overview of the factors influencing the market outlook for Australian hardwood forest product industries. Based on available data, trends in international markets are analysed and related to the outlook for Australian native forest products industries in terms of the major forest product groups — sawntimber, wood based panels and pulp and paper products.

### **International outlook for forest products markets**

North America dominates the production of all forest product categories, accounting for at least 30 per cent of global output. Western Europe and the Asia Pacific region are the principal importing regions, while the Nordic countries and North America are the principal exporting regions.

In recent decades, the rapid industrialisation of countries such as Japan, South Korea and Taiwan has resulted in an increase in per capita consumption of wood products, particularly paper products. Its proximity and potential for significant increases in consumption mean that the Asia Pacific region is likely to be the main market focus for any expansion of Australia's forest product industries. Economic developments over the past decade have resulted in significant changes to trade in wood products in the Asia Pacific region. Most notably, trade in unprocessed logs has declined as a result of the imposition of log export bans in Indonesia and Malaysia, moves to promote value added domestic processing, and increased domestic demand for wood products in traditional tropical wood supplying countries.

Additionally, the domestic market for timber products is strongly influenced by the international market because Australia is a large net importer of most forest products, with the exception of woodchips. Australian trade in most forest products is small in comparison with world trade, and domestic prices are largely determined by the landed price of imports.

With the recent large devaluations in many Asian currencies it is expected that Australian imports of forest products could increase in the short term. Imports could increase from Asian forest products exporters such as Malaysia and Indonesia, as well as from New Zealand if New Zealand product is displaced from Asian markets. Imports in 1997-98 are forecast to be \$2.6 billion, up from \$2.5 billion in 1996-97 (ABARE 1998).

It could also be expected that the increased cost in Asia of forest products imported from Australia and other countries such as New Zealand, the United States and Canada could cut Asian forest product imports in the short term. However, the total value of forest products exported by Australia for the first three quarters of 1997-98 was \$932.5 million, 16 per cent above the \$802.7 million value exported in the corresponding period of 1996-97 (ABARE 1998). Increases in the volume and value of paper and paperboard exports to China and Hong Kong are responsible for the recent growth in the value of Australian exports and have helped to offset recent quarterly decreases in the volume of broadleaved woodchips exported to Japan, the value of log exports to South Korea and the value and volume of sawnwood exports to Japan and South Korea. Despite the downturn in the Japanese economy, the Japanese Forestry Agency is forecasting that Japanese paper and paperboard production will rise slightly in 1998 (ABARE 1998). With the anticipated higher level of Australian woodchip exports to Japan, and paper and paperboard exports to China and Hong Kong, it appears likely that recent falls in log and sawnwood exports to Asia will be offset. Based on these expectations, the value of forest products exports in 1997-98 are forecast to be \$1.2 billion, up from \$1.1 billion in 1996-97.

### **Sawntimber**

Global production of sawn hardwood increased from 110 million cubic metres in 1980 to 130 million cubic metres in 1991, but has since declined slightly. The production of sawn hardwood in Asia is expected to continue to decline, given the decreasing availability of tropical hardwood logs. However, the Asia Pacific forest products sector has the potential to meet projected consumer demand and, as a result, significant real price increases are not expected. Demand could be met through a combination of more efficient use of existing Pacific Rim timber resources and the establishment of new manufacturing capacity to produce nontraditional products such as medium density fibreboard, oriented strandboard and other reconstituted panels (Johnson 1997).

Australian production of sawn hardwood has declined from a peak of 2.6 million cubic metres in 1964-65 to 1.4 million cubic metres in 1995-96, largely as a result of reduced resource availability in native forests and the increased substitution of softwood for traditional hardwood sawntimber. Annual sawn hardwood production is expected to fall from current levels until around 2000, before rising gradually over the next two decades as hardwood regrowth and possibly some hardwood plantation logs become available for harvesting. Softwood sawntimber production is also expected to rise as existing softwood plantations mature. Australia is likely to have a small export surplus of softwood sawntimber available by 2002-03 (ABARE 1997a).

Hardwood sawntimber production in Australia has traditionally been focused on producing timber for building applications and other structural end uses. Historically, the competition between softwoods and hardwoods in internal building applications was influenced by the greater availability and lower price of hardwood sawntimber. Competition from softwoods for external applications and other structural end uses has been constrained by the natural advantages of hardwoods, such as strength, durability and resistance to biological degradation.

However, softwood production costs have fallen dramatically in recent decades — mainly a result of large automated softwood mills and an increasing softwood resource base. The average cost of sawntimber produced by a new softwood mill is estimated to be around 10 per cent lower than that for a new hardwood mill producing predominantly unseasoned sawntimber (Jaakko Pöyry 1993). This has enabled softwood sawntimber to increase its market share of internal building applications.

More recently, competition from softwood sawntimber has also contributed to a decline in the market share of hardwood in external building applications. This has been possible as a result of the increasing size of the softwood resource and the decline in softwood production costs, combined with improved processing technologies and treatments for the preservation (for external applications) and lamination (for structural uses) of softwoods. This has allowed softwoods to be increasingly substituted for hardwoods in numerous external building applications, albeit from a small base.

A range of other minor sawntimber products is produced from forests — for example, posts, stakes, trellising, decking and packing cases. The natural advantages of hardwoods in these applications have also been offset by the improved treatments available for the preservation and lamination of softwoods. Softwoods are increasingly likely to be used as a substitute for hardwoods in many of these applications.

The competitiveness and increased availability of softwood sawntimber is indicated by the declining market share of hardwood sawntimber in total domestic sawntimber consumption. Apparent consumption of hardwood sawntimber was approximately 2.04 million cubic metres in 1985 (or 47 per cent of total apparent consumption) but only 1.58 million cubic metres (or 35.5 per cent of total apparent consumption) in 1995. Domestic annual production of softwood and hardwood sawntimber is estimated to have been 2.07 million cubic metres and 1.32 million cubic metres respectively in 1996-97 (ABARE 1997b).

Increased use of softwood sawntimber in building applications and other structural end uses over the medium and longer term is expected to continue — especially in Western Australia and Tasmania where hardwood sawntimber consumption still exceeds that of softwood sawntimber (reflecting the previously narrow softwood resource base). However, in line with future projected increases in the softwood resource base and the consequent rise in the availability of softwood sawlogs, softwood consumption in these States can be expected to increase.

The impact of substitution away from unseasoned hardwoods to lower cost softwoods in housing construction has been partly offset by hardwood sawmillers diversifying into, and expanding, markets for kiln dried timber — for example, furniture, flooring, mouldings and other value added products (Neck, Curtotti and Sar 1996). Many of these applications involve further processing and the replacement of imported products.

The continuing ability of the hardwood sawmilling industry to maintain profitability and compete against domestic softwood and imported timbers will depend on the underlying cost competitiveness of the industry. Increasingly, the focus is likely to be on the production of appearance grades of timber used in furniture and joinery, to capture the potential higher returns from the marketing of specific timber species which have distinct natural attributes. Many of these specific features may be exploited in product markets for furniture, linings, flooring, architraves, skirtings and seasoned beams. Despite the limited potential for price increases, an expected tightening in the supply of hardwood sawntimber in the Pacific Rim could provide continued opportunities for the use of high grade hardwoods for appearance purposes and certain structural applications.

### **Wood based panels**

Wood based panels comprise three main product categories — particleboard, medium density fibreboard and plywood — and are used in a wide range of building, construction and furniture uses. Total world consumption of wood based panels increased by around 400 per cent from the level in 1960 to reach around 125 million cubic metres in 1995. The growth in world production and consumption of composite wood panels and other engineered wood products reflects the growing market acceptance and competitiveness of these products in a diverse range of end use markets. Plywood is the most important panel produced in the Asia Pacific region in volume terms, accounting for over 70 per cent of total panel production of about 30 million cubic metres in 1995. However, in line with decreasing availability of veneer logs, production in the Asia Pacific region is expected to decline and investment in the processing capacity of other panel products is increasing.

Medium density fibreboard, of the wood based panel products currently available, has recorded the strongest market growth over the past decade. Rapid growth in the consumption of this product since the early 1990s in domestic and international markets is attributed to the widespread application and growing consumer acceptance of medium density fibreboard products in building and furniture making. Additional capacity is planned to be developed in the region over the next two years.

Australia's total annual consumption of wood based panels reached levels above 1.2 million cubic metres over the past few years, up from almost 1 million cubic metres in 1985. Australia was a net importer of wood based panel products before 1995-96, but is now a small net exporter.

In Australia, competition from softwood residues has affected demand for hardwood on two fronts: as an alternative input into wood based panels and as a substitute for hardwood sawntimbers and other residual hardwood products. Use of residual hardwood roundwood in composite wood based panels has decreased over recent years with the increasing availability of softwood residue. This has occurred as a result of the increasing size of the softwood resource, rising mill throughputs and the consequent increase in the availability of low cost residual softwood roundwood. Users have also been substituting composite wood panels for hardwood sawntimbers in internal building applications such as floors, ceilings and walls.

Future opportunities for Australian producers of hardwoods used in composite wood based panel products will be assisted by the forecast reduction in the supply of tropical timbers. An expected tightening in supply of hardwood timber in the Pacific Rim could also provide continued opportunities for the use of high grade hardwoods in select appearance applications. Australian veneer production for example, which targets the high value decorative veneer market is likely to continue to be competitive. The main factors influencing the ability of these producers to expand their market base is the future availability and quality of the resource and the price competitiveness of substitute products such as medium density fibreboard. Limited marketing opportunities exist for new panel producers in supplying the Australian market. Any new producer would need to rely on expanding export markets in the Asia Pacific region.

### **Pulp and paper**

Growth in world paper consumption closely follows changes in economic activity. Consequently, growth in consumption of paper products is expected to be particularly strong in the Asian region. World paper and paperboard consumption is projected to increase from the current level of about 280 million tonnes a year to around 420 million tonnes a year by 2010 (Margules Groome Pöyry 1997). The projected annual rate of growth in world paper consumption to 2010 (around 3 per cent a year) is well above projected world population growth rates (around 1.5 per cent a year). This reflects growing urbanisation and the expected increase in demand for paper as world literacy rates continue to rise. However, growth in paper consumption from 2010 to 2020 is expected to slow slightly, reflecting the slowdown in economic growth rates in developing countries.

An analysis of world market supplies of residual log indicates a gradual tightening of residual log supplies after 2010 (Cameron 1997). However, upward pressure on paper and paperboard prices and, hence, pulp prices will be moderated by increased use of recovered/waste paper, particularly in the production of lower quality paper products. Nevertheless, real world pulp prices may increase over the medium term. This expected real price increase, together with access to a large domestic forest resource, particularly from plantations, may encourage the expansion of Australia's pulp and paper industry. Australia has been a significant importer of paper products and pulp, allowing for the possibility that an expanding domestic industry could replace imports to some degree.

Hardwood and softwood pulps and woodchips are used in pulp and paper production and a degree of substitution between hardwood and softwood inputs is possible. Thus, in examining the outlook for hardwood residual log and woodchips, it is important to consider the characteristics of the different residual logs used, the types of pulps being produced and how these pulps are used in manufacturing paper.

Worldwide, hardwoods are primarily used to produce high quality printing and writing papers. Softwoods are generally used in the production of newsprint and lower value products such as industrial packaging and liner board. Wood fibres from coniferous timber are generally longer, wider and coarser than wood fibres from hardwoods. Consequently, softwood fibres provide resistance to tearing, an important attribute for wrapping and packaging papers. The smaller hardwood fibres

provide smoother and less transparent surfaces, making them more suitable for products such as printing and writing papers (Ausnewz 1996).

Woodpulp can be produced using three basic methods: mechanical, chemical and semichemical pulping. The mechanical pulp production process (grinding the wood to separate the fibres) produces a fine pulp and is suitable for newsprint and coarse printing and writing papers. However, the presence of lignin in mechanical pulps limits their use in the production of smooth writing papers. If a smooth finish is a requirement, chemical pulps (for which chemicals are used to dissolve the lignin which binds the woodfibres) and semi-chemical pulps (for which chemicals are first used to weaken the bonds between fibres which are then separated mechanically) are more appropriate. The mechanical pulping process uses both hardwood and softwood timbers, although it reduces the inherent fibre strength qualities inherent with long fibre woods. Paper products derived from mechanical pulps often contain a proportion of chemical pulp to add strength. Chemically produced pulps, therefore, are used more in the production of wrapping and packaging products where strength is more important.

### **Uses of eucalypt residual log**

Approximately 85 per cent of the world's eucalypt residual log is used to produce bleached and semibleached chemical pulp. The kraft (sulfide based) process is the most commonly used chemical pulping process and bleached eucalypt kraft pulp is used worldwide. Approximately 80 per cent of this pulp is used to produce printing and writing papers, and eucalypt pulp can make up to 100 per cent of the total furnish (fibre requirement). Eucalypt is especially suited to this product because the shorter fibres of eucalypts help to produce a good paper formation and a smooth surface for printing.

The stiffness of eucalypt pulps also makes them particularly suitable for some packaging grades, particularly in corrugating mediums used in supermarket boxes. However, there is strong competition from recycled fibre in these products. Chemical eucalypt pulps also provide the softness and absorbency properties which make them useful in the household and sanitary tissue markets.

Australian hardwood residual log and woodchips are either used in domestic pulp production or exported to Japan. In Australia, given the historical shortage of softwood and the abundance of eucalypt, the domestic pulp and paper industry has used eucalypt pulp instead of softwood pulps in higher proportions than used elsewhere in the world. It is likely that an increasing softwood resource will mean that the use of eucalypt pulp in these applications will decrease over time.

Australian hardwood residual log is also exported (as woodchips) and is primarily used in the production of bleached hardwood kraft pulp and, consequently, for high quality printing and writing papers. Japan is the only significant market for Australia's woodchip exports, accounting for over 99 per cent of Australia's hardwood and softwood chip exports in 1995-96. There has been little growth in Australia's woodchip exports in recent years, with shipments averaging 3.15 million tonnes over the five years to 1995-96. Given an expected increase in paper consumption and production in Asia, woodchip demand is projected to increase to 2020.

The absence of a suitable softwood substitute in the bleached hardwood kraft pulping process is likely to result in rising demand for Australian hardwood pulp, with the expected increase in Asian demand for printing and writing papers.

## **5.7 INDUSTRY DEVELOPMENT OPPORTUNITIES**

As part of the economic assessment underlying the future development of a North East RFA, an examination of timber industry development opportunities in the North East was undertaken (Kevin Wareing and Associates 1998). This assessment included analysis of the feasibility of future development of the native wood based industries of the North East, as well as detailed analysis of global industry and market conditions. This section outlines the main findings of that study, taking

into account forest product markets and the availability and quality of hardwood resources. The discussion below is based on the assumption that sustainable yield rates will be maintained.

### Hardwood availability

The availability and quality of hardwood resources from the North East region will have a bearing on development opportunities. The quantity of hardwood sawlogs and residual logs is not expected to change significantly over the next 20 years. Legislated sustainable yield and licensed commitments are shown in tables 5.10 and 5.11 for sawlogs and residual logs respectively.

**Table 5.10: Hardwood sawlog availability in the North East region (m<sup>3</sup> per year D+ net) <sup>a</sup>**

	Benalla/Mansfield	Wangaratta+Wodonga
	FMA	FMA
Sustainable yield (1 July 1996)	13 500	53 000
Licensed commitments to 2000	14 656	63 405 <sup>b</sup>
Licensed commitments to 2005	14 656	46 843

<sup>a</sup> Licensed commitments specified in tonnes, net volumes or gross volumes have been converted into equivalent total net volumes. <sup>b</sup> Excludes licence for 3 000 m<sup>3</sup> of D+ sawlog to be supplied predominantly from the Tambo FMA.

Sustainable yields specified by legislation from 1 July 1996 are 25 000 cubic metres, 28 000 cubic metres and 13 500 cubic metres of sawlogs (D+ net) for the Wangaratta, Wodonga and Benalla/Mansfield FMAs respectively. While current licence commitments exceed sustainable yield rates on an annual basis, the *Forests Act 1958* specifies that the total licensed level in a Forest Management Area (FMA) must equal or be within a permitted margin of the sustainable yield rate forecast over a 15 year timber supply period. Sustainable yield rates and licensed volumes in the North East FMAs will be reviewed on completion of the State Forest Resource Inventory (SFRI). The proportion of ash sawlogs in the total North East sawlog harvest is expected to remain high (in 1996-97 around 70 per cent of the total sawlog harvest was ash sawlogs). The wood characteristics and growth properties of alpine ash make them highly suitable for milling into sawntimber for use in appearance grade products and provide significant potential for further processing.

While the quantity of sawlogs available for harvesting is not expected to change, it is expected that log size will decrease over the period to 2020 as regrowth forests come on stream, particularly in the Benalla/Mansfield and Wangaratta FMAs.

The availability of residual logs is determined by the sustainable yield for sawlogs given that residual logs are produced only as a result of normal sawlog harvesting operations. Currently around 150 000 cubic metres of residual logs become available in the North East region each year as a by-product of sawlog harvesting (Table 5.11). It is expected that the availability of residual logs will fall slightly due to a declining ratio of residual logs to sawlogs over the period to 2020.

**Table 5.11: Hardwood residual log availability in the North East region (m<sup>3</sup> per year)**

	Benalla/Mansfield	Wangaratta+Wodonga
	FMA	FMA
Availability to 2000	27 000	148 400
Licensed commitments to 2000	< 10 000	< 15 000
Licensed commitments to 2007	< 10 000	< 20 000

A volume of approximately 25 000 cubic metres of residual logs is currently committed through licensed allocations, representing only around 15 per cent of annual availability. The utilisation of residual logs is currently low relative to their availability due to:



- the low level of availability relative to requirements for the development of competitive fibre based processing facilities located within the region; and
- the resource is dispersed and remote from existing processing facilities, involving long log haulage distances, particularly from the Wodonga FMA.

#### **Hardwood sawmilling development opportunities**

Development opportunities for the hardwood sawmilling industry in the North East region will be determined in part by the level of sawlog availability. However, in recent years the Victorian hardwood sawmilling industry has:

- increased the proportion of sawntimber seasoned;
- recognised that a number of species other than Victorian ash can be seasoned and used in applications where their properties provide a competitive advantage;
- refined sawing, drying and further processing techniques to improve the recovery of appearance grade products;
- increased the utilisation of lower grade logs and experienced an increase in the demand for accurately sized timber for pallets;
- developed a greater range of products and a broader customer base; and
- developed a co-ordinated approach to the development of export markets and introduced quality assurance procedures.

The progressive transition of production from predominantly unseasoned to seasoned products by the Victorian hardwood sawmilling industry is expected to continue.

Specific development options that could be considered by the sawn timber industry sourcing hardwood sawlogs and residual logs from the North East include:

- increasing the proportion of sawn timber that is kiln dried. Most producers processing logs from the North East have the capacity to increase the proportion of their production that is kiln dried and re-processed;
- increasing the processing of residual logs through investment in plants specifically designed to process logs that are smaller and more defective than sawlogs;
- developing networks between timber processors to facilitate investment in the specialised equipment needed to produce highly processed wood products;
- strengthening links with the furniture industry; and
- continuing to identify and expand markets where the properties of the various hardwoods from the North East (durability, appearance, strength and hardness) provide a competitive advantage.

These development options have been successful for a number of firms and there would appear to be scope for the sawmilling industry processing logs from the North East to extend their successful application.

In addition to these opportunities in the sawmilling industry, the alpine ash resource in the North East has potential for producing sliced veneer for appearance grade applications. This type of development would only appear to be feasible at mills with relatively large sawlog allocations. However, a number of problems (scale of operations, choice of equipment, lack of experience with veneer production and inadequate marketing) which contributed to the commercial failure of previous attempts at producing sliced veneer would need to be overcome.

#### **Residual log processing development opportunities**

Although it is estimated that the supply of residual logs in the North East will be around 150 000 cubic metres a year for at least the next 20 years, the resource is too small and too widely dispersed to support the development of competitive new industries manufacturing either panelboard or pulp and paper. However, the residual log resource may contribute to the development of new manufacturing industries if it is used in conjunction with resources from adjacent regions or supplemented from private hardwoods or from outside the region.

### **Development opportunities in conjunction with softwood processing**

Generally, the industries that have been established to process veneer logs, sawlogs and residual logs from the softwood plantations in the North East and southern New South Wales have been built specifically to process softwood and opportunities for processing hardwood are limited.

Carter Holt Harvey uses a limited volume of hardwood residual logs at Myrtleford to manufacture chemi-mechanical eucalypt pulp to mix with pine pulp for the manufacture of tissues. However, Carter Holt Harvey's preference for mountain ash regrowth, the scale of the current plant and quality considerations imply that it is unlikely that additional residual logs from the North East will be processed at its Myrtleford facility.

While it is technically feasible to use hardwood in the manufacture of particleboard and medium density fibreboard (MDF) there would appear to be little likelihood of either Monsbent or Dominance using significant amounts of hardwood. Monsbent uses some hardwood sawdust as a relatively low priced input in its raw material furnish with the level being determined by board quality considerations. Dominance intends to use plantation softwood for all of its wood fibre requirements.

The production of coated particleboard or MDF for use in cupboards and furniture provides a potential outlet for sliced veneer. In the event of the development of a sliced hardwood veneer industry there could be some benefits associated with having MDF and particleboard industries in close proximity.

In addition to the possibility of softwood mills processing hardwood logs there is the potential for hardwood mills to process softwood logs if they target specific markets which are not being supplied by the major softwood producers. For example, it is expected that one of the mills currently processing hardwood logs from the North East will begin processing softwood logs to produce squared flitches for resawing into fence palings

## 6. PLANTATIONS

### 6.1 INTRODUCTION

Plantations can contribute significantly to wood supply, particularly pulpwood and small diameter sawlogs for industry. They can contribute to regional economic development, especially if they are linked to downstream processing industries as they are in the North East region. Plantations on farms can also provide environmental and agricultural production benefits to landholders and the broader community.

Plantations in south-eastern Australia are typically of the exotic Radiata Pine (*Pinus radiata*) referred to as 'softwood', or of native species (predominantly *Eucalyptus* spp.) referred to as 'hardwood'. To date, hardwood plantations have been managed mainly on short rotations to produce pulpwood for paper manufacturing. However, with improved technology and emphasis on value adding, it is anticipated these plantations will increasingly be used for sawlog or veneer production similar to softwoods.

Current Victorian Government policy prohibits the clearing of native forest on public land to establish plantations. Native forest can be cleared on private land for plantation establishment subject to native vegetation retention controls to protect flora and fauna, and also to local government planning requirements. Consequently, opportunities for plantation development are available only on public lands that do not presently contain forest, which are limited in area, and on predominantly cleared areas of private land that satisfies the vegetation retention and planning controls.

Whilst the primary focus of RFAs is on public native forests, and where necessary private native forests, the Scoping Agreement for Victorian RFAs also provides for analysis of a region's potential for plantation expansion as an input to considerations of potential industry development and infrastructure options. However, it is important to note that the use and management of cleared private land is not covered by RFAs.

This chapter outlines the substantial North East region plantation resources and their potential for further development.

### 6.2 POLICIES, PROGRAMS AND INITIATIVES

#### Policies and programs

State and Commonwealth Governments have developed policies and programs to allow for plantation development and management in the context of economic efficiency, social considerations, and environment and heritage issues. It is a policy position of Victoria and the Commonwealth in the National Forest Policy Statement (NFPS) (Commonwealth of Australia 1992b) that:

*The wood products industry is drawing and will continue to draw wood from a mix of sustainably managed softwood and hardwood plantations and native forests.*

The Wood and Paper Industry Strategy (Commonwealth of Australia 1995) reaffirms the position.

#### **National Forest Policy Statement**

The NFPS sets several goals for forest management. For plantations:

*... One goal is to expand Australia's commercial plantations of softwoods and hardwoods so as to provide an additional, economically viable, reliable and high-quality wood resource for industry. Other goals are to increase plantings to rehabilitate agricultural land, to improve water quality, and to meet other environmental, economic or aesthetic objectives.*

Objectives in the NFPS directed towards achieving these goals for Australia's plantation resource are to:

- increase commercial plantation development on cleared agricultural land and, where possible, to integrate plantation enterprises with other agricultural land uses;
- improve the productivity of existing plantation areas by means of improved technology, breeding of genetically improved stock, and selection of species;
- encourage industrial growers, and where appropriate public forestry agencies, to expand their plantation base to satisfy specific requirements.

Governments also agreed through the NFPS that:

- decisions to establish plantations for wood production should rest on their economic viability. The States will adopt commercial approaches for their plantations and will continue to ensure that the public plantation resource is actively managed in order to maximise net returns;
- State and local governments will provide a planning framework that facilitates the development of large-scale industrial plantations by ensuring that impediments to plantation development are minimal in areas such as taxation, planning and access to information;
- consistent with ecologically sustainable management objectives, the States will not clear public land for plantation establishment where this would compromise regional conservation and catchment management objectives. In particular, Victoria has a policy of not clearing public native forests for plantation development.

The plantation objectives of the NFPS are being implemented through a number of initiatives, including the Wood and Paper Industry Strategy (WAPIS). The WAPIS is a four-year initiative of the Commonwealth Government to encourage investment, value adding, and growth in employment in forest related industries. To this end, it will promote continued development of a diverse, internationally competitive industry based on ecologically sustainable management practices and assist the integration of industry and conservation objectives for Australia's native forests and plantations.

Notable features of WAPIS include removal of impediments to plantation development in areas such as taxation; improved planning and access to information; review of pricing policies and export controls; and promotion of plantation research and development.

WAPIS acknowledges that plantation industries can contribute to regional economic development by locally value-adding to primary production, resulting in more jobs. When developed on farms, plantations also provide substantial benefits to landholders and the broader community in relation to greenhouse, environment, landcare and agricultural productivity.

The Commonwealth Export Control (Unprocessed Wood) Regulations have been amended under the *Export Control Act 1982* so that an export licence is no longer required for timber sourced from a plantation if the Minister for Primary Industries and Energy has approved a code of plantation practice for the State from which the wood is sourced. On 25 March 1997, following consideration of assessment reports prepared by the CSIRO and other relevant information, the Minister approved the Victorian Code of Forest Practices for Timber Production (NRE 1996a) and associated procedures.

The Victorian Private Forestry Program and the Commonwealth Farm Forestry Program are implementing initiatives addressing the NFPS objectives on plantation resources. In addition, Commonwealth and Victorian legislation pertaining to plantation development has been reviewed. Victorian forestry rights were approved by Parliament in 1996 under the Victorian *Forestry Rights Act 1996*, providing for Forest Property Agreements between landowners and tree growers that give legal title for trees separate from the land. This allows investors to grow and harvest plantations on land under separate ownership, which promotes the trading of trees through a legal market.

The Victorian *Planning and Environment Act 1987* provides for establishment of forestry plantations up to 40 hectares in some areas without a planning permit.

### ***Plantations 2020 Vision***

In 1996, the Ministerial Council on Forestry, Fisheries and Aquaculture (MCFFA) agreed to a national goal to treble the area of Australia's plantations by the year 2020. The Standing Committee on Forestry (SCF) was required to report on how the target might be accomplished. The SCF and industry have since formulated an implementation plan titled 'Plantations for Australia: The 2020 Vision', which was endorsed by the MCFFA in 1997 (MCFFA *et al.* 1997).

The Vision states that:

*'By 2020, plantation forestry in Australia will be a sustainable and profitable long rotation crop with significant private sector investment.'*

*The plantation growing and processing industries will:*

- *operate in the global marketplace;*
- *be internationally competitive; and*
- *be commercially oriented, market driven and market focused in all their operations.*

*Returning trees to the landscape as a profitable crop will also significantly benefit the environment.*

To treble the 1996 plantation estate of one million hectares will require a national average of 80 000 hectares per year of new plantations from 1996 to 2020. Governments and industry will collaborate to create an environment that will attract private investment to implement the plantation program and enhance the growth of forest industries to contribute to the Australian economy, rural communities and regional development.

In 1996, the Victorian Government established a Ministerial Taskforce to develop a strategy for private forestry in Victoria aimed at increasing plantation development in Victoria, in line with the national 2020 Vision. The taskforce's report - *Towards a Victorian Private Forestry Strategy* - was presented to the Victorian Government in May 1997 and resulted in the appointment of a Private Forestry Council by the Minister of Agriculture and Resources. Its membership is taken from key stakeholders in the private and public sectors and members are appointed for three years. The Council's task is to finalise the strategy and produce an implementation plan (PFC-VIC 1997). The taskforce report underpinned the preparation of the State strategy - *Private Forestry in Victoria: Strategy Towards 2020* - which aims to guide the expansion of plantations on private lands.

The Strategy has six elements:

- achieving broad public support for private forestry - *embracing community support;*
- providing clear roles for State and regional bodies to facilitate private forestry - *forging better links;*
- identifying suitable land for commercial tree growing - *finding the commercial land base;*
- strengthening local government support for regional private forestry - *developing the partnership with local government;*
- encouraging investment options in private forestry - *recruiting capital into the sector;* and
- increasing the competitiveness of the private forestry sector - *gaining the competitive edge.*

Achievement of the vision will have benefits such as improved investment & infrastructure; regional jobs; increased farm incomes where private forestry is fully integrated with other agricultural enterprises; a surplus in national trade deficit in wood and wood products; and provide catchment protection and other environmental benefits.

### ***Commonwealth Farm Forestry Program***

The Department of Primary Industries and Energy's Farm Forestry Program, commenced in 1993, aims to promote commercial wood production on cleared agricultural land and, where possible, the integration of plantation enterprises with other agricultural land uses.

Both the NFPS and WAPIS provide the framework for implementing the aims and objectives of the farm forestry program in relation to plantations. The key strategic aim is:

*'to develop and enhance regional farm forestry strategies, focusing in particular on industry development but also on integrating commercial tree growing activities with other land, water and vegetation management strategies.'*

Other actions that contribute to the aims of the program include the establishment of Regional Plantation Committees (including Plantation North East Inc.); enhancement of communication and cooperation amongst all stakeholders; training and education; local government planning reform and research into farm-forestry.

Through WAPIS, the Commonwealth Government has provided around \$17 million nationally for some 50 projects over the period of 1996 to 2000, including nearly \$5 million for 11 projects in Victoria, including the Cooperative Farm Forestry Initiative (COFFI).

The Natural Heritage Trust (NHT) will fund programs intended to develop sustainable agriculture and natural resource management while protecting biodiversity. Under this program, the Commonwealth has provided \$22 million to enhance the Farm Forestry Program during 1997-98 to 2000-01. Of this, \$0.65 million has been allocated for projects in Victoria in 1997-1998.

An additional \$14.5 million nationally will be invested from Bushcare: National Vegetation Initiative to develop and promote commercial wood and non-wood products, especially where priority is given to biodiversity and land degradation issues, such as the use of native species in lower rainfall regions.

### ***Co-operative Farm Forestry Initiative***

The Co-operative Farm Forestry Initiative (COFFI), is one of the programs in the North East region and will receive \$0.55 million under the Commonwealth Farm Forestry Program over the next four years. This is a community-driven program that uses part-time advisers to promote the commercial growing of trees on farms in dryland areas. There are three advisers in the North East region, who also help to co-ordinate the activities of the North East Victoria Forest Growers Co-operative, Benalla Landcare Farm Forestry Group, and the North East Branch of the Australian Forest Growers Association.

### ***Plantations North East Inc.***

Plantations North East Inc. (PNE) was established in December 1996 under the Commonwealth Farm Forestry Program and operates under a Management Committee comprised of State and local government, industry and private growers. Its aim is to facilitate the expansion of commercial timber plantations and associated industries in North East Victoria. For these purposes, the Committee has identified a number of activities that:

- promote expansion of softwood and hardwood commercial plantations;
- promote expansion of farm forestry to increase wood supply from the region;
- support & assist the timber industry;
- promote community understanding of the timber industry;
- liaise with all levels of government to promote empathy with the timber industry; and
- assist in the development of regional infrastructure to support an efficient timber industry.

The PNE region incorporates twelve shires in north east Victoria that cover dryland and irrigation areas with plantation potential, although the emphasis will be on plantations in dryland areas east of the Hume Highway. The Committee has engaged a consultant to produce a '*Regional Profile - Investment in the plantation based forest industry in the North East of Victoria*'. This profile will provide information on the region's forest resources, forest industries, key species for plantation development, opportunities for investment, and options to expand the plantation estate.

### ***Victorian Private Forestry Program***

The major role of the Department of Natural Resources and Environment's Private Forestry Program is to facilitate the development of the commercial private forestry sector.

In addition to the \$5 million of funding from the Commonwealth Farm Forestry Program over the next four years, Victoria will provide at least \$5 million of State funding over the same period to support extension, demonstration, education and training, information gathering and dissemination, planning and coordination, practical research and development activities, including inventory of private forests, land capability assessment, and growth modelling to enhance the uptake of farm forestry. A program covered by these initiatives is described below.

### ***Farm Forestry North East/North Central Victoria (FFORNE)***

This Farm Forestry North East/North Central Victoria Project (FFORNE project) has been initiated by the Victorian Government to establish hardwood plantations on cleared agricultural land in dryland and irrigated sites of North East and North Central Victoria. To date \$1.8 million of State Government funds have been committed to the project.

The main aims of the project are to:

- commence building a hardwood resource to demonstrate to industry and potential investors that they can invest in the future development of that resource;
- pursue the involvement of local government, industry and investment to develop the future of farm forestry on a regional level; and
- provide quality and consistent information on farm forestry (NRE 1996b).

A major output of this project has been the increase in hardwood plantations on private land. Since 1996, 935 hectares have been planted, and an additional 700 hectares are scheduled for planting in 1998. The target has been 800 hectares per annum over the three years of the project. The species mix to date is 70 per cent Southern Blue Gum (*Eucalyptus globulus* var. *globulus*), 20 per cent Shining Gum (*E. nitens*) and 10 per cent mixed Sydney Blue Gum/Flooded Gum (*E. saligna*/*E. grandis*). The project aims to produce sawlogs with clearwood timber as a prime consideration, utilising pruning and thinning over a rotation of 25 years and has a number of other outputs that will continue to benefit the broader Statewide program such as technical guidelines and communication strategies.

### ***Social and environmental implications of plantations***

Past experiences with plantation expansion in farming landscapes have revealed both favourable and unfavourable perceptions of their socio-economic and environmental consequences (Spencer and Jellinek 1995). Therefore, plantation expansion under the 2020 Vision will require careful attention to these issues in the planning and implementation phases. Plantations affect different sectors of society in different ways and generate a variety of concerns according to individual and group perspectives. Economically, agriculture and forestry exhibit major differences in cash flows, but these can be evaluated through cost-benefit analysis (Trapnell and Lavery 1989). Environmentally, plantations can confer many benefits, however, in the past, land purchase by governments and corporations for plantation establishment has led to concern by some landholders and rural communities about:

- population decline, leading to loss of community services and erosion of local government rate bases;

- falls in land value; and
- costs of maintaining road networks.

To address the issues, the Victorian Government initiated a State Plantations Impact Study (SPIS), which resulted in a comprehensive report on impacts to stimulate discussions (Centre for Farm Planning and Land Management 1989), followed by a report (SPIS 1990) with 41 recommendations relating to plantation development and management on cleared agricultural lands, covering:

- current and future wood demand;
- procedures for land purchase;
- relative socio-economic benefits of forestry and agriculture;
- socio-economic impact;
- plantation share-farming;
- fire management;
- environmental impact of plantations; and
- hardwood plantations.

Many of these recommendations have been subsequently addressed, either directly or indirectly, through reforms to administrative and operational procedures stemming from the NFPS. For example, the Victorian Government's Code of Forest Practices for Timber Production (NRE 1996a) directs plantation development and harvesting in a manner consistent with the principles of environmental care and is designed to ensure that appropriate attention is given to environmental aspects.

In agricultural landscapes many socio-economic and environmental benefits can be gained from further plantation development, including:

- protection for soil and water values;
- groundwater management;
- waste water disposal;
- landscape improvement;
- crop and stock protection; and
- diversification of farm income.

Active involvement of farmers in such development can improve their understanding and support of plantations and encourage a sense of local ownership. This in turn can help to achieve expansion targets in ways that maximise community benefits and economic viability.

## **6.3 CURRENT RESOURCE AND MANAGEMENT**

### **Current Resource**

There are some 240 000 hectares of plantations in Victoria; 220 000 hectares principally of Radiata Pine, and 20 000 hectares of various Eucalypts. Ownership of plantations in Victoria is fairly evenly divided between the public and private sectors, whereas the national average for private ownership is 27 per cent.

The North East region falls within the Murray Valley plantation region, which on the basis of area planted is the largest of Australia's 15 softwood plantation regions identified in the National Plantation Inventory (BRS 1997). Two of these regions are wholly within Victoria and another three are partly within Victoria. The Murray Valley region extends from Melbourne along the Hume Highway corridor to include the Hume region in southern New South Wales. In 1994 the Murray Valley region contained 162 270 hectares of plantations, of which 162 040 hectares (98 per cent) were *Pinus radiata* and 230 hectares hardwoods (BRS 1997).

The North East plantations are aggregated into three major zones: the Benalla-Mansfield, Ovens, and Shelley-Koetong zones respectively. In 1996, the total plantation area in the North East region was



approximately 53 000 hectares. Of this area, some 8 000 hectares was held in private ownership and the Victorian Plantations Corporation (VPC) held 45 000 hectares (TIRES 1996). The plantations in private ownership are generally owned by members of the North East Victoria Forest Growers Co-operative and a number of smaller investors.

The plantations support major regional softwood industries in Myrtleford (Carter Holt Harvey Ltd), Wangaratta (Dominance Industries Ltd) and Benalla (D & R Henderson Pty. Ltd./Monsbent Pty Ltd). Collectively, these industries process sawlogs, veneer logs, and residual roundwood for pulp. The smaller firms such as Hume Timbers Pty Ltd and Benalla Timber Products Pty Ltd, located at Euroa and Benalla respectively, process sawlogs, preservation roundwood and residual roundwood.

Products also flow to NSW in the form of sawlogs (Boral Timber, Tumbarumba) and roundwood (Australian Newsprint Mills, Albury), and as veneer logs/small sawlog/pulp logs to the export facility at Geelong through Radiata Exports/Softwood Plantation Exporters Pty Ltd.

The softwood sawlogs, veneer logs and residual roundwood from the North East region are converted to sawn timber, veneer, plywood, particleboard, medium-density fibreboard, and pulp and paper products.

Current roundwood supplies to industries in the region total approximately 800 000 to 900 000 tonnes(t) from all sources and are expected to rise to 950 000t in 2000 and to 1 000 000t by 2006. Supplies to the export facility at Geelong are approximately 100 000t per year. The eventual mix of timber products from plantations in the North East region is expected to be approximately 55 per cent saw and veneer log and 45 per cent roundwood. Most of the wood is provided under fixed term supply agreements from the VPC, however minor allocations come from the VPC outside these agreements. Private plantations are largely uncommitted and provide between 10 and 30 per cent depending on the customer. However, because the boundary of the North East region does not coincide with the VPC North East Zone, these figures are best estimates.

The VPC is not expanding its plantation base in the region, but is replanting harvested areas using enhanced silvicultural practices and genetically improved stock. Its plantations are managed on a rotation of around 35 years, but this can be varied to meet the requirements for different product mixes from thinnings and final fellings for established and new customers. The area of private plantations is also stable, with only minor additions being made by small growers.

Most private plantations were established after 1970 and range in size from 10 hectares to 200 hectares, with the exception of a number of major growers like RCA Management Ltd. and Midway Wood Products. Management intent and practices are also highly varied, and include erosion control, control of groundwater recharge and commercial timber production, including high pruning. Some problems are being encountered by private plantation owners associated with lower intensity of management, difficulty in marketing early thinnings, small size, and isolated locations on farms (Washusen & Reid 1996).

### **Plantation management**

Plantation management in Victoria must comply with the Code of Forest Practices for Timber Production (NRE 1996a). The Code provides Statewide goals and guidelines for plantation establishment and management, and a number of Statewide minimum standards (such as set back reservations along streamsides).

Compliance with the Code on private lands and public land vested with the VPC is required through Planning Schemes administered under the *Planning and Environment Act 1987*. Operations on these lands are monitored by local municipalities through their planning scheme provisions.

The VPC was established under the *Victorian Plantations Corporations Act 1993* to act as an independent State business corporation under the *State Owned Enterprises Act 1992* (VPC 1996). The

VPC is a commercially focused business responsible for the management, protection and marketing of State-owned plantation timber resources, both hardwood and softwood. It manages about 168 000 hectares comprising land vested by the Government, leasehold commitments and land acquired by the Corporation since its establishment (VPC 1997). The net plantation area managed by the VPC, is approximately 107 000 hectares of softwoods and 8 000 hectares of hardwoods, of which about 45 000 hectares of softwood are in the North East region and managed from Myrtleford.

The Victorian Code and associated controls have been accredited by the Commonwealth Government as the basis for removing export controls on plantation products.

## 6.4 PLANTATION POTENTIAL

Approximately one million hectares of the North East region is privately owned of which 900 000 hectares are classified as 'not forested' (BRS 1998). Although the region has the physical capability to support a variety of species, only a few would be appropriate for large scale plantation establishment. This is due to the availability of markets, the resource composition of existing plantations in the region, and processor preferences for a narrow range of species. Two species identified as having immediate plantation potential are *P. radiata* and *E. globulus*. Over the last five years, there has been very little expansion of the region's 53 000 hectares of softwood plantation, while most of its 900 hectares of hardwood plantation has been established in this period.

### Land capability and suitability

Plantation land capability assessment identifies locations where the biological growth requirements of a species are satisfied (Bush *et al.* 1998). The capability of cleared private land in the North East region for both *P. radiata* and *E. globulus* plantations has been assessed and mapped by Borschmann (1998).

Borschmann correlated rainfall, elevation and geology with growth rates of existing plantations to estimate the mean annual increment (MAI), expressed in cubic metres per hectare per year, that could be expected for new plantations in the region. The gross area of cleared land capable of growing commercial plantations of hardwood with an MAI of at least 16 cubic metres per hectare per year is 673 000 hectares and 647 000 hectares for softwood. However, land that is capable of growing commercial plantations may not always be suitable for this purpose.

Land suitability analysis involves the integration of biophysical ( i.e. land capability ) and socioeconomic factors to determine the economic viability and social acceptability of using land for a particular use (Bush *et al.* 1998). In some instances, for example, there may be alternative uses that yield a superior economic return or the land may be too steep or too distant from processing plants to be suitable for commercial plantations. The plantation suitability analysis for this report was restricted to an economic analysis based on current market conditions for two species: *P. radiata* managed for sawlog and pulpwood production; and blue gum (*E. globulus*) managed to produce pulplogs (Wareing and Baker 1998).

### Economic analysis of land suitability

Discounted cash flow analysis (see, for example, Department of Finance 1991) was used to estimate the value of land for softwood and hardwood plantation development. These values were then compared to current land values in order to determine economic suitability. The analysis was broad in scale and only intended to show variations across the region.

It should be noted that specific plantation investment proposals are a matter for commercial decision by corporations, companies and individuals, and would need to be evaluated on a case by case basis after detailed resource and economic assessment.

There are significant areas of capable land that are not economically suitable for pine plantations under the baseline assumptions due to high land prices reflecting current use or physical impediments such as rocky areas, remnant native vegetation and swamps. This leaves an area of about 290 000 hectares that is potentially suitable. Considering the above results in conjunction with land values, the best prospects for softwood plantation expansion would appear to be:

- in the extreme north east of the region;
- various locations near Myrtleford; and
- areas in and around the Strathbogie ranges, south of Benalla.

Investment in short rotation hardwood plantations for pulpwood production is typically limited by several factors including availability of local markets for hardwood pulpwood logs and the prevailing pulpwood export prices. Despite the current lack of a local market for hardwood pulpwood logs and the comparatively high haulage cost to export woodchips through the port of Geelong, there are at least 10 000 hectares in the region suitable for new hardwood plantations. This area is also highly suitable for softwood plantations. Opportunities for growing hardwood plantations for pulpwood in the region would be enhanced if prices for export woodchips increased and/or a suitable processing plant was built in or close to the region.

There is considerable interest in Australia in growing hardwood plantations for sawlogs because they can be used to make high value products with appearance and strength properties that are superior to pine products. Although this may result in higher log prices for hardwood, the costs of production are also higher. Other factors favouring hardwood sawlog plantations are their additional aesthetic and environmental qualities for farm forestry.

The potential for expanding farm forestry or agroforestry is less dependent on the price of land and size of property. Landowners pursue small scale forestry activities for various reasons, including:

- environmental benefits - as part of a whole farm management strategy;
- relatively low maintenance in comparison to agriculture (attractive to absentee landlords);
- taxation purposes; and
- diversification of income.

## 6.5 PLANTATION OPTIONS

There are a number of options for establishing plantations in the North East region. At one end of the spectrum, plantations could be established as a large scale commercial investment, whilst at the other, farm-forestry, agroforestry and land protection may be feasible options in certain circumstances. Whilst it is VPC's intention to replant second/third rotation plantations without expanding the current estate, the opportunity exists for increased private softwood plantation establishment as well as a continuation of hardwood plantation establishment commenced by the FFORNE project on dryland sites with suitable annual rainfall.

The integration of farm forestry (agroforestry and land protection) into Australian farming systems contributes to:

- delivery of environmental benefits;
- diversification of agricultural enterprises;
- enhanced agricultural production;
- sustainable land management practices;
- land rehabilitation;
- habitat enhancement and biodiversity conservation; and
- aesthetic enhancement (RIRDC 1996).

Examples of broad options are represented in Figure 6.1 and outlined below:

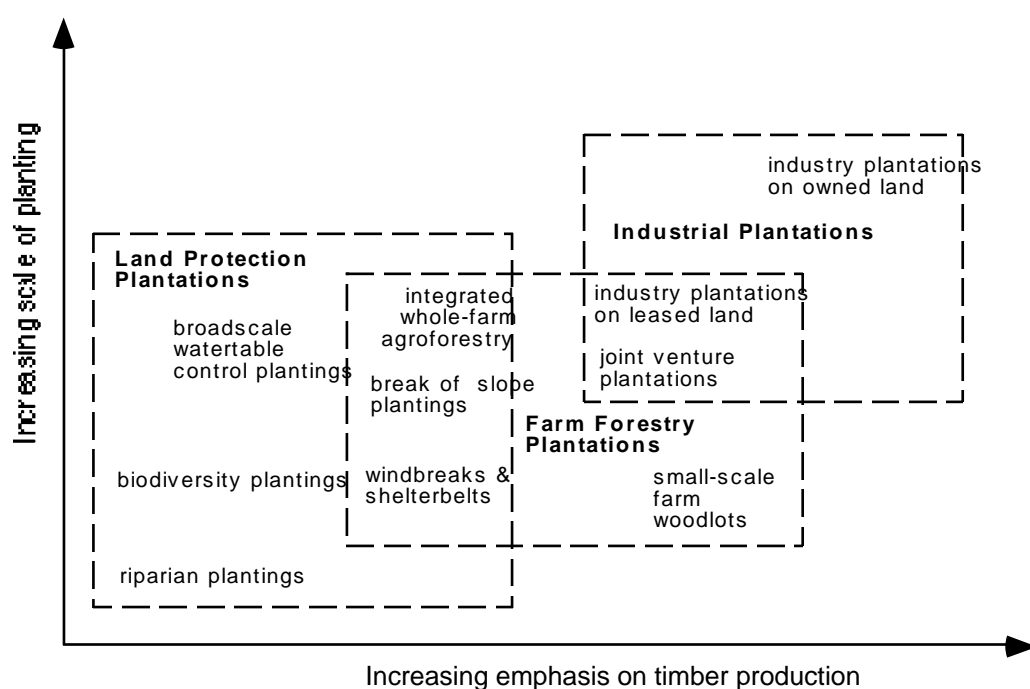
Industrial or off-farm investor plantation options:

- Sawlog-driven softwood plantation - close spacing, 2-3 thinnings for pulp or preservation and clearfelling for sawlogs at 30+ years;
- Clearwood sawlog -driven softwood plantation - high lift pruning operations, thinning to lower stocking for faster, increased diameter growth;
- Eucalypt pulpwood plantation - close spacing, short (10-20 year) rotation; and
- Eucalypt sawlog/veneer plantation - normal spacing, high pruning, thinning to lower stocking for faster diameter growth, on a medium (30-60 year) rotation.

Farm forestry / agroforestry options, which are integrated with a property's agricultural pursuits and are applicable to both softwood and hardwood:

- Timberbelts - alley farming system managed for timber with pruning and thinnings, while providing shelter for agricultural land;
- Wide spaced trees pruned for clearwood with grazing or inter-cropping; and
- Woodlots (small plantations) with lots greater than 10 hectares becoming more economically efficient - suited to joint venture arrangements or subject to Government funding initiatives (NRE 1997g).

**Figure 6.1: Plantation Options: Scale and Purpose**



## 7. OTHER FOREST PRODUCE

Forests of the North East supply a range of products and benefits in addition to the sawlog and residual wood discussed in Chapter 3. These include minor forest produce such as posts and poles, other hewn timber, firewood, wood chop blocks and specialty timbers, grazing and apiculture. The current economic values arising from these activities are described in this Chapter.

Other forest uses include recreation and tourism; water production; and mineral exploration and mining (including extractive industries such as gravel and stone). These uses are discussed in Chapters 8, 9 and 10 respectively.

### 7.1 MANAGEMENT

Like larger scale sawlog and residual wood production, management for other forest produce is aimed at sustaining supply and minimising environmental impacts.

Management planning and supervision normally increase in relation to the potential impact of the activity, but with minor products, the large number of individual operators can have a significant impact on overhead costs. As a result, costs of supervision may outweigh revenue raised from minor forest operations for example, domestic firewood collection. However, low returns to NRE should be considered in relation to the monetary and other benefits gained by the wider community.

Activities associated with minor forest produce sometimes complement other forest activities, for example firewood harvesting following timber harvesting; for other activities such as apiculture they may be separate.

Some other forest produce, such as specialty timbers, stakes and props, may be derived as by-products of harvesting or salvage operations.

### 7.2 PROFILE OF EXISTING SUPPLY, USAGE AND DEMAND

#### *Minor Forest Produce*

Much of the harvest for minor forest produce is undertaken under short-term, small quantity licences, issued to individuals for private and small scale commercial use.

Total royalties received by NRE for commercial activities related to other forest produce in the North East was \$ 39 030 in 1995-96 and \$ 37 900 in 1996-97 (Table 7.1). This excludes revenue from grazing and apiary licences which are discussed later in this chapter.

**Table 7.1: North East Other Forest Produce Royalty Revenues**

<b>Product</b>	<b>1995/1996</b>	<b>1996/1997</b>
Firewood	\$31 456	\$32 901
Posts and Poles	\$4 820	\$2 638
Wood chop blocks	-	\$839
Craftwood	\$1 263	\$1143
Sleepers	\$63	\$136
Bush Sawn / Split Timber	\$319	\$131
Hewn Timber	\$1 019	-
Stakes & Props	\$5	\$3
Seed capsules	\$26	\$3
Charcoal	\$61	-
Other		\$162
<b>Total revenue</b>	<b>\$39 032</b>	<b>\$37 956</b>

Source: NRE Annual Report 1995/96 and 1996/97

## **Firewood**

Within the North East, firewood is collected from State forest, some Parks and Reserves, and Shire roadsides. The level of use of public land for the provision of firewood varies across the region. Major towns, including Wodonga, Wangaratta, Beechworth and Benalla have the greatest demand for firewood due to their population size and the shift to wood heaters. Collection areas supplying these towns include Mt Pilot Multi-Purpose Park (MPP), Barambogie State Forest, Moyhu Forest Reserve, and Reef Hills Park. Areas of State forest in the south of the region such as Toombullup State Forest supply Mansfield and surrounding towns. Towns in the north east of the region such as Corryong and Tallangatta rely largely on private property for their firewood supplies.

Durable timbers including River Red Gum, Ironbark and box species are often preferred by firewood collectors given their high calorific value. Other species utilised include stringybarks, Narrow-leaf Peppermint and Alpine Ash. A zoning system for the sale of firewood licences exists across part of the North East including the towns of Wangaratta, Chiltern, Wodonga, Beechworth, Tallangatta, Corryong and Yackandandah. This zoning determines the place of collection and price paid for firewood. Areas including Mt Pilot MPP and Shire roadsides make up Zone 1 while designated areas in Barambogie, Moyhu, Upper Murray, Yackandandah and Beechworth State forests form Zone 2. A single royalty rate applies to each zone, and once the licence has been issued, the licensee is entitled to remove a specified quantity of any species from within that zone.

Toombullup State Forest (Mansfield) is the only area in the North East to currently provide wood to commercial firewood cutters. Commercial cutters collect firewood from logging residues following selective sawlog harvesting. These firewood areas are included within the Wood Utilisation Planning process discussed in Chapter 3.

Many firewood-collection areas are open to the public during the drier months of the year, and some suitable sites are open all year. Firewood can be supplied from:

- residual material remaining after normal timber-harvesting operations;
- salvage operations, following for example wild fire;
- thinning operations;
- timber stand improvement works;
- timber on the ground throughout areas of State forest and roadsides.

In all areas, firewood must be collected from material on the ground.

Firewood collection requires considerable management input to address issues such as the provision of winter access, minimisation of road damage, supervision of firewood cutters, marking of areas available for collection, safety, and licence and fee collection.

Firewood licences sold in 1996/97 returned \$32 000 in royalties (Table 7.1), which was for approximately 10 000 cubic metres.

## **Posts, Poles and Other Hewn Timbers**

While a few commercial cutters supply posts and other hewn timbers to the local market, many land-owners have traditionally met their own requirements under licences issued over nearby forest. In the North East, the existing demand for posts and other hewn timbers is supplied from State forest or from private property. The small market for such timbers is reflected in the relatively low returns outlined in Table 7.1.

Demand for post and pole material varies across the North East due to the lack of durable species in some regions. The demand for these materials in Corryong, Tallangatta and Mansfield is low, with most timbers supplied from private property.

In other areas, Red Stringybark, Red Box and other durable species are utilised from State forest. Collection tends to be from areas which are readily accessible.

### **Wood Chop Blocks**

The Department of Natural Resources and Environment supplies suitable material to the organisers of wood chopping events such as those associated with the Tallangatta and Benalla shows. Alpine Ash, Messmate or other non-durable species are preferred for woodchop blocks. The market for this product is unlikely to increase substantially in the future.

### **Specialty Timbers (Craft wood)**

Species such as Red Stringybark and River Red Gum produce timber with attractive colour and figure, making them sought after for use in furniture manufacturing and for wood-turning. Other species, for example peppermint, are also marketed as 'natural feature grade' timbers.

These specialty timbers become available in small quantities and may be tendered in small lots. Timbers may also become available in small quantities during sawlog harvesting operations or road construction and these are supplied under specialty timber/craftwood licences. Craftwood licences are also issued for the removal of species, such as Black Callitris Pine, where individual trees have fallen.

### **Grazing**

Cattle grazing in the High Country has a traditional association with the North East, dating back to the 1800s in alpine areas. Cattle are taken to high elevation grazing blocks on public land in late spring or early summer and remain there until autumn, subject to relevant licence conditions. Grazing in the higher elevations over the summer months allows for maintenance of stock condition and the conservation of home pastures for winter use. Grazing may also be carried out all year on lower elevation grazing blocks in State forest and on other public land. Graziers must be licensed to graze cattle or other livestock on public land.

In the North East, three types of licence are issued: Grazing, Seasonal Bush Grazing and Alpine Grazing. These licences are issued subject to conditions in accordance with the relevant legislation, namely the *Land Act 1958*, *Forests Act 1958* and *National Parks Act 1975*. Conditions to all licences usually include restrictions on the number of stock, access dates and transfer of these licences.

Since 1991, alpine grazing licences, which cover areas above the snowline (1220 m elevation), have been issued for a term of seven years in the Alpine National Park and annually in State forest although grazing may only take place during specified periods. Seasonal bush grazing licences cover sub-alpine and foothill forests on public land and only occurs during short periods during the year. Currently issued annually, seven year licences will be introduced for seasonal bush grazing in State forest in 1998. This applies to the 10 seasonal bush grazing licences in the North East. Other grazing licences are issued for a twelve month period.

In accordance with the *National Parks Act 1975*, alpine grazing licences were issued over areas of the Alpine National Park to those who held licences prior to the creation of the Park.

Grazing is prohibited in specified areas of the Park including Howitt Plains, northern Bogong High Plains, Mt Bogong and Mt Feathertop, as well as reference areas and parts of Falls Creek and Mt Buller Alpine Resort (LCC 1983).

Almost 220 000 ha of public land was subject to licences in 1996/97 which returned \$26 067 in royalties to NRE. As seen in Table 7.2, a large number of these licences were issued for grazing under the *Land Act 1958* which covers unreserved public land and water frontages.

**Table 7.2: Number and Area (ha) of Grazing Licences issued 1996/97**

Licence Type	<i>Land Act 1958</i>		<i>Forest Act 1958</i>		<i>National Parks Act 1975</i>		<b>Total</b>	
	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.
Grazing	21 821	(499)	15 613	(61)	-	(-)	37 434	(1381)
Bush Grazing (seasonal)	75 668	(10)	-	(-)	-	(-)	75 668	(1476)
Alpine Grazing	2 652	(1)	13 800	(8)	88 260	(31)	104 712	(2591)
<b>Total</b>	<b>100 141</b>	<b>(510)</b>	<b>29 413</b>	<b>(69)</b>	<b>88 260</b>	<b>(31)</b>	<b>217 814</b>	<b>(5448)</b>

Source: DNRE Land Information Management System (LIMS) December 1997

Cattle grazing on public land is economically important to graziers, allowing higher stock numbers to be carried by an individual farm. Many graziers have devised systems of management that integrate feed supplies from the home paddock and grazing runs. A study commissioned by the LCC in 1977 found that alpine grazing enabled licence-holders to run up to 40 per cent more stock on average than their farm would otherwise allow (LCC 1977b). Other studies on alpine grazing have found that cattle returning from runs are usually 'in first class condition and can bring top prices' due to a perceived increase in quality (Chisholm & Fraser 1997). At special autumn sales in Mansfield and Myrtleford, stock grazed in alpine areas have historically attracted prices 10 per cent higher than other stock from Victoria and southern New South Wales (pers. comm. Office of Valuer General 1998).

The beef cattle industry accounts for approximately 35 per cent of the gross value produced by agricultural industries in the North East; sheep and lamb production provide 6 per cent of the gross value in the region. As shown in Table 7.3, the contribution of beef cattle production to the total agricultural industry value in the North East is higher than the overall Victorian contribution.

It is not possible to quantify the contribution that public forests make to this industry, although it is considered to be significant.

**Table 7.3: North East Beef Gross Value of Production (GVP) 1994/ 95**

	<b>Beef GVP</b>	<b>Beef GVP</b>	<b>Total Meat Industry GVP</b>
	<b>(\$ million)</b>	<b>(%)</b>	<b>(\$ million)</b>
North East	101	35	291
Victoria	776	15	5 147

Source: Statistical Information Services, DNRE.; compiled October 1996 from ABS data.

### Apiculture

Apiculturists regard the drier foothill forests of the North East region, especially those supporting species such as Red Stringybark and Red Box, as among the most valuable for honey production per unit area in Australia (LCC 1981). Other forest types containing gum, peppermint, and alpine eucalypt species for example Snow Gum and Alpine Ash, and associated understorey species provide honey flow at times when the drier forest types are less productive.



As flowering declines at one site, hives are moved to another site where flowering is at its peak due to different species and/or site conditions. During periods of good flowering, hives may be shifted into the North East from outside the region or interstate. A large proportion of State forest in the region is not used by beekeepers, primarily due to poor access, inappropriate site conditions or unsuitable flora. Apiaries are excluded from areas reserved under the *Reference Areas Act 1978* and some other areas, such as Wilderness Parks and Zones declared under the *National Parks Act 1975*.

Bee-keeping on public land is controlled through the issue of annual licences for permanent sites and temporary permits (3 and 6 months) for temporary bee sites. Licences and permits allow access to a site for locating hives and use of forest nectar and pollen resources within a radius of 1.6 km or 0.8 km for permanent and temporary sites respectively. Currently there are 61 permanent bee sites and 145 temporary bee sites licensed in the North East (Table 7.4). There are numerous other sites in the region which are not currently licensed.

**Table 7.4: Licensed Bee Sites in the North East Region**

Land Tenure	Permanent	Temporary	Total
<i>Land Act 1958</i>	-	51	51
<i>Forest Act 1958</i>	61	82	143
<i>National Parks Act 1975</i>	-	12	12
<b>Total</b>	<b>61</b>	<b>145</b>	<b>206</b>

Source: DNRE Land Information Management System (LIMS) December 1997

In 1996/97, NRE received \$5 106 in royalties from the issue of beekeeping licences and permits in the North East. However, these royalties represent only part of the economic value derived from beekeeping activities. Although honey is the major product of the Victorian apiary industry, of which approximately half is exported, other produce includes beeswax, pollen and royal jelly. Pollination of food and seed crops is an external benefit of apiculture. It has been estimated that increased production through pollination is approximately \$251 million in Victoria (Gibbs & Muirhead 1997).

The level of honey production is estimated to be an average of 1700 tonnes per annum and as shown in Table 7.5, the total value of honey and related products is estimated to be \$3.1 million.

It is not possible to quantify the contribution that public forests make to this industry, although it is considered to be significant.

**Table 7.5: North East Beekeeping Production Values 1996/1997**

	Honey	Other goods & services	Total
North East	\$2 567 000	\$533 000	\$3 100 000
Victoria	\$7 700 000	\$1 600 000	\$9 300 000

Source: Gibbs & Muirhead 1997; North East production is estimated to be one third of the Victorian total (L.Briggs CEO, Federal Council of Australian Apiarists' Association)

### Other Produce

Presently there is low demand for forest produce such as understorey species, cut flowers and live plant specimens. Protected flora species can only be taken from public land when covered by a permit under the *Flora and Fauna Guarantee Act 1988*. A permit for harvesting of minor forest produce and payment of a royalty fee is usually required.

NRE employs contractors to collect seed for regeneration of logging coupes. In addition, small quantities of seed are collected by private companies and other organisations under permit and a royalty is paid by capsule weight. Very little seed is collected for private commercial purposes within the North East.

### **7.3 OUTLOOK AND OPPORTUNITIES FOR OTHER PRODUCE**

#### **Minor Forest Produce**

Due to the close proximity and size of the potential markets for minor forest produce in Wodonga, Wangaratta and Benalla, the demand for produce could increase in the future with the growth of these towns. Produce with the most potential includes firewood and specialty timbers.

#### **Firewood**

Steady growth in demand is expected with the increasing number of domestic wood burning stoves and heaters being installed in homes. While the long-term demand for fuel wood is linked with the price of major energy sources such as natural gas, the demand for firewood is expected to continue to increase with expanding development in the Albury - Wodonga area. Annual population growth in the North East is predicted to be approximately 1.4 per cent until 2001 (Government of Victoria 1995 in NECALP 1997).

Opportunities exist for commercial operators to harvest firewood from State forests of the North East for sale in local markets. Residual timber remaining after timber harvesting operations is currently under-utilised with only one commercial firewood operator currently working in the North East.

#### **Specialty Timbers**

At present, the craftwood market is small, supplying timbers for furniture manufacture and wood turning. Small-scale sawmillers use portable sawmills, followed by air or kiln drying, to supply timber for furniture production.

Timbers supplied are mostly small quantities of eucalypt species not normally taken by sawlog operations, for example, Red Stringybark for use in furniture manufacture. However, with effective marketing of such 'natural feature' grade timbers, it is likely that the market opportunities for these species will increase.

#### **Grazing**

Grazing of domestic stock in public land provides direct agricultural benefits to producers. In the North East grazing is likely to continue at its current scale for the foreseeable future.

#### **Apiculture**

Roads developed for timber production and other purposes potentially increase access to areas of State forest for beekeeping, and the NRE fire protection program provides a level of security for hives and other equipment used in the industry. Due to the preference for particular forest tree species found in the North East and access to suitable apiary locations, it is expected that current levels of demand are likely to continue.

## 8. TOURISM AND RECREATION

### 8.1 INTRODUCTION

The North East provides a range of opportunities for natural and cultural experiences for which the region's forests, rivers and ranges provide an important focus. The region is home to some of Victoria's great legends such as the mountain horsemen, the 'Man from Snowy River' and the Kelly Gang while natural attractions include the high country, Mt Buffalo, and the valleys of rivers like the Upper Murray. Skifields at Mt Hotham, Falls Creek and Mt Buller are also examples of the many recreational attractions.

Forested public land in the North East provides the basis for a diverse range of recreation activities that complement other attractions of neighbouring towns and rural landscapes. Activities such as bush-walking, forest drives, horse-riding and downhill or cross country skiing provide a contrast to the wineries at Milawa and Rutherglen, and the historic towns of Beechworth and Chiltern. Together they combine to offer a high quality recreation and tourism resource accessible to Melbourne and the Albury-Wodonga region for day visits and overnight trips.

The tourism and recreation industries make an important contribution to regional economies throughout Australia. In 1995/96, tourism and recreation (calculated as cultural and recreational services, and accommodation, cafes and restaurants) contributed around 3.8 per cent (\$4.2 billion) of Victoria's gross State product (ABS 1996). For the same period, employment in the recreational, personal and other services accounted for 7.5 per cent, or 142 900 people in the State.

In 1995/96, recreational, personal and other services employed over 5 400 people or 8.4 per cent of the total employment in the North East. This does not, however, include the contribution of tourism and recreation to the retail and wholesale industries. Combined, these industries were the second largest employer in 1995/96 in the North East employing approximately 11 500 people, or 17.7 per cent of the total workforce. Retail and wholesale industries contributed 13.7 per cent of Victoria's gross State product (ABARE 1998) for the same period.

Tourism in the North East is significant to the local economies of many centres such as Albury–Wodonga, Mansfield, Beechworth and Bright. Estimates of tourist spending for Albury indicate an expenditure of \$67.98 per visitor night and total expenditure in 1994/95 of approximately \$93 million (Pannell Kerr Forster 1997). Expenditure in the 'Legends, Wine and High Country' tourism region, which covers the majority of the North East region, was approximately \$219 million in 1995/96. In comparison, a North East Agribusiness study estimated the gross value of agricultural production in the region, including timber, livestock and dairying at \$795 million in 1996 (Pannell Kerr Forster 1997).

Regional Tourism Development Plans have been prepared for each of the thirteen tourism product regions across Victoria. These plans are strategically important in the economic development of the region, and to the improvement of marketing and product development in the tourism industry. The 'Legends, Wine and High Country' Regional Tourism Development Plan (Pannell Kerr Forster 1997), in conjunction with the Goulburn Murray Waters and Murray product region plans, provides a tourism 'vision' for the North East which incorporates experiences which can only be gained from forested public land. It envisages the North East as 'the place where Australians escape for outdoor adventure, skiing, sport and the good life, reflected in wine, food, quality accommodation and, year round events and activities which attract visitors from across Australia and overseas. Its historic towns, rich heritage, natural environment, lakes, rivers and scenic beauty will enrich the touring experience' (Pannell Kerr Forster 1997 p 4).

## 8.2 OVERVIEW OF TOURISM AND RECREATION IN THE NORTH EAST

Tourism Victoria defines a 'visitor' as an Australian resident or international visitor undertaking a trip within Victoria. A 'trip' is a tourism journey within Victoria and a 'visit' is a stay of one or more nights at a place during a trip. A 'day tripper' is a Victorian resident undertaking a day trip within Victoria (Tourism Victoria 1996a).

The Victorian Regional Travel and Tourism Survey (Tourism Victoria 1996a) found that the North East received approximately 1.5 million visitors in 1995, or 10 per cent of all visitors to Victoria. Within regional Victoria, only the tourist regions of the Great Ocean Road (2.2 million) and the Goldfields (1.7 million) received higher visitation. Visitors to the North East were predominantly intrastate travelers, with only 12 per cent of tourists arriving from outside Victoria (Tourism Victoria 1996a). Those people travelling from interstate were predominantly from country New South Wales (8 per cent), no doubt due to the proximity of the region to the State border. Table 8.1 shows characteristics of visitors to the North East.

**Table 8.1: North East visitor characteristics, 1995**

<b>Visitor Origin</b>	
Melbourne	914 794 (63%)
Country Victoria	358 697 (25%)
Victoria (total)	1 273 491 (88%)
Interstate	168 037 (11%)
International	14 296 (1%)
Visitors	1 455 824
Visitor Nights	4 823 338
Average length of visit (all visitors)	3.3 nights
<b>Average expenditure</b>	
Per Visitor Night	\$45
Per Trip	\$150

Source: Tourism Victoria (1996a)

A comparable number of day trippers visited the North East in 1995 with 1.3 million visitors spending a total of \$48 million, or an average of \$36 per trip (Tourism Victoria 1996b).

The most popular activities undertaken by both visitors and day trippers to the North East are shown in Table 8.2. These figures indicate that driving to sightsee or for pleasure and shopping are the most popular activities for all visitors. On a statewide basis, only visitors to the Grampians had a higher level of National Park and forest usage or bushwalking than the North East. The majority of visitors to the North East (71 per cent) were travelling for holiday purposes which is the highest level in Victoria (Tourism Victoria 1996a).

**Table 8.2: Most popular visitor activities in the North East, 1995**

	Visitors	Day Trippers
Activity	(% participating)	(% participating)
Drive to sightsee/pleasure	58	28
Restaurants/dining out	48	12
Shopping	43	26
Visiting national park/forest	35	11
Bushwalking	33	-
Visiting friends and relatives	27	29
Visit an art gallery/craft centre	22	-
Water skiing/snow skiing	21	-
Visit a museum or historic site	20	-
Fishing	19	-
Picnic/BBQ	-	20
Attend a festival/event	-	5

Source: Tourism Victoria 1996a; Tourism Victoria 1996b. Note: percentages may not add up to 100 as visitors may have participated in more than one activity.

Activities commonly associated with the North East are bushwalking, skiing, horse-riding and winery visits (Pannell Kerr Forster 1997). These are reflected by popular events such as the Rutherglen Winery Walkabout, the 'Man from Snowy River Festival' and Challenge, and other horse riding events. The annual Kangaroo cross-country ski race at Falls Creek and the bi-annual World Hang-gliding Championships at Bright both attract over 1000 competitors, including 100 to 200 international competitors.

Lake Hume and Lake Dartmouth provide a base for picnicking, fishing and water activities attracting over 100 000 people (Goulburn Murray Water pers. comm. 1998). Murray River reserves and State forest between Rutherglen and Corryong also provide a variety of campsites and attractions such as fishing, canoeing and sightseeing for over 500 000 visitors annually (Pannell Kerr Forster 1997).

Seasonal variation in visitor numbers in the North East is not as acute as many other regions in Australia. Over a three year average of visitor nights, January (21 per cent of all nights) and April (13 per cent) are the most popular times for visitors, particularly to the High Country and Lake Eildon. While these months reflect the main holiday periods, several other months also attract 8-10 per cent of visitors, including the ski season months, July to September (Pannell Kerr Forster 1997). The lack of marked variation may reflect the diversity of available activities and tourism features in the region.

### 8.3 TOURISM AND RECREATION ON PUBLIC LAND IN THE NORTH EAST

The North East is one of the most significant and concentrated areas for outdoor activities in Victoria, much of which occurs on forested public land. Both State forest and parks and reserves are popular and complement each other as visitor destinations. Attractions that can be found on public land in the region include:

- the Alpine National Park including Mt Bogong, Mt Feathertop and The Bluff;
- the snowfields at Mt Buller, Mt Hotham, Falls Creek and Mt Stirling;
- the Murray River, Lakes Hume and Dartmouth and other rivers and streams which are popular for fishing, rafting and camping;
- horseriding on the Bogong High Plains and to Craig's Hut and surrounding Clear Hills;
- rock climbing and abseiling at Mt Buffalo National Park;
- nature observation in a variety of forested landscapes;
- mountain biking and 4WD opportunities on roads and tracks through the area;
- opportunities for deer hunting in Victoria's mountain region; and
- historic features such as the Eldorado dredge, and other relics of mining, grazing and timber production across the region.

Over 200 km of the 655 km Alpine Walking Track cross the region, as does part of the Bicentennial National Horse Trail.

Tourism has been widely advocated as an industry for regional economic growth as the North East has a diversity of natural resources. National Parks, State forests and Alpine Resorts contribute to the overall attractiveness of the region as a potential tourist destination. However, there are some differences in recreation opportunities available in National Parks compared with State forests. The type of activity which occurs in individual parks and forests is largely governed by legislation, including regulations, which vary with tenure, and the management plans which accompany the park, reserve or forest. There are generally tighter constraints placed on recreation and tourism in National and State Parks in comparison with State forests.

Regional Tourism Boards co-ordinate tourism promotion, including the distribution of promotional material. Membership of these Boards is drawn from local tourist operators, business, and local and State Government representatives. Parks Victoria has membership on behalf of NRE on some of these Boards and liaises with them, local tourism associations, municipalities and Tourism Victoria to promote attractions in the North East as required. Information about NRE and Parks Victoria facilities and recreational opportunities on public land is made available to the Regional Tourism Boards for inclusion in tourism promotion activities.

NRE and Parks Victoria play major roles in the development and promotion of public land in the North East region as a tourism and recreation destination. A wide range of information is provided for school groups and the general public for educational and promotional purposes. A number of education and information centres provide the basis for interpretation and activities, and numerous pamphlets, guides and brochures are produced to provide information on facilities and activities in individual areas.

#### **Tourism and Recreation in National Parks and Reserves**

Land reserved under the *National Parks Act 1975* is managed to preserve and protect flora, fauna and other natural features and to provide appropriate opportunities for enjoyment by visitors. Within the North East there are:

- five National Parks - Mt Buffalo, Burrowa-Pine Mountain, the newly created Chiltern Box-Ironbark National Park and part of the Alpine and the newly created Lake Eildon National Parks;
- three State Parks - Mt Granya, Mt Lawson and Mt Samaria ; and
- other parks - the Wabba Wilderness Park, Beechworth Historic Park and Reef Hills Park.

The Alpine National Park and Mt Buffalo National Park are two of the most significant areas of public land in Victoria and visitor numbers to these areas have been increasing since 1989. In the Alpine National Park, this may be due to increased summer usage (Pannell Kerr Forster 1997).

Visitor numbers to parks in the North East are shown in Table 8.3. A 'visit-day' is defined as a person staying in a protected area for a day or part day and each overnight stay counts as an additional visit day.

**Table 8.3: Visitation to Parks in the North East managed under the National Parks Act, Total Visit - Days 1989 - 1997**

Park	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97
Alpine NP <sup>(a)</sup>	158 800	98 200	194 800	215 200	222 000	240 000	351 200	376 100
Burrowa-Pine Mountain NP	9 800	18 000	10 000	10 000	10 000	11 000	16 780	19 760
Chiltern Box-Ironbark NP	4 600	5 000	5 200	9 000	9 000	10 500	10 853	8 876
Mount Buffalo NP	198 400	165 700	179 320	190 200	190 200	188 021	203 136	236 582
Lake Eildon NP	-	-	-	-	-	-	-	-
Mount Granya SP	-	-	-	-	-	-	2 545	2 310
Mount Lawson SP	-	700	-	700	1 800	2 050	1 680	1 290
Mount Samaria SP	16 900	10 500	14 170	14 000	15 000	3 300	13 630	17 744
Wabba WP	-	-	-	-	-	220	250	294
Beechworth HP	73 900	88 000	96 800	100 000	115 000	125 000	134 000	115 200
Reef Hills Park	16 000	8 000	-	-	15 000	15 200	16 000	13 942
<b>Total</b>	<b>478 400</b>	<b>394 100</b>	<b>500 300</b>	<b>539 100</b>	<b>578 000</b>	<b>595 291</b>	<b>750 074</b>	<b>792 098</b>

Source: Parks Victoria (1998); NP = National Park, SP = State Park, WP = Wilderness Park, HP = Historic Park; (a) this estimate for the North East region is based on 80 percent of total visitation to the Alpine National Park

Land managed under the Victorian *National Parks Act 1975* received approximately 13.3 million visit days in 1996/97. Of these visits approximately 5 per cent were to National and State parks within the North East. It is estimated that more than 80 per cent of the visit days to the Alpine National Park, as shown in Table 8.3, are to the North East section of the park. Visitor numbers to the portion of Lake Eildon National Park in the North East are currently not recorded. However, visitors to the Delatite Arm Reserve probably also use the park for trail-bike riding and bushwalking (Parks Victoria pers. comm. 1998).

In 1996/97, 70 000 visit days were recorded in the Delatite Arm Reserve and Upper Goulburn Historic Recreation Area, with campers making up more than half the visitor numbers to these areas (Table 8.4). Other reserves managed by Parks Victoria in the North East are also popular.

**Table 8.4: Visitor Numbers to Other Parks and Reserves 1996/97**

Area	Day Visits	Overnight Stays	Total Visits
Upper Goulburn Historic Recreation Area	20 300	19 248	39 548
Delatite Arm Reserve	10 229	19 735	29 964
Other NE Area Conservation Reserves	12 000	0	12 000

Source: Parks Victoria (1998)

Visitors use parks and reserves in the North East for activities such as picnicking, camping, fishing, bushwalking, horse riding, rock climbing and abseiling, hang-gliding, canoeing, cycling, and four-wheel and pleasure driving. Downhill and cross-country skiing are also popular activities. In some cases and under special conditions, organised or competitive events, such as ski and foot races, rogaining and orienteering, may be permitted in some areas. Deer hunting by stalking is legally permitted on a seasonal basis in parts of the Alpine National Park.

In order to preserve the natural environment in parks and reserves, recreation activities are managed with the general aim of minimising impacts on the environment. Park regulations and management plans specify which activities are permitted in Parks. General restrictions also apply across National Parks including the prohibition of pets such as cats and dogs. Voluntary codes of practice have been developed in association with user groups for activities such as horse-riding, bush-camping, trail bike and mountain bike riding, and bush-walking.

Management zones and overlays are designated in management plans to provide a geographic framework in which to manage the Park. Zones indicate which management objective has priority in different parts of the Park. The six primary zones are: reference, wilderness, conservation, conservation and recreation, recreation development and education zones. The zoning system is designed to reduce conflicts between various types of visitor use and protection of other park values. Overlays are used to reinforce or modify the management of the underlying zone and can include land use designations to provide for legislative requirements, special protection areas or special management areas.

### **Tourism and Recreation in State forest**

State forests of the North East are estimated to attract around 360 000 visitor days each year as shown in Table 8.5. Picnicking, camping, walking, fishing, horse-riding, trail bike and mountain bike riding, and four-wheel driving are the most popular activities on State forest as are nature observation and forest drives. In the more remote areas of State forest, activities can also include deer hunting. Main recreation areas in the North East include State forest around tourist towns such as Mansfield, Beechworth, Bright and Mt Beauty.

Popular sites in State forest include: Craig's Hut attracting more than 30 000 visitors per year (Garry Wilson, NRE pers comm 1998); camping areas near the Upper Goulburn which are visited by approximately 36 000 people annually; and areas near Beechworth and Yackandandah Creek, which attract a similar number of visitors (Harty and Bartlett 1996).

**Table 8.5: Recreational Usage in North East State Forest 1994/95**

Forest Management Area	Day Visitors to sites	Campers to sites	Disperse	Total
Benalla-Mansfield	69 000	83 000	45 500	197 500
Wangaratta	65 000	32 000	28 000	125 000
Wodonga	5 000	10 000	25 000	40 000
<b>Total</b>	<b>139 000</b>	<b>125 000</b>	<b>98 500</b>	<b>362 500</b>

Source: Read Sturgess and Associates (1995)



In managing State forest, NRE aims to provide a wide range of recreational opportunities while conserving the natural environment. Forest Management Plans are prepared to ensure State forests continue to provide opportunities for public recreation and education. A Forest Management Plan for the North East region is currently in preparation.

### Tourism and Recreation in Alpine Resorts

Victoria's alpine resorts are some of Australia's premier tourist attractions and ski-field developments represent the greatest concentration of tourism investment in the State outside Melbourne. Alpine resorts in the North East attracted nearly 500 000 visitors during the 1997 snow season (ARC 1998) as shown in Table 8.6. Mount Buller has the highest visitation of any attraction in the North East, with 243 000 visitors in 1997. However, the quality of snow and length of the ski season can significantly affect visitor numbers to Alpine Resorts.

**Table 8.6: Visitor Numbers 1990 - 1997 (Snow seasons)**

RESORT	1990 (000's)	1991 (000's)	1992 (000's)	1993 (000's)	1994 (000's)	1995 (000's)	1996 (000's)	1997 (000's)	Average (000's)
Mt Buller	340	288	308	88	210	221	262	243	245
Falls Creek	178	154	156	119	149	167	161	131	152
Mt Hotham	118	101	106	76	109	118	123	101	107
Mt Stirling	24	14	17	3	10	13	10	7	12
<b>North East Total</b>	<b>660</b>	<b>557</b>	<b>587</b>	<b>286</b>	<b>478</b>	<b>519</b>	<b>556</b>	<b>482</b>	<b>516</b>
Lake Mountain <sup>a</sup>	200	170	151	35	124	160	81	98	117
Mt Baw Baw <sup>a</sup>	39	36	36	14	30	38	21	26	30
<b>Total</b>	<b>899</b>	<b>763</b>	<b>774</b>	<b>335</b>	<b>632</b>	<b>717</b>	<b>658</b>	<b>606</b>	<b>673</b>

Source: ARC Alpine Resorts (Management) Regulations 1997; a) outside North East RFA Region

The alpine resorts provide a unique recreational experience. During the snow season they provide for downhill and cross country skiing, snow play and general alpine experience. In the summer period, the resorts offer active and passive recreational opportunities such as mountain biking, bushwalking, horse-riding and four-wheel driving. Approximately 200 000 people frequent all alpine resorts in the summer period (including Lake Mountain and Mt Baw Baw) (ARC 1998).

The alpine resorts in the North East received 556 000, or 84 per cent of all visitors to Victorian snowfields in 1996. The vast majority of these visitors were from within Victoria (87 per cent) with the remainder primarily from interstate. There are relatively few visitors (< 3 per cent) from overseas (Pannell Kerr Forster 1997). Table 8.7 indicates the origin of Alpine Resort visitors in 1996.

**Table 8.7: Origin of Visitors to Alpine Resorts 1996**

Field	Mt Buller	Falls Creek	Mt Hotham	Mt Stirling
All Visitors	262 000	161 000	123 000	10 000
Melbourne (%)	73	36	49	55
Country Victoria (%)	20	30	34	43
Interstate (%)	7	34	17	2

Source: Pannell Kerr Forster 1997

The *Alpine Resorts (Management) Act 1997* introduced a new management regime for Victoria's alpine resorts, including Falls Creek, Mt Hotham, Mt Buller and Mt Stirling. The Act provides for the control and management of these resorts through separate Alpine Resort Management Boards. Resorts must be managed in a manner that recognises the varied, and potentially conflicting, needs of recreationists, commercial interests and the environment. Resort planning must also consider issues such as the re-establishment of vegetation and the protection, conservation or preservation of flora, fauna or natural features.

### **Outdoor Education**

Outdoor education is an important activity which is undertaken by a number of commercial operators, school groups and clubs on public land in the North East. Activities provided by these organisations include bushwalking, rafting, rock climbing, horse riding, abseiling, mountain bike riding, skiing, wildlife observation, historic site interpretation and camping.

Currently five commercial operators conduct educational and training tours in the forests of the North East and provide the opportunity for over 1 500 people per year to participate in outdoor education activities. The outdoor education industry estimated that, in the Central Highlands, the industry was growing at a rate of 15 to 20 per cent per annum (VicRFASC 1997c). This estimate also applies to the industry in the North East.

School groups, from primary to tertiary level, are the most prolific users of public land for educational purposes. As many schools utilise the full extent of the North East, including many from outside the region, it is impossible to accurately estimate user numbers. It is estimated more than 10 000 student days per annum are spent in the region (Outdoor Education Association pers. comm. 1998). Activities usually include an interpretation component, particularly those for the Victorian Certificate of Education (VCE) subject 'Outdoor Education' which has components related to human impacts on the natural environment.

A number of formal education and interpretation facilities exist in the North East. NRE operates two such facilities, Toorour Forest Lodge and Shelley Forest Camp, established for schools, clubs and individual groups to learn about natural heritage. Other privately operated 'not-for-profit' outdoor education centres are also located in the North East and provide educational services to schools utilising forested public land. In addition, a number of schools have out-station campuses which use public land.

### **Commercial Tourism Operations on Public Land**

The private sector's role in providing a range of services to tourists and recreationists is increasing in importance, and commercial tours are becoming a popular means for tourists to enjoy forest areas. Most tour operators in the North East utilise parks and conservation reserves including the Alpine National Park and Mount Buffalo National Park. Mansfield State Forest, Jamieson State Forest and State forests adjoining the Alpine National Park are also popular for horse-riding, 4WD and bushwalking.

Regulation of commercial tours is through a Commercial Tours Permit System that operates across all public lands. These permits set out conditions for tour operations and are renewed annually. However, three year permits can be issued to industry-accredited operators. Parks Victoria administers this system on behalf of NRE.

There are currently 110 commercial tour operators in the North East which represents about 30 per cent of all tour operators licensed by NRE in Victoria.

In the North East, bush-walking tours are most popular, with 40 per cent of the commercial tour licenses issued providing for this type of activity. Other licensed tour activities include horse-riding, canoeing, vehicle-based tours, snow-based activities and natural history tours as shown in Table 8.8. Although many tour operators are licensed to utilise public land in the North East, tours may be

seasonal or run on an irregular basis. Horse-riding, bushwalking and 4WD tours are the most regular form of tour undertaken.

**Table 8.8: Commercial Tour Activities on Public Land in the North East**

Activity	No. of Commercial Tour Operators
Bushwalking	43
Four-wheel drive tours	26
Raft/canoe/kayak	25
Skiing and other snow-based activities	25
Horse riding	21
Vehicle based tours	16
Mountain bike tours	15
Rock climbing/abseiling	14
Natural history/nature observation	10
Other including mountain biking, fishing and cultural tours	19

Source: Parks Victoria (1998); Note: numbers may not add up to 110 as tour operators may provide for more than one activity.

#### **8.4 ECONOMIC VALUE OF TOURISM IN NATIONAL PARKS AND STATE FOREST**

A study by Read Sturgess and Associates (1995) suggests that the net economic value of recreation in Victorian State forests is within the range of \$6-\$18 per visitor day. Another study (Read Sturgess and Associates 1994b) suggests a net value of \$18 per visitor day for the Grampians National Park, however, caution is required in extrapolating this figure to other Victorian parks. An economic assessment of all Victorian parks is in progress and is due for completion later this year.

In 1994-95 there were an estimated 362 500 visitors to State forest and 595 300 visitors to National Parks in the North East. Using the estimates from the above reports, this equates to a total net economic value for tourism and recreation of between \$2.1 million and \$6.5 million in State forests in the North East region, whereas parks may have a net economic value for tourism and recreation of \$10.7 million.

The 1995 study also suggests that a range of \$20 and \$50 per visitor day be used as a guide to calculate the stimulus of tourism and recreation in State forests to the regional economy. On this basis State forest is estimated to contribute between \$7.2 million and \$18.1 million per year to the regional economy in the North East. Using an estimate of \$131 per visitor day as a guide to calculate the stimulus of tourism and recreation to the regional economy derived from the 1994 Grampians study, parks in the North East could generate up to \$78 million, however as indicated above caution is required in extrapolating these figures to other Victorian parks. Based on these aggregated figures, tourism and recreation based on public land in the North East is estimated to contribute between \$85.2 million and \$96.1 million per year to the regional economy.

These estimates suggest that tourism and recreation is an important part of the economic values derived from North East forests.

The resorts managed by Alpine Resorts Management Boards in the North East, at Falls Creek, Mt Hotham, Mt Buller and Mt Stirling, provide significant input into Victoria's economy. A study of the economic significance of alpine resorts, undertaken in 1991, indicated that the resorts created more than 5 700 full time equivalent jobs. This study also estimated a winter gross expenditure by visitors of \$230 million, and an additional \$39 million from summer visitors (ARC 1998). These figures represent the economic significance of all alpine resorts however, at the time of the study, resorts in the North East accounted for 73 per cent of all alpine visitors.

In addition, resorts support a large number of commercial enterprises that offer services that are reliant on the alpine environment (e.g. ski lift and ski hire businesses) or which service the resorts (e.g. bus charter firms).

## **8.5 DEMAND FOR TOURISM AND RECREATION**

Tourism is one of Australia's fastest growing industries. The Tourism Forecasting Council predicts that during the period 1997 to 2007, domestic visitor nights in Victoria will increase by 1.8 per cent per annum. This growth rate is slightly higher than the expected national average of 1.1 per cent per annum (ONT 1998a). Total international visitor arrivals are expected to grow at an average annual rate of between 3.6 and 6.1 per cent to reach 5.9 to 7.5 million visitors in 2006 (TFC 1997) depending on economic conditions in Asian countries. These forecasts are lower than previous forecasts of 7.8 per cent growth per annum to 2006. As Asian countries account for half of Australia's inbound tourist arrivals, recent changes in economic conditions in several Asian countries suggest that earlier forecasts may not be met.

Ecotourism, or nature-based travel, has broad appeal among international visitors and domestic tourists, and the demand for ecotourism experiences in Australia has increased with growth in the nature-based travel market. Ecotourists generally appear to be seeking travel experiences that involve areas or attractions of natural beauty, are away from crowds and have some level of interaction with the environment (ONT 1998b). Increased sales of four-wheeled drive vehicles, camping and outdoor equipment has led to an increased demand for places for recreation. In addition, production of specialist recreational magazines, and increased awareness of activities such as abseiling and paragliding has also led to an increase in the number of people participating in these activities (Pannell Kerr Forster 1997).

The Victorian National Parks Visitor Segmentation Study was completed by NRE in March 1996. The main findings relating to the total population of park visitors were similar to those of the Office of National Tourism (ONT 1998b) and included:

- visitors were concerned with doing things with the family and enjoying the great outdoors during their leisure time;
- there was strong interest in educational and adventure activities;
- visitors had a high interest in rainforests and a moderate interest in forests, rivers, beaches and mountains;
- main reasons for visiting parks included picnicking, day bushwalking, visiting historic sites and experiencing aboriginal culture; and
- visitors had large, but mainly un-realised interests in experiencing four wheel driving, canoeing, learning about aboriginal culture/history, white water rafting, scuba diving, cross country skiing, hang gliding and working as volunteers in parks.

Using these findings as a guide, public land in the North East region is well suited for much of the population as it provides for these activities. For example, the region provides opportunities for

family activities and enjoying the great outdoors. Educational opportunities are provided for visitors and there are opportunities for adventure activities such as rock climbing, cross country skiing, canoeing and four wheel driving, and opportunities to undertake picnics and short bushwalks. The trend toward nature-based tourism over recent years suggests an increase in tourism and recreation in North East forests in the years to come.

The growth in visits to Victorian State forests has been estimated to remain at least in the order of 3 to 5 per cent per annum until the end of the decade. Applying these growth rates to the 1995 visitation levels in the North East, between 420,000 and 462,000 visits are expected in the region's State forests by 2000. Visits to National Parks in Victoria averaged around 5 per cent per annum in the 8 years to 1996-97 and this growth is expected to continue. Using current visit levels, over one million visit days are expected in parks in the North East by 2000.



## 9. WATER AND CATCHMENTS

### 9.1 INTRODUCTION

Water is essential for maintaining natural environments and for recreational, agricultural, industrial and domestic uses. It is an important resource that is harvested from forested catchments in the North East region. These catchments are also used for a range of other activities such as recreation, conservation, agricultural production and timber production. Any activity within a catchment has the potential to affect both the quality and quantity of water supplies.

The relationship of water, forests and forest use is complex, and based on many variables including climate and geology, lithology and vegetation. Links exist between the properties of soils, the forest structure, the impacts of land use (including both the area and spatial distribution of uses) and water quality and quantity.

As with other activities in catchments, such as agriculture and recreation, timber harvesting, roading or any major forest disturbances have the potential to affect water quality and quantity. The significance of these effects depends on physical factors such as soils, topography, vegetation and climate, as well as the scale and spatial distribution of forest activities.

This chapter describes the policy and planning framework that governs water management in Victoria and examines water resources, production and use in the context of the current land uses in the North East region. These descriptions include a brief review of relevant research underpinning forest management.

A major consideration of the RFA process is the implementation of ecologically sustainable forest management (ESFM). Principles of ESFM encompass the protection of water and other resources, including maintaining both quality and quantity of these resources. A review of the Statewide systems for ESFM is described in a separate report (VicRFASC 1997a) and summarised in Chapter 17 of this report.

### 9.2 WATER RESOURCES IN THE NORTH EAST

Water resources can be broadly classified as surface water or ground water. Water enters a forested catchment as rainfall, snow, fog or sleet, and is usually intercepted by vegetation before reaching the soil. At the soil surface, water infiltrates until saturation occurs, then runs off as surface flow. This surface flow contributes to short term river flow following rainfall, whereas infiltration contributes to underground water (aquifer) reserves which may be discharged into rivers and streams over a longer period.

Infiltration is a function of soil porosity and storage capacity. Sands and loamy soils absorb water more quickly than clays or rock, but have limited storage capacity. When soil becomes saturated, or rain falls quicker than it can infiltrate, overland flow occurs which can lead to erosion. Vegetation disperses the energy of water before it hits the ground and has the capacity to bind soil, thus stabilising slopes. Vegetation also uses water to maintain physiological functions. Water use by forests varies with forest type and age. For example, a very young forest uses less water than a mature forest, but the greatest demands for water are usually associated with vigorously growing, even-aged juvenile forests.

Human activities can also affect water values through their impact on vegetation cover and the levels of disturbance associated with different patterns, types and intensity of land use. Management arrangements and practices implemented at the local level can also influence *in situ* as well as downstream water characteristics. The relationships between land use and catchment values at the local level are well documented and these are considered in Section 9.5.

At the broader level, catchments in developed or developing areas of the North East have undergone complex landuse or management changes including:

- modification of vegetation cover;

- resource production/extraction activities;
- modification of waterways;
- application of fertilisers, herbicides, pesticides and other chemicals;
- road construction, maintenance and use;
- various forms of recreation; and
- urban and rural residential development.

Although the CRA is concerned largely with public lands, some water storages, including Lake Eildon, Lake Hume and Lake Nillahcootie also draw water from other tenures including private property. Land uses on private property in the North East include agriculture, residential and industrial activities and these have significant implications for water yield and quality. Within forests, recreation, tourism, grazing, extractive (for example, gravel) and other production activities may also impact on water quality and yield.

In general, public land in the North East is concentrated on the Great Dividing Range, coinciding with the upper portions of the drainage basins described below in Table 9.1. Public land accounts for 1 260 700 ha or 54 per cent of the region and over 90 per cent of this area is forested. Of the remaining 1 057 300 ha of private land, approximately 83 per cent is cleared and 177 000 ha, or 17 per cent, is forested. Map 1 shows the land tenures in the region and the detail of public land tenures is provided in Chapter 2 of this report.

While native vegetation has been retained in the mountainous areas to the south and east of the region, clearing has been extensive on the plains to the north-west and along the valleys of major rivers such as the Kiewa and Ovens Rivers. These areas are substantially freehold and land uses include urban/rural residential, industrial, agricultural/horticultural, and extensive plantations.

### Surface Water Resources

The Australian Water Resources Commission (AWRC) has divided Australia into twelve Drainage Divisions which are further sub-divided into river basins. The North East region is almost entirely within the Murray-Darling Drainage Division, and covers sections of seven river basins which are described in Table 9.1.

**Table 9.1: Drainage Basins in North East RFA region**

	<b>AWRC Basin &amp; No.<sup>(a)</sup></b>	<b>Major Rivers in North East<sup>(a)</sup></b>	<b>% in North East<sup>(b)</sup></b>	<b>Land Tenure<sup>(b)</sup></b>	<b>Total Area (ha)<sup>(b)</sup></b>	<b>% Forest Cover<sup>(b)</sup></b>
1	Upper Murray River	Mitta Mitta	71	Public land Freehold Total	69% 31% 709 294	93 23 <b>72</b>
2	Kiewa River	Kiewa	100	Public land Freehold Total	52% 48% 196 051	87 16 <b>53</b>
3	Ovens River	Ovens, King, Buffalo	92	Public land Freehold Total	53% 47% 719 860	96 16 <b>58</b>
4	Broken River	Broken	24	Public land Freehold Total	37% 63% 181 870	96 14 <b>45</b>
5	Goulburn River	Goulburn Howqua, Jamieson Delatite	28	Public land Freehold Total	36% 64% 458 826	90 15 <b>42</b>
24	Mitchell River	Wongungarra, Wonnangatta	9	Public land Freehold Total	100% 0% 51 109	100 0 <b>100</b>
25	Thomson River	Barkly	< 1	Public land Freehold Total	100% 0% 224	100 0 <b>100</b>

Source: a) DWR 1989; b) NRE unpublished data (1998); forest cover is defined as vegetation > 2m height or > 10% crown density.



Only the Kiewa River basin is entirely within the region, while less than one per cent of the Thomson River basin is covered by the North East. The Thomson River basin was covered in detail in the Central Highlands Regional Forest Agreement (VicRFASC 1997b). Approximately nine per cent of the Mitchell River catchment is within the North East region, with all of this area being forested public land. All areas of public land within the North East have high proportions of forest cover although clearing on freehold land has reduced the total forest cover across these catchments (Table 9.1).

Monitoring of stream health through the National River Health Program between 1994 and 1996 indicated that water quality in the upland forested headwaters of streams was of good to excellent quality, while in the lowland cleared to semi-cleared areas, indicators of river health revealed moderate to severe impacts (NRE 1997i).

In general, turbidity levels in the North East are low although measurements have indicated increased levels in rivers and streams in the western part of the region (Lanigan 1998). This trend is reflected across Victoria. The headwaters of rivers and streams in mountainous areas tend to have low turbidity whereas high turbidities usually occur in lowland river reaches (NRE 1997i). In the North East, past mining activities and current agricultural practices, such as access of stock to waterways, have resulted in increased turbidity levels and stream velocities (NECALP 1996).

Increased sediment movement has also increased the transport of nutrients and pesticides attached to soil particles. In the North East, nutrient levels are low to moderate in the mountainous areas although high levels, resulting in algal blooms, have been recorded in water bodies such as Lake Dartmouth, Lake Nillahcootie and Lake William Hovell (Lanigan 1998; GWQWG 1996). Lanigan (1998) found that in the Upper Murray and Kiewa catchments, clearing of native vegetation and various agricultural uses have had an impact on water quality. In general, streams in cleared areas were in a poorer condition than those in vegetated areas.

Estimates of the area, mean annual streamflow and the divertible and developed surface water resource of each of these basins are provided in Table 9.2. The five catchments draining northward cover only 19.3 per cent of the State yet provide 43.2 per cent of the total State mean annual streamflow (DWR 1989) with much of this streamflow utilised outside the catchments. The Upper Murray, Ovens and Kiewa basins contribute approximately 38 per cent of water in the Murray-Darling system while 11 per cent is contributed from the Goulburn - Broken system (GBCALP (1997), NECALP (1997)). The catchments of the North East cover approximately three per cent of the Murray Darling Basin but contribute about 50 per cent of its stream flow.

**Table 9.2: Mean Annual Streamflow of River Basins**

<b>River Basin</b>	<b>Total Area (ha)</b>	<b>Mean annual streamflow (ML)</b>	<b>Divertible resource (ML) <sup>(a)</sup></b>	<b>Developed resource (ML) <sup>(b)</sup></b>
Upper Murray	1 000 000	3 920 000	550 000	4 640
Kiewa	198 500	705 000	350 000	8 950
Ovens	777 841	1 620 000	500 000	100 000
Broken	772 386	325 000	180 000	100 000
Goulburn	1 619 158	3 040 000	1 930 000	1 780 000
Mitchell	544 884	960 000	640 000	18 000

Source: DWR 1989; (a) the divertible resource is the average annual volume of water which could be removed from the water resource on a sustained basis; (b) the developed resource is the proportion of the divertible resource which has already been harnessed to supply water use requirements

Australian rivers and streams have highly variable flows (Table 9.3) with much of the variability being a function of seasonality. Most streams carry the greater proportion of their annual flow in winter and spring. Water storages in the North East, such as Lakes Hume, Dartmouth, and Eildon are used to modify and regulate streamflow in major rivers.

As water storages are used to artificially regulate stream flows, allocations for the use of water are required to make provision for the maintenance of ecological values. Under the *Water Act 1989*, all future water resource developments are required to make provision for the maintenance of environmental flows. These minimum flows, also known as passing flows, are provided along rivers in the North East such as the Goulburn River and Ovens River for maintaining aquatic ecosystems.

**Table 9.3: Mean annual discharge, maximum and minimum daily discharge for selected watercourses in the North East**

Watercourse	Gauging station	Mean daily discharge (ML)	Max daily discharge (ML)	Min. daily discharge (ML)
<b>Upper Murray River Basin</b>				
Mitta Mitta River	Hinnomunjie	1242.2	3790.0	324
Mitta Mitta River	Colemans	3171.0	19331.0	294.0
<b>Kiewa River Basin</b>				
Kiewa River	Mongans Bridge	2195.3	7301.0	538.0
Kiewa River	Kiewa (Main Branch)	2410.8	5299.0	606.0
<b>Ovens River Basin</b>				
Ovens River	Bright	830.4	2479.4	142.0
Ovens River	Myrtleford	2235.6	6480.0	296.0
Rose River	Matong North	203.0	721.0	7.4
King River	Docker Rd Bridge	1786.8	8839.0	144.0
<b>Broken River Basin</b>				
Broken River	Moorngag	199.8	778.0	8.8
<b>Goulburn River Basin</b>				
Delatite River	Tonga Bridge	308.7	895.0	65.6
Goulburn River	Dohertys	880.5	4078.0	136.0
Seven Creeks	Euroa	277.1	1039.0	15.9
<b>Mitchell River Basin</b>				
Wonnangatta	Crooked River	953.0	3643.0	208.0

Source: NRE (1996c)

## Ground Water Resources

The North East region lies predominantly within the Highlands groundwater province and also occupies a small section of the Murray province to the north west. The Highlands are made up of sedimentary basement rock of Palaeozoic age with igneous intrusions, while the Murray province is distinguished by younger unconsolidated Cainozoic sediments that form the plains to the north and west of the region. Sediments also partially fill valleys that dissect the Highlands.

Fractured rock aquifers and alluvial valley aquifers which occur in the North East include:

- shallow aquifers formed mostly from Palaeozoic sedimentary rocks. Granites and associated metamorphic rocks also occur in the Highlands but are restricted to the uppermost 30 - 40 m
- alluvial aquifers on the Kiewa River and other major streams ranging to a depth of 60 - 100 m
- 'shoe string' sand deposits in the silts and clays of the Shepparton Formation near the northern reaches of the Ovens River
- outcropping rock overlain, in valleys in the highlands, by Quaternary alluvial sand and gravel
- the deep Calivil sand aquifer which lies 80 - 100m beneath the Ovens Valley (DWR 1989; LCC 1986).

Aquifers of the Highlands provide baseflow for many upland streams which enable some major rivers to continue flowing throughout the year (Heislars 1993).

In the Highlands, yields of groundwater are relatively low because of the low effective porosity of the rock types. Water quality is fresh with salinity levels generally less than 500 mg/L. However, water quality varies across the region, declining to brackish (salinity 1500 - 5000 mg/L) in the north-west, with areas of localised saline (salinity > 5000 mg/L) groundwater (DWR 1989).

Groundwater is the primary water source for rural water use in the Ovens, Upper Murray and Kiewa river basins in the North East. In the Broken River basin, groundwater is used for irrigation purposes. The majority of groundwater is self-extracted from divertible or minor resources. Towns including Chiltern, Barnawartha, Dinner Plain and Myrtleford are reliant on groundwater supplies.

A number of Groundwater Management Areas (GMA) have recently been delineated where usage is currently close to the Permissible Annual Volume or where there is significant potential for further development of the resource. Two such Groundwater Management Areas exist in the North East. The Mullindoolingong GMA that runs in a narrow strip along the Kiewa River has significant potential for further development while the Murrumbidgee GMA along the Ovens River is fairly intensively managed (Rae Moran pers. comm 1997).

## 9.3 WATER USE AND STORAGE IN THE NORTH EAST

The forested slopes of the Great Dividing Range are an important source of water for use both within and outside the North East region. The streams and catchments of the region also have significant ecological, heritage, tourism and recreation values.

Water derived from the region is primarily used for domestic, industrial, agriculture, irrigation and recreation purposes, and for maintaining stream environments. A large proportion of the water is utilised by irrigation districts to the west of the region. Storages in the region, including Lakes Eildon, Hume and Dartmouth, have a combined capacity of over ten million megalitres of water. Major water storages constructed in the catchments of the North East are listed in Table 9.4 and are shown on Map 9.

**Table 9.4: Major surface water storages in the North East**

River Basin	Storage	Capacity (ML)	Primary Purpose
Upper Murray	Lake Hume	3 038 000	hydro-electricity, irrigation
	Lake Dartmouth	4 000 000	
Kiewa	Rocky Valley and Pretty Valley Dams	28 400	hydro-electricity
Ovens	Lake Buffalo	24 000	irrigation, urban
	Lake William Hovell	13 500	
Broken	Lake Nillahcootie	40 000	urban
Goulburn	Lake Eildon	3 390 000	irrigation, flood mitigation

Source: DWR 1989, LCC 1991

The relative amounts of water used for different purposes are shown in Table 9.5. Large urban consumption centres in the North East are Wodonga, Wangaratta and Benalla. Much of the water used across the North East is surface water, however localised groundwater resources are important in rural areas.

**Table 9.5: Water use within river basins in the North East**

River Basin	Urban and Industrial (ML)	Rural (ML)	Irrigation (ML)	Total Use (ML)
Upper Murray	1 140	130	3 560	4 830
Kiewa	6 410	560	6 190	13 160
Ovens	9 670	3 450	16 460	29 580
Broken	28 560	31 160	741 804	801 524
Goulburn	14 920	26 760	739 020	780 700
Mitchell	3 000	1 060	11 000	15 060

Source: DWR 1989

The Upper Murray basin produces 17.5 per cent of Victoria's mean annual streamflow (DWR 1989), yet little of this is used within the basin itself. It also receives water which is diverted from New South Wales through the Snowy Mountains hydro-electric scheme. Much of the streamflow is held in storage in Lake Hume or Lake Dartmouth, or is used for irrigation downstream in the Goulburn-Murray, Robinvale and Mildura Irrigation Districts. Irrigation is also the main use of water from the Goulburn River and Broken River basins. Lake Eildon, the major water storage in the Goulburn River basin, is located in the North East and Central Highlands RFA regions. It supplies more than half the water used in the Goulburn Murray Irrigation District (DWR 1989).

Each of the river basins in the North East imports surface water from the Murray River, mainly for irrigation use. It is a relatively small proportion of total water used in most catchments other than the Broken River basin, which imports 505 000 ML from the Murray River and 236 000 ML from Lake Eildon, mostly for irrigation and rural use in the region.

Water in the North East is used to irrigate pastures, mostly for dairy cattle, and crops including tobacco and hops, vineyards and horticulture.

A number of hydro-electric schemes operate in the North East and are situated on the Upper Kiewa River, Lake Dartmouth, Lake Hume and Lake William Hovell. These schemes are dependent on water from the forested Upper Kiewa, King and Hume Catchments. The Rocky Valley storage and associated power stations on the Kiewa River provides 300 GWatt hours per year and is an important producer of peak load power (DWR 1989).

Many of the forested catchments of the North East also provide for a diverse range of water-based and water-enhanced recreational activities in State forest and parks and reserves. Popular activities include fishing, canoeing/rafting, boating, water skiing, swimming, and associated activities such as camping and nature observation.

Over 500 000 people use the lakes and rivers in the North East each year for recreation purposes, particularly along the Murray River. Other popular destinations include Lakes Eildon, Dartmouth and Hume, and the Ovens River and Yackandandah Creek for camping, fishing and boating. Further discussion of tourism and recreation is included in Chapter 8.

## 9.4 LEGISLATIVE AND POLICY FRAMEWORK

### Commonwealth Policies and Initiatives

Under the Australian constitution, responsibility for water resource planning and management lies with the State and Territory Governments. The Commonwealth Government has a complementary role in natural resource management. This relationship is best demonstrated in the Council of Australian Government (COAG) Water Reform Framework.

#### *COAG water reform framework*

In 1994, COAG agreed to a strategic framework for water reform in Australia. This framework has a key role in improving the sustainability of natural resource use, achieving better environmental outcomes and contributing to the overall micro-economic reform agenda. In the case of rural water services, the framework is intended to generate the funds to maintain supply systems and through a system of tradeable entitlements, to allow water to flow to higher value uses subject to social, physical and environmental constraints.

The key elements of the framework are:

- pricing reform;
- clarification of property rights;
- allocation of water to the environment;
- adoption of trading arrangements in water;
- institutional reform; and
- public consultation and participation.

The framework also includes the adoption of an integrated catchment management approach to water resource management.

It is intended that the State and Territory Governments will have implemented the framework by 2001 with property rights in place (including environmental allocations) and water trading occurring no

later than 1998. Implementation will be measured progressively by determining whether or not milestones have been met by the States. The implementation of the framework is linked to payments to State and Territory Governments by the Commonwealth Government that will be made available under the Competition Principles Agreement (COAG 1994).

Each State and Territory is currently in the process of developing approaches to implement the framework. This has been assisted by the work of the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) and the Australian and New Zealand Environment and Conservation Council (ANZECC). ARMCANZ developed a paper entitled 'Water Allocations and Entitlements - A National Framework for the Implementation of Property Rights in Water' (ARMCANZ 1995) and ARMCANZ and ANZECC developed the 'National Principles for the Provision of Water for Ecosystems'.

### ***National Water Quality Management Strategy (NWQMS)***

The NWQMS has been developed since 1992 and consists of a number of separate documents that outline national approaches and guidelines for different water qualities. The objective of the NWQMS is to achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development. The NWQMS provides for a nationally consistent approach to water quality management through the co-operative development of guidelines. These guidelines promote a shared national objective while allowing flexibility to respond to regional and local differences.

One of the guiding principles of the Strategy is the adoption of an integrated approach to water quality management. Such an integrated approach to resource management includes:

- a holistic approach to natural resource management within catchments, marine waters and aquifers with water quality considered in relation to land use and other natural resources;
- co-ordination of all the agencies, levels of government and interest groups within the catchment;
- community consultation and participation (ARMCANZ/ANZECC 1995).

As part of the NWQMS, guidelines have been developed for Fresh and Marine Waters which collate available scientific information to recommend water quality guidelines for aquatic ecosystems; drinking water; recreational water; industrial and agricultural water (ANZECC 1992).

### ***National River Health Program (NRHP)***

The objective of the NRHP is to improve the management of Australia's river systems through improved information bases on the state of rivers (PMSEC 1996). The NRHP was primarily established to implement the Monitoring River Health Initiative that aims to develop a national approach to river health monitoring. Under this program, the Australian Rivers Assessment Scheme (AUSRIVAS) has developed a number of predictive models to evaluate and report on river health. Another major component of the NRHP is developing means of assessing the water requirements that are necessary to maintain a healthy functioning river ecosystem (NRHP 1993).

### ***National Rivercare Initiative***

The proposed National Rivercare Initiative will build on existing programs to help ensure the sustainable management, rehabilitation and conservation of rivers outside the Murray-Darling Basin. It is intended that the Initiative will provide financial assistance for catchment management planning and implementation. Local communities will be encouraged to develop catchment and sub-catchment management plans to ensure water resources are managed sustainably according to local goals that are consistent with NWQMS guidelines (PMSEC 1996).

### ***Murray - Darling Basin Commission***

Established in 1985, the Murray Darling Basin Ministerial Council co-ordinates land management within the basin. The Council consists of representatives from all governments covered by the Murray Darling Basin, including the Commonwealth Government, and provides a strategic focus for planning and management for the sustainable use of the basin's natural resources. Since 1985, the Council has put in place a wide range of initiatives through its executive arm, the Murray-Darling Basin Commission (MDBC). The Commission is involved in the following initiatives:

- the implementation of a broadly based Natural Resource Management Strategy (NRMS) that includes a significant level of support for community-based works and measures;
- an ongoing program of investigations and the construction of salt interception schemes under the Salinity and Drainage Strategy;
- a coordinated Drainage Program of joint government and community works and measures to combat land salinisation and waterlogging;
- the regulation of the River Murray to distribute water to New South Wales, Victoria and South Australia;
- the ongoing community consultation activities of the Community Advisory Committee; and
- cooperative education and information programs throughout the basin.

Objectives of the NRMS are implemented by several national and State strategies including the National River Health Program, National Water Quality Monitoring Strategy and the Victorian Nutrient Management Strategy.

In June 1995, the MDBC decided a 'cap' had to be set on water usage across the whole Basin to prevent water usage becoming unsustainable. This cap sets physical limitations on the use of water and is the 'volume of water that would have been diverted under 1993/94 levels of development' (MVEC 1997). A single cap exists for all of Victoria's Murray use and is currently 1 621 GL per annum on average.

### **Victorian Policies, Legislation and Initiatives**

Victorian State Government Policy, as reflected in recent initiatives and legislation, emphasises that land and water are inseparable and, consequently, the State Government has directed public authorities to aim for stable, well managed systems which will protect and not damage rivers and their environments. State Government policy to protect water quality is implemented through a range of policy and legislative mechanisms, including:

- *Water Act 1989*;
- *Catchment and Land Protection Act 1994*;
- State Environment Protection Policies declared under the *Environment Protection Act 1970*;
- *Environment Conservation Council Act 1997*;
- the former *Land Conservation Act 1970*;
- Management Planning, Code of Forest Practices for Timber Production and Regional Prescriptions enacted under the provisions of the *Forests Act 1958* and the *Conservation, Forests and Lands Act 1987*; and
- Management planning under the provisions of the *National Parks Act 1975*.

### ***Provisions of the Water Act 1989***

Water Authorities and River Management Authorities were appointed for catchments under the provisions of the Water Act. The general objectives of Water Authorities are related to the management of the major water systems, the provision of bulk supplies to (Non-Metropolitan) Urban and Rural Water Authorities, and delivery of irrigation water, domestic and stock supplies, and drainage services. Through amendments to the Catchment and Land Protection Act in 1997, River and other waterway Management Authorities no longer exist as separate statutory bodies.

The *Water Act 1989* establishes a system of allocating the available water resource outside the Melbourne Metropolitan Area and provides for the integrated and sustainable management of water resources across the State. The Act sets up a system of well-defined rights which partitions the water available to each consumptive user and to the environment. The Act allows for these rights to be traded amongst water authorities.

The Act provides for entitlements, known as 'bulk entitlements', to be granted to water authorities, other public bodies and the environment. Furthermore, it provides for the rights which are allocated from the bulk entitlement to an authority to be passed on to private individuals or the environment. These allocations for example may be a licence to take and use water from a waterway or groundwater.

Bulk water entitlements are currently being established in the North East. Victoria has made some progress in meeting the COAG reforms in relation to clarification of property rights by formalising existing bulk water entitlements (both consumptive and environmental). The bulk water entitlement conversion process is based on recognition of existing infrastructure, and community investment, of each water supply system. In many systems this may result in bulk entitlements being issued for greater volume than is currently used. Under these arrangements there is the potential for the environment to suffer and so Victoria has established an environmental review panel to assess the likely impact on downstream flow and review storage operation to identify opportunities for increased environmental flows (Allan and Lovett 1996).

In the North East, this water allocation process was completed in 1995 for the Goulburn system, which represents one third of Victoria's water usage (MVEC 1997). The Upper Murray, Kiewa and Ovens River basins will be considered as part of the Murray system, which represents another third of Victoria's usage. Allocations for this system should be completed by the end of 1998 (Rae Moran pers comm 1998).

#### ***The Catchment and Land Protection Act 1994***

Catchment Management Authorities (CMA) were established under the *Catchment and Land Protection Act 1994* and take on the roles of the Catchment and Land Protection Boards, River Management Authorities and other waterway management groups. The North East is covered by three CMAs - Goulburn Broken, North East and East Gippsland. The major task of these CMAs is the implementation of regional catchment strategies (GBCALP 1997; EGCALP 1997; NECALP 1997). The objectives in implementing the regional catchment strategies include the maintenance and improvement of the quality of water and condition of rivers, and conservation and protection of the diversity and extent of natural ecosystems.

Land managers are required to have regard to any regional catchment strategy applying to the land.

Areas within catchments warranting particular attention, such as areas required for water supply, can be declared Special Areas by CMAs under the *Catchment and Land Protection Act*. In the North East RFA region, there are 21 Special Areas classified as Special Water Supply Catchments (Table 9.6). These areas were formerly called Proclaimed Water Supply Catchments under the now repealed *Soil Conservation and Land Utilisation Act 1958*. Special Water Supply Catchment Areas are identified because of their significance as a source of water.

Under the Act, Special Area Plans, which can be prepared for declared areas, specify how particular land management issues in the special areas will be addressed. Land Use Determinations previously prepared for proclaimed water supply catchments are now regarded as Special Area Plans under the *Catchment and Land Protection Act*.

Land managers, including NRE, must have regard to any Special Area Plan applying to land under its control. Special Area Plans within the North East place specific requirements on forest management including seasonal restrictions on harvesting in particular areas, and restrictions on the level, type and location of activities including recreation and extractives. The Ryans Creek Water Supply Catchment provides an example of this form of management arrangement. In this area, provisions have been set



out in a Special Area Plan (Tonkin 1986) relating to modified timber harvesting practices and slope limitations in the protective zone surrounding Ryans Creek and associated water storages, and the development of recreational facilities within the catchment.

**Table 9.6: Special Water Supply Catchment Areas in the North East**

Name of Catchment	Area (km <sup>2</sup> )	For the protection of:	Special Area Plan	Slope (°)	Seasonal Closure	Stream Buffers	Filter Strips
Bakers Gully (Bright)	7	Town Water					
Barambogie Creek (Chiltern)	11	Town Water					
Buckland River	322	Town Water					
Buffalo River (Lake Buffalo)	1150	Irrigation Town Water					
Diddah Diddah Creek (Springhurst)	11	Town Water					
Fifteen Mile Creek (Glenrowan)	310	Town Water Irrigation Stock, Domestic					
Honeysuckle Creek (Violet Town)	25	Town Water					
King River (Lake William Hovell)	332	Irrigation					
Lake Hume (Northern Section)	6902	Town Water Irrigation	Yes	18 <sup>a</sup>			
Lake Hume	10062	Irrigation			1 July - 30 Sept.		
Lake Nillahcootie	413	Irrigation, Stock, Domestic			1 June - 31 Oct.		
Lake Eildon (environs)	868	Irrigation	Yes				
Mitchell River (part)	3900						
Nine Mile Creek (Longwood)	4	Town Water					
Nine Mile, Clear and Hurdle Creeks (Beechworth & Yackandandah)	63	Town Water					
Ovens River (Bright)	350	Town Water					
Ovens River (Wangaratta)	3070	Town Water					
Ryans Creek	77	Town Water Industrial	Yes	12 <sup>b</sup>	1 Mar - 31 Oct <sup>b</sup> 1 May - 31 Oct. <sup>c</sup>	100 <sup>d</sup> 40 <sup>e</sup> 20 <sup>f</sup>	
Seven Creeks and Mountain Hut Creek (Euroa)	191	Town Water					
Upper Goulburn	2836	Irrigation			1 June - 31 Oct.		
Upper Goulburn (Upper Delatite)	242	Town Water	Yes		1 June - 31 Oct.		
Upper Kiewa	409	Hydroelectricity					
Upper Kiewa (East Kiewa U2)	17	Hydroelectricity Town Water	Yes	30 25 <sup>g</sup>	-	40 <sup>h</sup> 20	-

Source: *Catchment and Land Protection Act 1994*; DWR 1989; a) applying to pasture establishment, pine plantation establishment or any other purpose, but excluding forest operations carried out under management prescriptions approved by the Soil Conservation Authority (SCA) b) protective zone; c) Utilisation zone; d) full supply of Loombah Weir, Lake McCall-Say or Ryans Creek to junction with Cherry Tree Creek; e) other streams and watercourses on plan No S-085; f) other watercourses and streams within catchment; g) forest operations be generally restricted to below 25° slope within the fall into the domestic water supply portion of the Bald Hill Creek Catchment; h) Bald Hill Creek

The Code of Forest Practices for Timber Production (Code) requires that water quality and yield are protected in water supply catchments. These requirements are discussed in more detail in Section 9.5. Where Special Area Plans do not exist or specify minimum standards, the Code or local prescriptions provide minimum requirements for seasonal closures, stream buffers, filter strips and slope limitations. Minimum widths for stream buffers and filter strips are a function of the soil type, stream class and slope, and can vary from 10 to 40 metres depending on soil permeability and potential for overland flow.

### ***Land Conservation Council (LCC) Recommendations***

The *Environment Conservation Council Act 1997* came into operation on 1 July 1997. This Act established the Environment Conservation Council, revoked the *Land Conservation Act 1970*, and replaced the Land Conservation Council. Previous recommendations made by the LCC have continuing operation.

### ***1981, 1983 & 1986 Land Use Recommendations***

Under the *Land Conservation Act 1970*, the LCC completed reviews of public land use in the North East area. The most recent land use recommendations were completed in three stages (LCC 1981, LCC 1983 & LCC 1986), and Statewide Special Investigations into both Wilderness, and Rivers and Streams were completed in 1991.

The LCC recommended that a range of public land tenures, namely State forest, National Parks and State Parks, within the North East also be used for water supply and to protect stream and water catchments. No catchment in the North East is used solely for water production, although restrictions can limit the type of activity permitted. Restrictions exist in the Upper Kiewa catchment where water is used in the Kiewa hydro-electric scheme and relate to vehicular use, camping and lighting of fires (LCC 1983).

In 1981, the LCC was directed to investigate the use of public lands to fulfil the Government's objective for softwood establishment. The LCC recognised the importance of maintaining water quality and quantity particularly in domestic water supply catchments for example, the Fifteen Mile Creek catchment. General planning guidelines for plantation management related to slope restrictions and stream buffers were proposed and specific recommendations were made for the Boggy Creek catchment in order to protect water catchment values (LCC 1981).

### ***Upper Kiewa Catchment Management Agreement***

As part of the Alpine Area Special Investigation (LCC 1983), the LCC recommended that hydroelectricity production in the Upper Kiewa catchment should continue. The Council also recommended that plans and policies for this land should be reached through agreement between all agencies involved in management of the catchment.

With the sale of the hydro-electric scheme infrastructure in 1997, a formal agreement and lease arrangement was entered into by the Victorian Government and the new owners. Further details on this agreement are included in the relevant sections of the National Parks Act.

### ***1991 Rivers and Streams Special Investigation***

In recognising the diverse values of streams and water catchments within North East, the LCC made specific recommendations for the protection of Heritage Rivers, 'Essentially Natural Catchments', River Zones in State forests and Natural Feature Reserves (i.e. Public Land Water Frontage reserves passing through freehold and public land Streamside Reserves).

Heritage Rivers were identified in the LCC's Statewide investigation into Rivers and Streams (LCC 1991) in which the Council was required to 'carry out an investigation of the scenic, recreational, cultural and ecological values of rivers and streams in Victoria, and to make recommendations on the use of these rivers and how their identified values can best be protected.' Recommendations for the management of heritage rivers included:

- protection of the specified values;
- provision of a range of recreational activities;
- structural barriers or impoundments that impede flow or the passage of in-stream fauna should not be constructed;
- establishment and maintenance of appropriate environmental flows;
- timber harvesting should not be permitted except where specified. Timber harvesting is allowed in the Howqua River Heritage Area, where land status permits, subject to the Code of Forest Practices for Timber Production and local prescriptions providing for a buffer around recreation routes and destinations.
- strict controls on grazing;
- road construction should minimise on-site sediment losses to the stream network; and
- controls on the location of new roads and bridges relative to watercourses.

In the North East, the corridors of the Howqua and Goulburn Rivers have been designated as Heritage Rivers and are protected under the *Heritage Rivers Act 1992*, which implements the LCC recommendations described above.

Those catchments which have not been subject to physical or biological processes which leave the environment impaired or changed have been designated as Essentially Natural Catchments. In the North East, eight catchments were identified and recommended as Essentially Natural Catchments: Log Bridge Creek (East Branch), Mt Tabor Creek, Banimboola Creek, Devils Creek (Middle Branch), Yarrarabula Creek, Long Jack Creek, Williams Creek and the Wongungarra River Headwaters. These areas are to be managed with little or no modification or disturbance to the environment in accordance with the Heritage Rivers Act. However, they are to be available for water production, education and existing recreational activities.

The Heritage Rivers Act overlays but does not change existing land tenure, however it may require changed management objectives to achieve protection of special values. Draft management plans, for heritage rivers and natural catchments in the North East were released for comment in November 1997 (NRE 1997h). These plans were prepared by the Department of Natural Resources and Environment as the principal land manager in these areas in conjunction with Catchment Management and other waterway Authorities.

Representative Rivers have also been recommended by the LCC (LCC 1991a) as a part of this investigation. These rivers contain significant natural or scenic values and are representative of distinct river-catchment types found across Victoria. There are two rivers designated as Representative Rivers in the North East, - the Upper Big River (above Glen Valley) and Snowy Creek. The primary aims for the protection of these Representative Rivers is to maintain examples of these river types and thus to avoid or prevent modification to their geomorphological and hydrological attributes (LCC 1991a).

### **State Environment Protection Policy - *Environment Protection Act 1970***

The *Environment Protection Act 1970* provides for the declaration of State Environment Protection Policies (SEPP) for defined areas in order to maintain environmental quality sufficient to protect existing and anticipated beneficial uses. State Environment Protection Plans relevant to the North East include:

- State Environment Protection Policy (Waters of Victoria) 1988. This SEPP applies to surface waters throughout the State except when varied by separate SEPP's for specific areas. There are currently no specified schedules for rivers in the North East;
- Draft SEPP (Groundwaters of Victoria).

Each of these documents sets out the beneficial use to be protected, objectives for various water quality indicators and a program for attaining these objectives.

### **Controls enacted under the *Forests Act 1958***

The Timber Industry Strategy (Victoria Government 1986) cites “ensuring the sustained capability of forests to maintain and enhance water quality and yield” as one of six objectives for environmental management. It also indicates that priority will be given to water production in those catchments with limited stream flows that service regions with high current or potential water demand. The strategy for achieving this water quality and yield objective includes undertaking land capability assessments to delineate hazardous areas; preparing appropriately detailed codes of practice/prescriptions to set required standards; and, monitoring adherence to standards, together with periodic re-evaluation of the standards themselves. To maintain or enhance yield, the forest age class distribution, forest structure and rotation lengths may be manipulated.

The implementation of management arrangements under the *Forests Act* are considered in Section 9.5. These include provisions of the Code of Forest Practices for Timber Production, forest management plans and local harvesting prescriptions.

### **Provisions of the *National Parks Act 1975***

National Parks and State Parks are managed in accordance with the *National Parks Act 1975*. In 1989, the Act was amended to allow for existing operations related to the Kiewa Hydro-electric Scheme in the Alpine National Park at Kiewa.

Under the Act, a company associated with the electricity industry may:

- occupy and utilise works required for the operation and maintenance of the hydro-electric undertaking;
- perform functions and exercise powers which relate to the undertaking and to the protection of the quality, quantity and availability of water produced for the requirements of the undertaking; and
- plan fire protection works (including construction of vehicular tracks) to protect works required for the undertaking in consultation with NRE.

Following amendments in 1995, the Minister may grant or renew a lease or licence to a generation company for any area of land in the Alpine National Park to be used for the purposes of generating electricity for supply or sale.

The Minister may also enter into an agreement with a generation company related to the management or control, or the carrying out activities, functions and controls in, any area of the park that is used for the purposes of or in connection with the generation of electricity. This written agreement must contain provisions with respect to the protection and conservation of the land subject to the agreement.

In December 1997, Southern Hydro, the successor to the State Electricity Commission (SEC) and involved in the management of the Kiewa Hydro-electric Scheme, was sold to a private partnership. A lease covering the power stations and hydro-electric infrastructure within the Alpine National Park, State forest and Crown land was executed on this date, for a term of 99 years.

A Catchment Management Agreement covering the operational responsibilities of both parties within the Kiewa River catchment on public land was also executed at the time of sale. This agreement includes all National Park, State forest, and Crown land within the catchment. It provides surety to a private operator that land management activities undertaken by NRE will continue to protect the hydro scheme, and similarly that a new operator will protect public land values. The Agreement incorporates an existing Timber Harvesting Agreement, of 15 April 1992, between the SEC and the former Department of Conservation and Environment which provides for harvesting in a particular part of the East Kiewa catchment, adjacent to Lake Guy storage.

A similar lease and Catchment Management Agreement covers the Falls Creek Alpine Resort which also lies within the Kiewa River catchment.

### **Victorian Water Quality Monitoring**

There are two major Statewide environmental water quality monitoring programs in Victoria:

- the Victorian Water Quality Monitoring Network (VWQMN), managed by the Department of Natural Resources and Environment; and
- a network of fixed sites run and funded by the Environment Protection Authority (EPA).

Under these programs, physico-chemical, biological and salinity monitoring is undertaken at a number of sites across Victoria. The water quality monitoring and reporting arrangements were reviewed in 1991 and 1996 resulting in proposed extensions to the Statewide coverage of the VWQMN and changes in the parameters monitored. The VWQMN currently monitors water quality and algae in rivers and streams, lakes and wetlands across Victoria.

Extensive and intensive regional water quality monitoring programs are also conducted by the Murray Darling Basin Commission, along sections of the Murray River and its major tributaries, and as part of the Major Storages Operational Monitoring Program. Water Authorities may also undertake water quality monitoring within their boundaries.

## **9.5 ISSUES FOR WATER MANAGEMENT**

The major issues for water management are related to the quality and quantity of water. As discussed earlier, many water quality issues are related to land tenure, as this is a major determinant of the condition and level of disturbance as well as the use of the land, which largely determines the access and management arrangements applicable to an area.

### **Water Quality and Quantity**

The physical, chemical and biological characteristics of water determine its quality. A significant loss of quality can have a deleterious effect on aquatic ecosystems and the value of the resource for a range of human uses. Catchment conditions and water quality are closely linked. Undisturbed and forested catchments generally ensure high water quality while, in contrast, agricultural and urban environments are often associated with lower water quality. As a result, some domestic water supplies in the North East require treatment to ensure that water quality is suitable for domestic consumption. Land use practices resulting in erosion and the transport of nutrients, as well as urban runoff and point discharges of pollutants, are major causes of poor water quality in streams.

Water quality issues in some areas of the North East include nutrient enrichment, sedimentation, eutrophication and turbidity of surface waters. In general, water quality is very good within the forested areas of the North East (DWR 1989; NECALP 1997). However, there is a trend for water quality to deteriorate in the lower catchments in the North East in response to land uses in non-forested areas (DWR 1989).

Recreational activities can adversely affect water quality where activities, such as camping and recreational vehicle use, results in significant soil compaction, erosion or bacteriological contamination of surface water. A reduction in water quality through erosion of roads and tracks attributable to forest activities and recreational vehicle use has been identified within some areas in the North East, though this is not widespread.

Water quantity (including quantity of surface and groundwater available) is influenced by a range of land use activities occurring in a catchment, and is therefore an important consideration in forest management. The potential for forest management activities to impact water quality and water quantity, and aquatic values is well recognised, and a large amount of information has been compiled

on this subject both in Australia and overseas. The following sections outline research and management arrangements relating to water quality and quantity.

### ***Research on water quality and yield***

Two longer-term forest hydrology studies have been conducted in the North East - the Cropper Creek Project and the East Kiewa Project. Data from the East Kiewa Project indicates that streamflows and sediment concentrations increase in response to harvesting. However, results from this study are qualified by inadequacies in the sampling of sediments and the effects of a relatively dry period during part of the study. Results from the Cropper Creek study indicate that water quality is high in forested catchments; a change from eucalypt forest to Radiata Pine plantation has no great effect on water use; and that roads produce significantly higher volumes of stormflow compared to undisturbed areas from low and medium rainfall events (O'Shaughnessy and Bren 1998). Comparisons of data from the Cropper Creek Project with similar catchments indicate that results are generally applicable to the North East region.

Much research on water quality and yield has been undertaken in forested catchments of the adjoining Central Highlands region given the importance of these catchments to Melbourne's water supply. About half of Melbourne's forested water supply catchments are covered by ash-type forests, with the remainder covered by mixed species eucalypt forest. The ash-type forests yield 70-80 per cent of Melbourne's water and, therefore, most catchment research has concentrated on the ash forests. Results from this research are relevant to ash-type forests in the North East and more generally to other forest types.

In the Central Highlands, catchment experiments have been established in both mature and regrowth dominated catchments. Studies have included the affects of fog drip, canopy interception, soil moisture depletion, transpiration and plant water relations on water yields in Mountain Ash. This research has also investigated the effects on water yield of:

- the conversion of old forest to regrowth stands, through wildfire and clearfelling;
- the selective cutting of mature stands;
- thinning in regrowth stands; and
- initial stand stocking at the time of regeneration.

Furthermore, aspects of water quality have been investigated through studies on:

- fuel reduction burning;
- wildfire; and
- the effect of traffic patterns and road maintenance procedures on the generation of silt from un-surfaced roads (O'Shaughnessy and Jayasuriya 1987).

The effects of 'best practice' forest harvesting and regeneration operations on water yield and water quality were investigated in the Corranderrk Experiment, which involved a comparative study based on analyses of long term base data, a control catchment, and two roaded and logged catchments. One of the logged catchments was clearfelled and regenerated and the other was selectively felled (O'Shaughnessy and Jayasuriya 1991). The results to date indicate that water yield in the selectively felled catchment declined less than in the clearfelled area. However, the more intensive road network of the selectively felled catchment affected water quality for ten years, compared with 5 years for the clearfelled catchment (Langford *et al.* 1982).

The hydrology of 1939 regrowth ash forests has been studied using fifteen catchments receiving various treatments since 1969 as part of the North Maroondah Experiments. These treatments include:

- **Thinning** - a 54 per cent patch cut and a 50 per cent uniform thinning increased streamflows by about 20 per cent over 12 years, with the 50 per cent thinning being more persistent. The thinned forest maintained its annual growth rate because the remaining trees grew faster (O'Shaughnessy and Jayasuriya 1991).

- **Clear felling and regeneration** - at densities of 500, 2 000 and 20 000 trees per hectare. Monitoring of the effects on streamflow is continuing, but a longer data run is required before conclusions can be drawn (O'Shaughnessy and Jayasuriya 1991).
- **Strip thinning** - alternate 35 m wide strips cut along the contour have increased streamflow by 20 - 25 per cent (O'Shaughnessy and Jayasuriya 1991, O'Shaughnessy *et al* 1993). Overall reduction in annual growth rate by ~40 per cent has occurred because growth response to thinning has been restricted to the boundaries of the retained strips (O'Shaughnessy and Jayasuriya 1991).

A study by Grayson *et al.* (1993) in catchments in the Central Highlands concluded that the impact of well supervised timber harvesting on water quality is small. They noted that the suspension of logging during wet weather, the use of buffer strips, and the management of runoff from roads, snig tracks and log landings, eliminated contaminated runoff into streams. O'Shaughnessy (1995) noted that roads and tracks may present a greater hazard than timber harvesting with regard to sedimentation of streams. The research by Grayson *et al.* (1993) and work by Haydon *et al.* (1991) suggests that there is a positive relationship between the frequency of road use and the production of *coarse* sediment and total sediments. This highlights the need for high standards of road construction and management to help prevent the entry of runoff into streams (Haydon *et al* 1991).

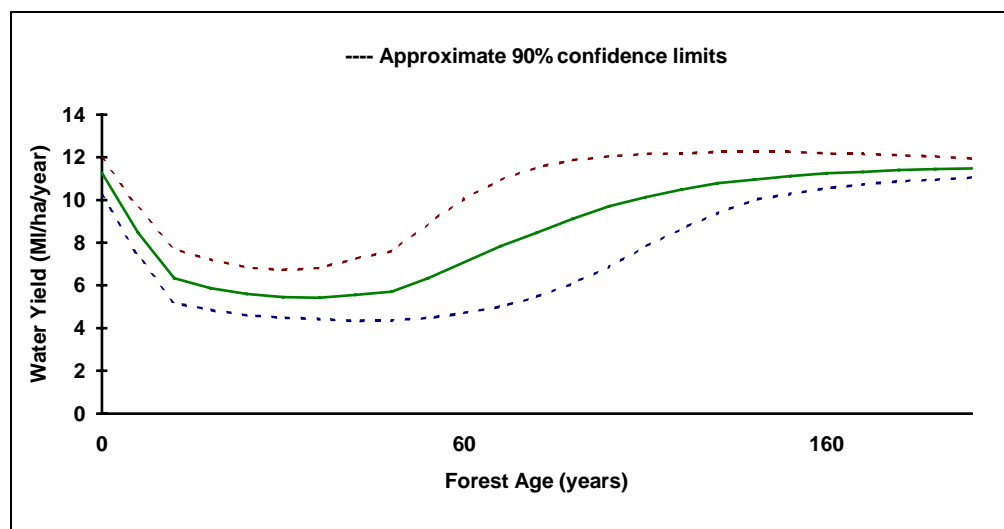
Dargavel *et al.* (1995) also discussed the impact of timber harvesting and roads on water quality. Based on local and overseas studies, they concluded that avoiding direct stream disturbance and preventing turbid inflows provided a high level of protection. Dargavel *et al.* (1995) highlighted the importance of developing standards, and the application and monitoring of these in forest management. These include the application of codes to road construction and maintenance.

The literature demonstrates that different silvicultural systems have different impacts on water yield and quality within the harvesting areas, but that the greater impacts are caused by associated infrastructure and roading. In clearfelling operations, for example, much of the road network can be closed and revegetated after harvesting, whereas the alternative selection systems might require more regular access, hence the need to maintain the road network (O'Shaughnessy and Jayasuriya 1987). In this sense, alternative silvicultural systems may generate higher sediment loads in comparison with clear felling systems.

Hydrological research in the Central Highlands also indicates that large-scale regeneration or reforestation activities following timber harvesting or wildfire may reduce long term water yields in Ash forests (Kuczera 1985), as young, fast growing forests use more water. A significant reduction in water yield has the potential to adversely affect aquatic values and may also necessitate additional water storage capacity to maintain domestic and irrigation water supplies.

In a study of water yields of regenerating Ash forests following the 1939 bushfires, Kuczera (1985) established a model for predicting changes in water yield following wildfire. The model indicates that immediately following wildfire there is an initial increase in water yield due to increased surface runoff and groundwater flows. As the forest regenerates, water yield decreases to a minimum of about half the original yields at 20-30 years, and then steadily increases to pre-fire yields at around 150 years (Figure 9.1). This relationship between forest age and water yield in Ash forest also applies to areas subjected to clearfelling, which can be considered as a silvicultural replication of wildfire disturbance. Kuczera (1985) also showed that for every one per cent of mature forest converted to regrowth, a decline of 6 mm in annual water yield could be expected some 30 years later. The model has wide confidence limits, particularly for forests aged between 50 and 120 years, and Kuczera (1985) indicated that another 30-40 years of data are required for validation of the model.

**Figure 9.1: Relationship between forest age and water yield in Ash forests of the Central Highlands**



Source: Abbott *et al.* 1993

Monitoring of sub-catchments under controlled conditions has shown the effects of clearfelling/regeneration in the Melbourne Water experimental catchments to be broadly consistent with the Kuczera model. In the Piccaninny catchment, a decline in water yield to 50 per cent of the pre-treatment level has been recorded in response to clearfelling and regeneration of 80 per cent of the catchment. Similarly, harvesting and regeneration of Alpine Ash in the West Kiewa River catchment in the North East, between 1960 and 1982, led to a reduction in streamflow that approximated predictions made by Kuczera's model (Lawrence 1990 in O'Shaughnessy and Bren 1998).

The effects of timber harvesting and wildfire on water yield in mixed species forests are less well understood. Read Sturgess and Associates (1994) in a study of the Thomson catchment noted that water yields from mixed species forests are much lower than in ash forests because these forests grow in areas with lower rainfall and have higher evapotranspiration rates. Mixed species forests are generally found in the more exposed, lower elevation areas, and on northern and western slopes at higher elevations, where fire occurs more frequently, but at lower intensity than in ash. Consequently, mixed species forests are dominated by fire resistant eucalypts, such as the stringybarks and peppermints. They are capable of recovering from low and medium intensity fire disturbance and are usually of mixed age, with fewer areas of regrowth forest created after a given disturbance event (Kuczera 1985).

Accordingly, fire may not have as significant an effect on the water yield in these forests as in ash type forests. There are no recent long term catchment results available for mixed species forests on the eastern seaboard that indicate the effects of clear felling and regeneration on streamflows (Dargavel *et al.* 1995). However, following clearfelling of mixed species forest in the Reefton experiment in the Central Highlands, Nandakumar and Mein (1993) estimated that a reduction of 10 per cent in the catchment forest cover, led to a corresponding 33 mm increase in runoff. Water yields peaked 2 to 3 years after the clearing and then declined to pre-treatment levels after 5 to 8 years. These results should be regarded as preliminary at this stage.

Other research which addresses water yields and silvicultural practices in mixed species forest has produced variable results. The yields from these forests, according to Moran (1988), vary considerably depending on the location and vigour of stands and possibly the forest age, with little or no change in catchment yield with age in the drier forests and changes similar to low rainfall ash forests in the



wetter areas. O'Shaughnessy *et al* (1995) showed that in the Lerderderg mixed species forest there was no statistical long term effect on water yield, after logging sixteen per cent of an area. However, work by Cornish (1993) in high rainfall (non-ash) forests of Karuah in northern NSW has shown a similar response to Victorian ash forest over the six years since harvesting. In response to these disparate results, Dargavel *et al* (1995) recommended that further research was required into the hydrological responses in mixed species forests.

### Forest Management Arrangements

On State forest, water quality is protected through a range of techniques that limit the opportunities for soil or high energy water to flow directly into drainage lines. Forest operations in the North East region are regulated in accordance with the Code of Forest Practices for Timber Production (NRE 1996a) and local prescriptions which provide for the protection of filter strips and buffers on drainage lines and streams, and sets limitations on timber harvesting operations in steep terrain. Standards for the design, construction and maintenance of roads consider soil properties and their management to protect water quality. Timber harvesting and road use are constrained seasonally in response to weather conditions through the application of road closures and harvesting restrictions to minimise adverse effects on water resources.

The Code provides the basis for detailed harvesting prescriptions and the preparation of individual coupe plans, taking account of local conditions such as soil type, rainfall and the type of harvesting operations. *Minimum* standards are provided as guidelines, but these may be increased to enhance environmental protection through local prescriptions in coupe plans. Forest operations in the North East region are also conducted in accordance with a set of local timber harvesting prescriptions (NRE 1997f), which include specifications for the construction, drainage and maintenance of roads and tracks.

Key features and provisions of the Code for minimising soil erosion and protecting water quality in forest areas are summarised in the box below. However, it is emphasised that the full Code and local prescriptions contain significantly more detail on measures to protect water quality and aquatic habitat.

The road and track network in forests of the North East is managed by NRE, Parks Victoria, local municipalities and the Roads Corporation (VicRoads). The majority of roads in State forest were built prior to the introduction of the Code of Forest Practices for Timber Production. Since the release of the Code there has been a progressive improvements in the standard of road construction and maintenance. However, some of the road network, established prior to the Code, does not meet current standards and therefore is a potential source of sediment. Many of these roads were built to carry traffic for a short period, or to cater for infrequent use in the drier periods of the year, but they are now used for recreation purposes throughout the year. The use of these roads and tracks can be unsafe during wet conditions and can cause serious degradation to environmental values. Restrictions on the use of roads occur in some water supply catchments.

Increased stream sedimentation is regarded as a threat to species, such as the Spotted Tree Frog that is listed as endangered in Victoria. Therefore, management prescriptions, including special requirements, are in place for stream buffers, roads and stream crossings in catchments containing these species.

The affect of timber harvesting and regeneration on water quantity and quality can also be managed by spatial (size and distribution) and temporal (time) controls on timber harvesting operations in catchment areas.

The standards established by the Code provide a high level of security to water quality and yield over the majority of the North East forests. However, for some catchments used for domestic water supply, and where treatment is minimal, an additional level of security for the water supply may be warranted. In catchments where State forests comprise a large proportion of the catchment, the catchment is

relatively small or where minimally treated water storages lie within or adjacent to State forest, water yield and quality may be influenced by forest operations. In these instances, special management strategies may be defined in Forest Management Plans to apply to these designated catchments, including seasonal suspension of operations, maximum coupe size and annual harvest area, and road and track management.

<b>OVERVIEW OF CODE OF PRACTICES FOR TIMBER PRODUCTION (NRE 1996a) RELATING SPECIFICALLY TO WATER QUANTITY AND QUALITY ISSUES</b>	
(As noted in the text, it is emphasised that the full Code and local prescriptions are detailed documents and this description provides an indication of the mechanisms that are employed to protect water quality and aquatic habitat.)	
ISSUE	CODE OF PRACTICE
<b>Water Quantity</b>	<p>Priority to be given to the protection of catchments with limited streamflow which service regions with high current or potential water use. Consultation required with appropriate authorities.</p> <p>Adoption of longer rotations, control of stand density by thinning to maintain streamflow, limits on annual harvest areas (if appropriate) or other techniques as research knowledge becomes available.</p>
<b>Water Quality and Aquatic Habitat</b>	<p>Maintenance of buffer and filter strips, the minimum width of which will be determined by stream classification and will take account of local conditions including soil erodibility, rainfall erosivity and slope.</p>
Slope limitations	<p>Harvesting operations should be excluded from slopes <math>&gt;30^\circ</math>, or on lesser slopes of unstable soil where erosion risk is high.</p> <p>Lower slope limitations will apply as necessary according to soil type, stability and moisture content, intensity and magnitude of the harvesting, the type and size of logging machinery, and season.</p>
Log landings and dumps	<p>Located, constructed and maintained to minimise soil disturbance and water quality deterioration. Stockpiling of topsoil should occur, where appropriate, for later use during rehabilitation. Rehabilitation required when no longer used.</p>
Snig tracks and forwarding tracks	<p>Must not be located parallel to drainage lines.</p> <p>Crossing of filter strips is to be limited.</p>
Fuel dumps and machinery servicing	<p>Located to minimise pollution of streams and wetlands.</p>
Wet weather restrictions	<p>Snigging and forwarding operations must be suspended when stream quality is threatened by compaction, rutting or soil mixing, or when water begins to flow along tracks.</p> <p>Flexible prescriptions for closure when climatic conditions make timber harvesting detrimental to the environment.</p>

<b>Roading</b>	
Design	Roads must accommodate anticipated frequency, type and speed of traffic, soil and subgrade conditions, road drainage and water quality requirements.
Location	<p>Roads must be located to minimise the number of stream crossings and interference with natural drainage.</p> <p>Align roads with topography, avoiding steep side slopes and damp southern aspects. Roads should not be located in or closely aligned to natural drainage lines or areas of poor or restricted drainage.</p> <p>Avoid steep and unstable slopes, and any disturbance to streams, buffer strips, riparian vegetation and rainforest in areas not associated with approved crossings.</p> <p>Avoid entry of sidecast material into streams or drainage lines.</p> <p>Road surface runoff to be discharged away from streams and drainage lines, as far as practicable.</p>
Construction	Undertaken when climatic and site conditions minimise impact on water quality.
Culverts and drains	Must be installed concurrently with road construction. Draining by cross drains or outsloping required if construction is to be left over winter or an extended period.
Partially built roads	Closed to traffic until completed. Temporary stabilisation works required for drainage and erosion control.
Drainage	Roads must be cross sloped and crowned to minimise concentrated flows and to < runoff velocities.
Provision of silt traps	Drainage must discharge onto undisturbed vegetation or energy dissipating structures.
Stream crossings	<p>Fill positioned to minimise sediments being transported into streams.</p> <p>Earth embankments revegetated or surfaced, or retaining walls constructed.</p>
Maintenance	Road drainage must be maintained to minimise discharge of turbid water into streams

The Code of Practice for Fire Management on Public Land (CNR 1995d) lays down principles, standards and guidelines that apply to fire management on all public land in Victoria. This code is complementary to the Code of Forest Practices for Timber Production. It provides guidelines for fire preparation, suppression and rehabilitation activities to ensure the conservation of water catchment values. They specify that:

- fire preparation activities should be conducted in a manner that protects water values by minimising the impact of these activities, for example, location of water points must include consideration of impacts on wetlands, riparian and aquatic communities;
- soils should be protected to prevent destruction of physical and chemical properties, and to promote stabilisation of bare or disturbed earth;
- fire control lines should be constructed outside stream beds and riparian zones and be constructed around the contour on sloping ground;
- rehabilitation works should consider the risk of erosion, particularly in water supply catchments; and
- fire access tracks must, where practicable and without compromising their primary purpose, be constructed and maintained to minimise soil disturbance and erosion.

### ***North East Forest Management Planning Process***

The North East Forest Management Plan is currently being developed in accordance with the requirements of:

- the *Forests Act 1958*;
- the *Flora and Fauna Guarantee Act 1988* and associated Statements;
- the *Catchment and Land Protection Act 1994*; and
- the Code of Forest Practices for Timber Production.

Maintaining the quality and yield of water supplied from State forest is a key objective of forest management planning. A Forest Management Plan establishes a series of management actions and guidelines to protect water yield, and prevent soil erosion and stream sedimentation. Planning objectives in relation to water and catchments include maintaining biological values associated with rivers and streams; ensuring water quality is suitable for current and likely future use; and maintaining at least current water yields from catchments used for domestic and irrigation supply.

The forest management planning process must consider the range of legislation and policies discussed in Section 9.4 that are relevant to State forest. Prescriptions set out by Special Area Plans prepared under the *Catchment and Land Protection Act 1994* are applied where relevant. Similarly, requirements of the *Heritage Rivers Act 1992* for Heritage Rivers and Essentially Natural Catchments are incorporated into the planning process.

The development of strategies to protect the quality and yield of water requires consideration of a wide range of issues in the context of a management plan, several of which are briefly discussed below.

- **Coupe planning and design.** The planning process provides direction for harvesting within catchments to prevent loss of water quality and yield. Guidelines can relate to the need for varying silvicultural practices, and limitations on annual harvest area.
- **Roading.** Planning considers the extent and condition of the road network and may incorporate guidelines relating to road design, construction and maintenance activities. It also reviews the need for seasonal, temporary or permanent road closures based on the requirements of harvesting, recreation and fire management activities, and environmental protection.
- **Fire.** The planning process, in conjunction with the Code of Practice for Fire Management, considers the effects that fuel reduction burning may have on water quality and yield, and aquatic habitat, providing guidelines for the use of fire in water supply catchments.
- **Other forest uses including recreation and extractive activities.** The impact of these activities is addressed through the use of forest management zoning or the implementation of management

actions aimed at protecting water quality and yield, such as the rehabilitation of redundant gravel pits.

### ***Monitoring***

The management arrangements in place for the protection of water values are not static, and are subject to review through Victoria's environment management systems, which are considered further in the ESFM assessment. However, the major processes and actions relevant to monitoring and reporting of hydrology related issues include:

- regular audits of timber harvesting operations against the Code and local prescriptions; and
- regular monitoring of water quality in State forest streams through the Victorian Water Quality Monitoring Network, including monitoring by the EPA. Data from this is used to detect trends in water quality and yield in forest catchments.

## **10. MINERALS**

### **10.1 INTRODUCTION**

The aim of the regional assessment of minerals potential is to draw together new and existing information to aid the consideration of economic effects of forest use options to be considered in the development of the RFA. In particular this assessment contributes to the evaluation of:

- the nature of mineral resources in forested land;
- current and potential uses of forested land;
- economic value of mineral products;
- structure and regional significance of the mining industry; and
- resource, infrastructure and policy requirements for the establishment of minerals industries.

The National Forest Policy Statement recognises the need to consider access for mineral exploration and extraction activities in deciding on land use for public native forests. Access for mining and exploration varies with land tenure. Due to the incomplete nature of information on minerals resources and the fact that exploration is a dynamic information-gathering process, continued access to land is a significant issue for the mining industry and for future mineral development.

This chapter outlines identified mineral deposits, the potential for a number of deposit types, indicators of the region's potential mineral value and factors affecting this value. Mineral deposits outside but close to the boundary of the region (within 15 km) are noted if they are considered to have significance for mineral potential within the region. In this chapter the study area is referred to as 'the North East region' or as 'the region'. A technical report detailing the assessment of mineral resources is available on request.

The ACI feldspar mine at Beechworth was recently opened in the North East region (Map 2). The region was a major gold producer last century, and many old deposits have recently attracted exploration interest. Resources have been identified at a number of prospects within the region or just adjacent to it. The Golden Mountain prospect, located in the Hell's Hole gold field, appears to be the most significant prospect in the region.

The region is highly to moderately prospective for a number of mineral deposit types and is therefore likely to contain a number of undiscovered deposits.

Where access for exploration is possible, both undeveloped and as yet undiscovered deposits may be mined in the future, subject to normal approval processes, and yield economic benefits.

### **10.2 KNOWN AND POTENTIAL RESOURCES OF METALLIFEROUS AND EXTRACTIVE MINERALS**

#### **Geological Setting**

In the North East region the Palaeozoic basement rocks are grouped into three tectonic zones (Map 10.1, and Appendix 5). From west to east these zones are:

- Melbourne Zone;
- Tabberabbera Zone;
- Omeo Zone.

The Tabberabbera Zone is bounded on the west by the Mount Wellington Fault Zone which marks the eastern limit of the thick Silurian-Devonian marine Melbourne "Trough" sequence. The Kiewa/Kancoona Fault zones mark the eastern limit of the Tabberabbera Zone and separates it from the Omeo Metamorphic Complex to the east. All of these zones are part of the central Lachlan Fold belt. In the northwest, the Palaeozoic rocks are covered by Tertiary sediments of the Murray Basin.

The geological history of the region can be broadly divided into three main episodes:

- Cambrian to Early Carboniferous (ca 500 - 350 Ma): the development of the Lachlan Fold belt with cycles of marine and non-marine deposition alternating with three major phases of rock deformation (Benambran (ca 430 Ma), Tabberabberan (ca 385 Ma), Kanimblan (ca 350 Ma)), involving folding, faulting, intrusion of granites, volcanism and metamorphism. Most of the mineral deposit formation in the region took place during this episode; it is associated with magmatic, volcanic and metamorphic processes and with phases of major deformation;
- Early Carboniferous to mid-Mesozoic (ca 355 - 100 Ma): widespread erosion followed the land uplifts associated with the Tabberabberan and Kanimblan deformations resulting in a landscape of low to gentle relief over most of south eastern Australia;
- Mid-Mesozoic to the present day (ca 100 - 0 Ma): Australia separated from Antarctica and New Zealand during the break-up of the Gondwana supercontinent at about 95 million years ago. The Tasman Sea began to open and the North East region was uplifted followed by erosion of the landscape and a brief period of basaltic eruption. The extensive alluvial gold and tin deposits mined at the turn of this century were formed near the end of this period.

### **Known Occurrences and Resources of Metalliferous and Extractive Minerals**

Map 10.2 shows 1 994 mineral occurrences, old mines and deposits in North East region. Most of the 1 772 gold occurrences occur within 43 gold and tin fields. Another 168 occurrences and 16 goldfields are outside but near the boundaries of the region. Exploration and mining has historically focused on gold, with some periods of significant tin production. Production of tungsten, fluorite and related minerals has been recorded and there are localised concentrations of minerals such as stibnite, bismuthinite, and some occurrences of tantalum and uranium minerals (Oppy *et al* 1995).

The largest feldspar mine in Victoria is in operation near Beechworth in the central north part of the region, where feldspar is extracted from a biotite granite and used for glassmaking. There are 25 active or intermittently active construction materials and construction materials worth at least \$20.5 million were extracted in the region in 1994/95 (Maher *et al* 1997).

### **Gold**

Victoria's total gold production until 1988 was approximately 2450 tonnes of gold (Ramsay and Willman 1988), of which 60 per cent was alluvial and 40 per cent from primary (hard rock) sources (Ramsay 1995). The total recorded gold production for the Tallangatta and Wangaratta 1:250 000 scale map sheet areas was about 121 tonnes (Oppy *et al* 1995; Maher *et al* 1997). Most of the significant goldfields for this production are within the region.

Current gold mining operations are restricted to several small producers of less than one kilogram of gold per year with one larger operation, south west of Falls Creek, that produced 5.8 kilograms of gold in 1996/97 (Minerals and Petroleum Victoria 1998). These are included in 29 current gold mining tenements in the region which experience intermittent mining activity.

Gold resources have been identified at a number of old gold mines including Golden Mountain (about 1 million tonnes at 1.9 gm/tonne), Homeward Bound (306 000 tonnes at 15.2 gm/tonne), Great Rand Mine (215 000 tonnes at 6 gm/tonne) and in the Glenn Wills - Sunnyside field (146 000 tonnes at 12.4 gm/tonne and 220 000 tonnes of tailings at 3.9 gm/tonne).

Low grade (less than 1 gram/tonne) shear zone-quartz stockwork gold ore was mined from mid 1989 to mid 1993 at Nagambie, just outside the northwest part of the region. Heap leach technology was used to extract 4176 kilograms of gold (Register of Australian Mining 1991/92 to 1997/98).

### **Tin**

The Beechworth-Eldorado (Pilot Range) alluvial deposits were the largest source of tin in Victoria with over 9 900 tonnes produced, mostly as by-product of alluvial gold mining (Nott 1988). Known resources of tin at the Walwa tin prospect amount to 6.8 million tonnes at 0.19 per cent tin and 60

gm/tonne tantalite (containing 12 920 tonnes of tin and 408 tonnes of tantalite). There are 172 primary (hard rock) and alluvial tin occurrences in the region (Map 10.2).

### ***Molybdenum***

The Everton Molybdenite Mine was the largest producer of the Everton molybdenite field and total molybdenite production was 12 591 tonnes at 1.54 per cent between 1917–1940 and 4 377 tonnes at 0.41 per cent between 1940 and 1944 (Kenny 1948, in Maher *et al* 1997).

### ***Tungsten***

Recorded tungsten production in the region includes 5.2 tonnes from Keady's reef, Koetong in 1915, 29.1 tonnes from the Womobi Wolfram mine during the period 1919-1952, and 2.7 tonnes from various reefs during the period 1917-1918 (Oppy *et al* 1995). Thirty-five tungsten occurrences have been recorded in the region.

### ***Bismuth***

Bismuth has been recorded as a minor accessory to tungsten mineralisation at the Womobi Wolfram mine and to primary gold mineralisation from the Granya and Freeburgh goldfields. Alluvial bismuth is an accessory to alluvial tin and gold in the Mt. Wills and the nearby Wombat Creek goldfields (Oppy *et al* 1995). Twelve bismuth occurrences have been recorded in the region.

### ***Base metals***

Copper production from major gold mines of the Bethanga goldfield totals about 383 tonnes of concentrates produced intermittently between 1880 and 1908. Minor copper occurrences are known in the Mansfield Basin (Maher *et al* 1997), and near Corryong in the north east of the region (Oppy *et al* 1995). Recent exploration drilling in the south west of the region, has intersected gold-copper and gold-silver-barium mineralisation at Hill 800, about 40 km south east of Mansfield (Maher *et al.* 1997; Fraser 1998; Map 10.2).

The Pine Mountain mine produced 6.4 tonnes of lead concentrate (and 51.8 tonnes of fluorite) in 1957 and 5240 tonnes of fluorite and an unknown amount of lead concentrate from 1918-1972. There are a number of other base metal occurrences scattered through the eastern part of the region and they are often associated with more important gold mineralisation in some of the goldfields, with tungsten-tin at Womobi and with tin at Mt Alwa (Oppy *et al.* 1995).

### ***Antimony***

Small lodes of stibnite occur in quartz veins at Hollands Creek near Toombullup, in the central west of the region. The Tatong Antimony Mine operated for three periods between about 1895 and 1925, and produced about 37 tonnes of fairly clean stibnite. The small Carry On mine, in the Mitta Mitta goldfield, produced 33.5 tonnes of antimony concentrate from 1914 to 1945. About 19 antimony occurrences have been recorded in the region, including eight gold occurrences with minor antimony.

### ***Silver***

Goldfields in the eastern part of the region have a high silver content and significant silver production as a by-product of gold mining. This includes 53.8 kg of silver from the Maude and Yellow Girl mine, in the Mt Wills goldfield, during the period 1962-1967 and 136.7 kg of silver from the New Bethanga Gold Mine, in the Bethanga goldfield, during the period 1907-1908. Silver has been recorded in association with lead at a number of localities including the Danes Creek Ag-Pb lode, Victoria Ag-Pb lode, Silver Flat, Quartz Pot Flat, Pine Mountain mine and the Mammoth Complex.



### ***Platinum group metals***

Platinum group metals are associated with widespread non-economic copper-nickel sulphide mineralisation associated with the dyke swarm of the Woods Point-Walhalla gold sub-province in the southwest of the region (O'Shea *et al* 1992).

### ***Feldspar***

Feldspar for glassmaking is mined about four kilometres south west of Beechworth, in biotite granite of the Pilot Range Granite Complex. Approximately 60 000 tonnes/year of material will be mined to produce high quality feldspar (Mathrick 1998). This is the largest feldspar mine in Victoria (Map 10.2).

At Sheep Station Creek, 3 km east of Beechworth, pilot plant test indicate that an orthoclase feldspar resource of three million tonnes is suitable for glass manufacture.

Industrial tests indicate that massive orthoclase feldspar in a pegmatite dyke at Tallangalook, in the central south west of the North East region, is suitable for use in the manufacture of ceramics. Similar pegmatite dykes have been reported from Huon Hill, Mount Pilot and Mount Lady Franklin in the Beechworth-Albury-Wodonga area (Maher *et al* 1997). Small-scale production is reported from feldspar-rich at Huon (McHaffie & Buckley 1995). A resource of 750 tonnes has been inferred for two pegmatite dykes at Kookaburra Creek (Tan & Atkinson 1988). Other significant occurrences of feldspar are at Koetong Creek and Tallangatta (McHaffie & Buckley 1995).

### ***Construction materials***

There are 25 active or intermittently active construction materials quarries, not including numerous smaller pits used for minor rural road maintenance. Construction materials worth at least \$20.5 million were extracted in the region in 1994/95 (Maher *et al* 1997).

Much of the construction material activity is concentrated in the north of the North East region near the larger population centres of Albury-Wodonga and Wangaratta, and along the Hume Highway to Melbourne. At Glenrowan large quantities of Glenrowan Granite are extracted for aggregate, road base and fill and a small quantity was mined for dimension stone (Maher *et al* 1997).

The Murray Valley flood plain near Wodonga is a major source of river sand and gravel with deposits up to 30 metres thick (Bowen 1988b). Quaternary age Coonambidgal Formation clay and sand is extracted from the Murray, Broken and Ovens Rivers close to Albury, Everton and Wangaratta and is used for aggregate, fine sand, concrete, fill and road base. Small amounts of clay were also extracted for brick making (Maher *et al* 1997). River gravels in old gold sluicing tailings dumps on the Mitta Mitta and Ovens Rivers have been used locally for road construction (Oppy *et al* 1995).

Shale, mudstone and sandstone of the Hotham Group near Glenrowan, Chiltern and Benalla are used for aggregate, road base and fill. Siluro-Devonian age sandstone is extracted for aggregate, fill and road base near Euroa and Karn (Maher *et al* 1997). Contact metamorphosed rock (hornfels) of the Hotham Group is also used as aggregate (Maher *et al* 1997) and is extracted at Chiltern. Crushed hornfels has been sourced from the Walwa Road Quarry for road building and maintenance.

Near Violet Town, Devonian age rhyodacite is used for road base and aggregate (Maher *et al* 1997). Phyllitic shale has been quarried on the Mitta Mitta North road and at the junction of Mitta Mitta and Yabba Roads (Oppy *et al* 1995).

### ***Dimension Stone***

The North East region has several currently inactive quarries and occurrences of various types of dimension stone. Various intrusions in the Pilot Ranges, in the north of the region, were used extensively for building in Beechworth between 1857 and 1864 and some of these rock types may be

suitable for use as dimension stone. Porphyry dykes in the Tallangatta area have a history of extraction and use as dimension stone, particularly for monument building in Melbourne. Numerous dyke swarms occur at Tallangatta, Cudgewa, Walwa, Bullioh and other localities and while their extensive jointing detracts from large volume uses, some of the dyke rocks may be suitable for monument construction (King and Weston 1997).

### ***Fluorite***

Victoria's only fluorite production has been from the Pine Mountain mine, near Walwa in the north of the region, which produced 5240 tonnes of fluorite during the period 1918-1972. The Pine Mountain mine has a resource of 75 000 tonnes of 100 per cent  $\text{CaF}_2$ , assuming 75 per cent recovery and in excess of a million tonnes of low grade ore. Fluorite has been recorded at about 20 localities including Sandy Creek, Walwa, Womobi Wolfram mine, the Tin Hut and Granya View lodes in the Granya goldfield and an isolated occurrence in the Mitta Mitta goldfield (Oppy *et al* 1995).

### ***Precious and semi-precious stones***

In excess of 78 diamonds were recovered during mining of deep lead deposits of gold and tin within the Eldorado, Beechworth and Chiltern-Rutherglen goldfields. Most of these diamonds are derived from alluvial gravels in Reedy Creek from Wooragee to Eldorado and many were recovered from the Woolshed Creek portion of Reedy Creek (Birch and Henry 1997). The two largest diamonds (6 and 8.2 carats) in the region were from the Beechworth goldfield but most other diamonds weighed less than 0.5 carats (Maher *et al* 1997).

Sapphire, topaz, zircon and quartz crystal have been extracted from shallow leads in the Toombullup goldfield, in the central part of the region. Rock crystal, citrine, cairngorm and amethyst are common in Reids Creek and such ornamental stones were commonly found in old alluvial workings of the Woolshed Valley, north of Beechworth.

South east of Benalla, the Edi-Cheshunt turquoise fields (includes Whitfield) were worked between 1893 and 1921. Turquoise occurs as compact veins up to 2 cm thick in black shale and slate, and can be traced intermittently for about 30 km. Similar rocks host the Greta South turquoise fields (includes Ryans Creek) (McHaffie & Buckley 1995).

### ***Limestone***

Minor resources of Devonian limestone have been worked for lime and ornamental stone at Howes Creek, south west of Mansfield.

### ***Phosphate rock***

The ten phosphate occurrences in the region are confined to the Benalla-Mansfield area. Six are located around Mansfield and three of these occur at Howes Creek in Lower Devonian age phosphatic sediments where several hundred tonnes of material were mined prior to 1920. The other four occurrences are turquoise (a secondary phosphate mineral). Although not rich enough nor large enough to be economic, the mineralised beds coincide with similar enrichments in sediments of the same age worldwide.

### ***Quartz Crystal***

Laing *et al* (1977) report mining of quartz crystals from coarse-grained biotite granite at the Crystal King Mine near Tallangalook for use in radio transmitters during the 1940s. A recent upsurge in interest in quartz crystals for ornamental and "new-age healing" purposes has led to reworking of this deposit (McHaffie & Buckley 1995).

***Barite, Calcite, Wollastonite, Pyrophyllite, Talc***

A barite lode occurs seven kilometres south east of Walwa, and has also been recorded at Thowgla and Gibbo River and as fluorite-barite in the Pine Mountain Adamellite (Oppy *et al* 1995). At Boxwood a large calcite vein has been worked by a series of pits over 360 metres length. Calcite was burned to produce lime for use in agriculture and plaster (McHaffie & Buckley 1995). Wollastonite has been recognised around the margin of the Strathbogie Granodiorite, north of Bonnie Doon, and in metamorphosed calcareous sandstone at Chesney Vale (McHaffie & Buckley 1995). Pyrophyllite is associated with gold mineralisation in acid volcanics at Rhyolite Creek, in the south west of the region. Talc production of 83 tonnes during 1948-49 came from crushed and faulted margins of a Cambrian greenstone (diabase) in the Howqua Hills, in the south east of the region (Bowen 1988a).

**Potential Mineral and Extractive Resources*****Mineral potential assessment methodology***

A qualitative assessment of the potential resources of an area is an estimate of the likelihood of occurrence of mineral deposits which may be of sufficient size and grade to constitute a mineral resource. The term 'mineral resource' is restricted to material, the extraction of which is judged to be potentially viable, either now or within the next 25 years.

The mineral potential of the North East region has been assessed by determining the types of mineral deposits likely to be found within the geological framework known or believed to exist there. This approach identifies geological units (tracts) which could contain particular types of mineral deposits. The general methodology was developed by the United States Geological Survey and has been used successfully for mineral resource assessments of wilderness areas in North America and elsewhere. A summary of the qualitative assessment methodology is described by Marsh *et al* (1984), Taylor & Steven (1983), and Dewitt *et al* (1986).

An assessment of a region's potential mineral resources combines knowledge of its geology, geophysics, geochemistry, mineral deposits and occurrences with current theories of mineral deposit genesis and results of mineral exploration. The assessment uses available geoscientific data to determine the history of geologic processes and environments. Geologic environments judged to have characteristics known to be associated with specific types of mineral deposits are then identified. In particular, the assessment draws on regional and local characteristics of mineral deposit models to establish whether or not specific types of deposits are likely to occur.

The mineral potential of an area — that is, the likelihood of a particular type of mineral deposit occurring — is ranked as 'high', 'moderate', 'low' or (where there is insufficient data) 'unknown'. To reflect the differing amounts of information available, assessments of mineral potential are ranked from A-D according to levels of certainty, 'A' denoting the lowest level of certainty and 'D' the highest (Figure 10.1).

As geological knowledge of an area can never be complete, it is not possible to have a 'final' assessment of potential mineral resources at any given time. Mineral resource potential needs to be monitored and periodically reassessed to take account of new data and advances in geological understanding, including new mineral discoveries. Advances in mineral exploration and mining technologies and market changes may also change the mineral resource potential of an area.

**Figure 10.1: Relationship between levels of resource potential and levels of certainty**

Mineral potential decreasing	H/D  HIGH POTENTIAL	H/C  HIGH POTENTIAL	H/B  HIGH POTENTIAL	U/A    UNKNOWN POTENTIAL
	M/D  MODERATE POTENTIAL	M/C  MODERATE POTENTIAL	M/B  MODERATE POTENTIAL	
	L/D  LOW POTENTIAL	L/C  LOW POTENTIAL	L/B  LOW POTENTIAL	
	N/D  NO POTENTIAL			
	D (High)	C	B	A (Low)
<div><div></div><div>→</div></div> <div>Level of Certainty</div>				

***Mineral potential in the North East region***

Mineral potential tracts were identified for 14 types of mineral deposits and 4 types of industrial mineral and construction materials deposits (Table 10.1).

The tracts of mineral potential for various types of mineral deposits have been combined and summarised in two different ways in Maps 10.3 and 10.4. Extraction sites for low value construction materials are often dictated by other land uses and by costs of transport and mineral potential for construction materials is not included in combined mineral potential Maps 10.3 and 10.4.

The levels of mineral potential for the various types of mineral deposits are summarised in Table 10.1. Descriptions of the favourable geological tracts for deposit types are summarised in Appendix 6 and are fully described in the North East minerals assessment report (VicRFASC 1998a).

**Table 10.1: Summary of potential mineral resources as at April 1998**

<b>Deposit type</b>	<b>Mineral potential</b>	<b>Certainty level</b>	<b>area of tract (sq km)</b>	<b>% of region covered by tract</b>	<b>% of tract in Exempt Crown Land*</b>
Slate belt gold	High	B-C	14287	61.7	16.1
	Moderate	B	1067	4.6	<0.1
	Low-moderate	B	3464	14.9	11.1
Disseminated gold	Moderate-high	B	14287	61.7	16.1
	Low-moderate	B	1067	4.6	<0.1
	Low	B	3464	14.9	11.1
Alluvial gold	Low-moderate	B	5190	22.4	2.0
Epithermal gold-silver	Moderate-high	B-C	3142	13.6	13.2
Porphyry copper-gold	Moderate-high	B	102	0.4	0.1
	Moderate	B	739	3.2	17.6
Volcanic associated massive sulphide base metals	High	B-C	105	0.5	26.1
	Moderate-high	B-C	237	1.0	63.4
Volcanic associated massive sulphide gold	High	B-C	105	0.5	26.1
	Moderate	B-C	237	1.0	63.4
Tin veins	Moderate	B-C	3751	16.2	16.5
	Low-moderate	B	2960	12.8	9.5
Tin greisen	Moderate	C	211	0.9	<0.1
	Low-moderate	B-C	1460	6.3	18.8
	Low	B	1519	6.6	11.5
Tungsten-molybdenum veins	Moderate	B-C	966	4.2	4.4
	Low-moderate	C	5453	23.5	14.7
Tungsten skarn	Moderate	B	472	2.0	3.5
Nickel-copper deposits	Moderate-High	B	474	2.0	1.3
Sediment hosted copper	Moderate	C	680	2.9	0.9
	Low-moderate	B	418	1.8	68.6
Sandstone uranium	Low-moderate	C	1098	4.7	26.7
Dimension stone	Moderate	B	4082	17.6	10.7
	Unknown	A	11721	50.6	21.2
Feldspar	Moderate	B	2609	11.3	7.3
	Low-moderate	B	5996	25.9	18.3
	Unknown	A	935	4.0	20.1
Limestone	Low-moderate	C	1193	5.2	6.3
Kaolin	Moderate	B	5193	22.4	2.0

\*Exempt Crown Land in this column comprises National and State Parks, Wilderness and Reference Areas.

Map 10.3 is a composite of mineral potential tracts over the North East region (Table 10.1) and shows the highest level of mineral potential assessed (in April 1998) for any particular area in the region. Where tracts for different types of deposits overlap, this area is assigned the highest potential level of all the overlapping tracts. In this approach, the tract having the highest mineral potential in any particular area obscures tracts of lower mineral potential.

Map 10.3 shows that most of North East region is covered by a tract of high potential for deposits of slate-belt gold, with smaller tracts of high potential for volcanic associated massive sulphide deposits in the south west of the region. This tract includes 43 former goldfields which generated past gold production. A small tract of moderate to high potential for porphyry copper-gold deposits occurs east of Wangaratta and other small tracts of moderate potential for porphyry copper-gold are present in the eastern part of the region but are obscured by tracts of higher potential. Additional areas of moderate to high potential for nickel-copper deposits underlie the high potential slate belt gold tract in the far southwest of the region along the Mount Wellington Fault Zone.

Map 10.3 is a composite of mineral potential tracts for different types of mineral deposits that do not have equal economic values. For example, a tract with moderate to high potential for slate belt gold may be considered to have a higher economic value than a tract with moderate to high potential for dimension stone.

The mineral potential tracts are superimposed on Map 10.4 to highlight areas with overlapping tracts. This presentation takes account of the diversity of mineral resource potential as well as the level of potential. This was done by allocating standard scores according to a subjective ranking of levels of mineral potential. In those areas where tracts overlap, the scores are added and this cumulative score is assigned to overlapping areas (see note Map 10.4).

It should be understood that the areas with overlapping tracts highlighted by Map 10.4 emphasise the diversity of deposit types and their mineral potential, but these areas are not necessarily always more prospective than a single tract of high potential, for example, slate-belt gold. As with Map 10.3, the relative economic potential of different deposit types has not been accounted for. The relative economic significance of the tracts for different types of mineral deposits, as perceived by mining companies, would be influenced by their perceptions of prospectivity, future market conditions, land access and other factors.

On Map 10.4 the cumulative mineral potential scores reflect the widespread potential of slate belt gold and disseminated gold deposits throughout the region. The area with a high cumulative score in the region occurs west and north of Beechworth, and is due to the cumulated scores of potential for eight types of deposits. This area also includes the ACI feldspar mine.

### **10.3 CURRENT EXPLORATION, MINING AND EXTRACTION ACTIVITIES AND POTENTIAL ECONOMIC VALUE**

The potential economic value of the region's mineral resources is affected by a number of factors including: mineral prospectivity; geological knowledge base and intensity of data over the region; timing and significance of discoveries; future metal prices and mining costs; and rules and regulations governing exploration and mining.

The mineral potential assessment provides an indication of areas of land which are more likely to be most prospective for particular minerals. However, an assessment of the potential value of mineral resources in these areas is not possible without an estimate of the number and type of deposits likely to occur in a particular region. Therefore it has not been possible to compare the 'mineral' value of particular areas of land that have been assessed as prospective for minerals with other land (whether prospective or not). These limitations, when combined with the dynamic information-gathering nature of exploration, have significant implications for land access arrangements for exploration and mining in these areas.

Current and historical exploration expenditures provide some indication of the potential value of the undiscovered mineral resources of North East region. This is because a decision to invest in exploration is based largely on a company's perception of the mineral potential of an area. That is, exploration expenditure will tend to be higher in areas of higher perceived mineral potential. However, given the uncertainty, different risk attitudes of companies and the difficulty of exploration, expenditures only provide an approximation of true prospectivity. Sometimes deposits are found in previously unprospective areas when new ideas or technology are applied where little previous exploration has occurred.

### **Exploration**

While there are presently no significant operating metallic mineral mines in the North East region, exploration expenditure totaled about \$9.3 million in 1996-97. Much of this amount (about \$6 million) was directed at locating feldspar occurring within granite bodies in the Beechworth district. The other major commodity target was gold, with a little interest in base metals.

Alluvial gold was discovered at the present site of Beechworth in 1852. Major goldfields established during the early days included Rutherglen, Chiltern, Beechworth, Harrietville, Bright, Wandiligong, Freeburch, Mt. Wills and Bethanga. Mining of alluvial gold was extended with the arrival of low-cost alluvial dredges or floating large scale processing plants on pontoons which were introduced in the 1890s and early 1900s.

An Exploration Licence system was introduced by the Department of Mines and Industrial Development in the mid 1960s which allowed exploration over large areas. This greatly facilitated company-scale exploration for minerals. Since 1965, about 330 Exploration Licences have been granted over the North East region or its margins (Figure 10.2).

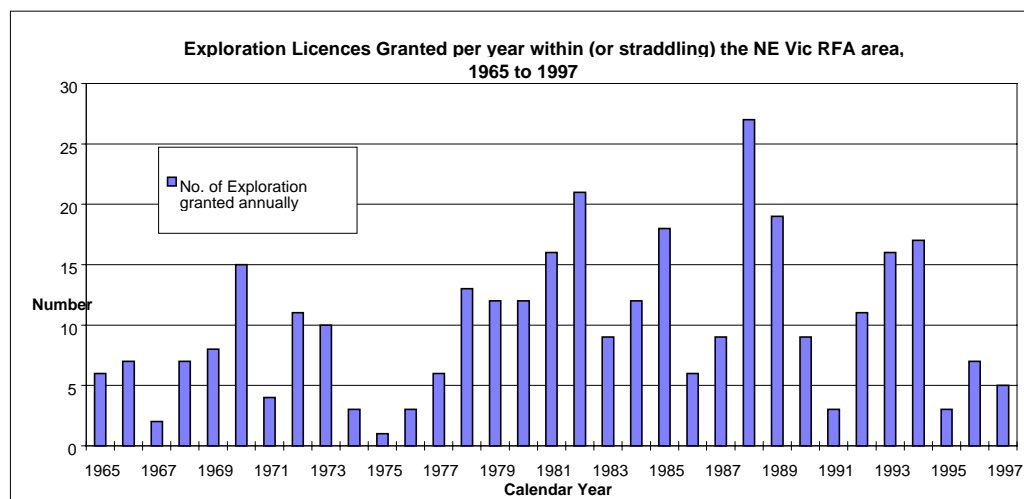
Exploration in some areas has been hampered by rugged topography, difficult access and at times severe weather. Hence, at least some exploration programs in the region may have been ineffective and significant mineral deposits may remain undetected and a number of quite prospective areas remain, to a large degree, untested.

The exploration targets sought since 1965 have varied in accordance with relative metal prices, perceived prospectivity, relative recovery costs of metals and new exploration paradigms or mineral deposit models. Commodities explored for in the region include gold, silver, copper, lead, zinc, platinoids, tin, tungsten, molybdenum, antimony, mercury, uranium, tungsten, feldspar, fluorite and phosphate.

During the period 1965 to 1977, the region attracted about 100 companies most of whose exploration targets were either base metals or tin/tungsten. However, a small proportion of companies were exploring for alluvial gold and some also for reef gold. In 1966, IMC Development Co explored for phosphate and in 1972-1973 CRA Exploration Pty Ltd and others were exploring for uranium. Diamond was first targeted by explorers in 1977. The period 1978 to 1983 witnessed a growth in exploration activity based on strong interest in tin and also in base metals and gold within the region. In the mid 1970s to early 1980s, sedimentary copper (& uranium) was targeted in the Mt Typo basin and in the red bed sedimentary sequence of the Mansfield Basin.

Exploration activity peaked in 1982 when 21 exploration licences were granted. Interest in tin/tungsten during the period 1978-1983 was mainly due to the then sustained high prices for tin and the known occurrence of tin in the region, and also to the high gold price (about 15 per cent of the exploration programs were for gold.)

From 1984 to the end of 1997, the major exploration focus over the area has been for gold and about 160 exploration licences have been granted during this time. In 1988, 27 exploration licences were granted in the region, the highest number of exploration licences granted in any year.

**Figure 10.2: Exploration licences granted for the North East**

At the time of this assessment, there were 31 active exploration licences in the North East region (Figure 10.2), distributed among 23 companies. In 1996-97, total exploration expenditure in the North East region was about \$9.3 million (Minerals and Petroleum Victoria, 1997), being \$1.8 million on exploration licences and \$7.5 million on exploration under mining licences (Tables 10.2 and 10.3).

**Table 10.2: Mineral exploration expenditure on Exploration Licences, North East region (1996-97 dollars)**

Year	North East Region exploration expenditure (\$)	Victorian exploration expenditure MRD Act (\$)	North East Region exploration, as a percentage of Victorian exploration expenditure
1991-92	615 056	11 200 000	5.5
1992-93	660 434	16 300 000	4.0
1993-94	1 680 117	20 400 000	8.2
1994-95	919 431	43 400 000	2.1
1995-96	910 368	35 600 000	2.6
1996-97	1 799 314	37 600 000	4.8
<b>Totals</b>	<b>6 584 720</b>	<b>164 500 000</b>	<b>4.0</b>

Note: Mineral exploration expenditure on Exploration Licences, as derived from Mineral and Petroleum Victoria records. Expenditures expressed in current dollars in each financial year have been converted to constant 1996-97 dollars using changes in the consumer price index.

Of the 31 exploration licences in the region, there are many prospects where resources have been identified and exploration has proceeded to more advanced stages.

Resources have been identified at a number of prospects within the region or just adjacent to it. New Holland Mining NL are currently exploring for gold and base metals at their Hill 800 prospect about 40 km southeast of Mansfield. The Golden Mountain prospect, located in the Hell's Hole gold field, appears to be the most significant known prospect in the region. It lies just inside the study area at the



northern end of the Walhalla–Woods Point–Gaffneys Creek–Jamieson gold belt, 45 kilometres north west of Mansfield. Duketon Goldfields NL is conducting a feasibility study on an open cut development of the deposit. Measured, indicated and inferred resources total 1 million tonnes at an average grade of 1.9 g/t. The low grade ore may be amenable to heap leaching.

Other important gold resources just outside the region are subject to development. These include the Morning Star mine and the A1 mine, both of which are also in the Walhalla–Woods Point–Gaffneys Creek–Jamieson gold field.

### ***Mining licence expenditure***

In addition to expenditure on exploration licences there has been significant expenditure on mining licences in the North East region, which includes expenditure on exploration and developmental activities (Table 10.3). For metallic minerals, and gold in particular, most of this expenditure has been on mining licences which overlie historical workings. The greater part of exploration and development from 1995-96 results from the development of a feldspar mining operation by ACI Limited and subsequent exploration to assess further resources.

**Table 10.3: Expenditure on Mining Licences in the North East Region (1996-97 dollars)**

<b>Year</b>	<b>Mining licence exploration expenditure (\$)</b>	<b>Mining licence other expenditure (\$)</b>	<b>Total expenditure mining licences (\$)</b>	<b>Number of mining licences</b>
1991-92	499 074	147 742	646 815	3
1992-93	308 962	161 818	470 780	7
1993-94	917 497	243 445	1 160 942	20
1994-95	390 215	1 456 386	1 846 600	28
1995-96	948 305	1 229 771	2 178 076	34
1996-97	7 539 840	8 170 858	15 710 698	36
<b>Totals</b>	<b>10 603 893</b>	<b>11 410 020</b>	<b>22 013 911</b>	<b>Totals</b>

Note: Figures derived from Mineral and Petroleum records. Expenditures expressed in current dollars in each financial year have been converted to constant 1996-97 dollars using changes in the consumer price index.

### **Mining and Quarrying**

In addition to the feldspar mining operation and associated mining expenditure outlined above, quarrying is a major activity in the region, with 25 construction material quarries in operation from which at least \$20.5 million of construction material was extracted in 1994-1995 (Maher *et al.* 1997).

The re-development on a very small scale of old quartz crystal workings for the domestic and international gem market is also planned on two licences in the region.

Sand and hard rock quarries supplying the construction needs of the Albury-Wodonga region and the Hume Highway dominate industrial mineral production in North East region. Most of the quarries in North East region are situated on private land, so are unlikely to be affected by the outcomes of the RFA. Quarries are often located on private land because construction materials in Victoria are owned by the land owner, not (as in the case of minerals) exclusively by the Crown. This provides an incentive for quarry operators to develop their operations on private land.

### Case Study: Slate Belt Gold and the Nagambie Mine

While the resource assessment found that the region is prospective for slate belt gold deposits, no assessment was made of the potential number or size of undiscovered slate belt gold deposits that may lie within the North East region. However, the size of identified slate belt gold deposits in Victoria (which contain virtually all the gold mined in Victoria to date) provide an indication of the potential size of undiscovered slate belt gold deposits that may lie within the region.

Of 163 Victorian slate gold deposits surveyed by Bowen (1974), 85 per cent had total production of between 1000 and 6228 kilograms. The Nagambie mine, which lies just outside the study area and recently closed after production of 4185 kilograms (Register of Australian Mining), provides an example of a gold deposit within this range. Moreover, the Nagambie mine occurred close to a small rural town and the history of the Nagambie operation provides a useful insight into the effect that such a mine (if found in the North East region) could have on local towns and regional economies.

The Nagambie gold deposit was discovered in 1985 by Frank Green of East Union Prospecting (Hughes 1990). Perserverance Corporation acquired the title over the area in 1987 and began a program of drilling to delineate a resource of 7 million tonnes at a 1.2 grams per tonne gold grade using a 0.4 grams per tonne cut off grade (Hughes 1990). Ore was mined from July 1989 until June 1993, however spraying of the heap leach to extract minor amounts of gold continued until March 1997. The mine generated gross revenues of around \$74 million over the eight year mine life. Direct employment and gross revenue flows from the mine over its operating life are shown in Table 10.4.

**Table 10.4: Gross revenue & direct employment, Nagambie Gold Mine, in 1995-96 dollars**

Year	Gross revenue (\$)	Direct employment (no.)
1989	2 663 377	90
1990	25 129 676	178
1991	18 095 995	105
1992	12 370 433	125
1993	11 155 253	34
1994	3 387 699	32
1995	1 251 428	21
1996	351 320	14

Source: J. Kelly, Perserverance Corporation Ltd, personal communication, February 1997.

Adding to the net economic benefits associated with the rents from production (not calculated in this chapter), the Nagambie mine also generated considerable indirect benefits which have been detailed by Sinclair (1991):

- It was estimated that the mine resulted in the stimulation of an additional 73 jobs in Victoria and 7.5 jobs within the Nagambie region through indirect employment multiplier effects;
- Perserverance spent \$465 000 on local infrastructure, which included upgrading the electricity relay station and road improvements. These enabled a \$1.5 million mushroom farming business to establish in the area which created eight new jobs in the region. These benefits are in addition to the multiplier effects described above;
- The mine introduced a variety of workers into the region, increasing the diversity and level of skill in the Nagambie region's occupational structure (31 of the mines' employees were new residents to the area). In addition, the population growth in the region was around 4.5 per cent over the period 1989–91 — reversing the previous trend of population decline in the area.

Mines like Nagambie may be temporary (three to ten years life in many cases) but it is apparent that these projects — in addition to bringing economic benefits to the local and wider economies during

their operating life — also provide infrastructure and demographic benefits to smaller communities, which can have lasting effects.

### **Outlook for Mineral Production**

Developments in world metals markets will greatly affect development opportunities for the minerals industry in the North East region. The outlook for the gold and base metal markets is reviewed in this section. Detailed market outlook assessments for the medium term are given in Allen and Clarke (1998) and Haine (1998) for gold and base metals, respectively.

#### ***Gold***

Real gold prices have experienced a clear declining trend since 1980 (see Figure 10.3). This trend in price reflected important changes in the structure of the world gold market which are expected to continue into the coming decade. Over this period annual gold consumption declined, whilst annual non-investment gold consumption (mainly jewellery) increased. The growth in world consumption of non-investment gold has stemmed mainly from changes in a number of developing economies (notably India and China), as incomes in these countries increased. Although non-investment gold consumption has increased faster than world mine production (tending to increase prices), real prices have been prevented from rising by concurrent sales of investment gold bars and coins (by governments and private investors).

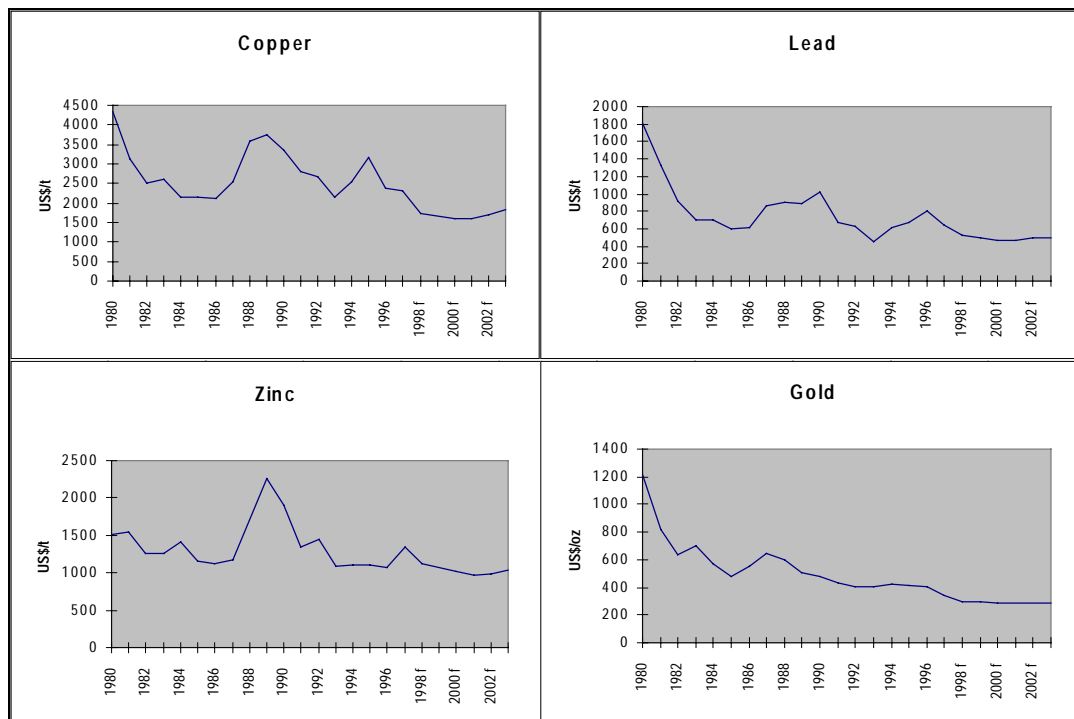
Changing patterns in gold holding and consumption behaviour which underlie the easing real price are expected to continue into the medium term, although real price falls will be mitigated by various market influences (VicRFASC 1998a).

Overall, the forecast for strong world demand for gold is expected to be met by expanding mine supply and from official and investment sources. While periodic market imbalances are likely, particularly some shorter-term price volatility, the easing trend in real prices seen over the past two decades is expected to be maintained at least over the medium term.

Overall, world consumption of base metals increased by 1.7 per cent in 1997 and is estimated to grow by a further 1.6 per cent in 1998. Reflecting expected trends in world economic growth and industrial production, world base metals consumption is projected to increase at around 2.0–2.5 per cent a year over the medium term, easing gradually over the longer term.

World mine supply of the three base metals is estimated to rise in 1998. World refinery production of the three base metals is expected to keep pace with increases in mine production. A number of large committed and planned development projects are expected to be the major contributors to the projected rise in base metals supply over the next few years. Substantial increases are projected up to the end of 2000 as low cost mines, primarily copper mines in Chile and zinc and lead mines in Australia, commence production. However, these rises are expected to be partially offset by the closure of some older, high cost, producers which are likely to become uneconomic with projected lower prices, particularly for copper.

Over the longer term, continuing technological developments can be expected to place downward pressure on costs. Thus, together with projected demand growth, the long term downward trend in real prices experienced for each of the base metals is expected to continue. Price projections to 2003 are shown in Figure 10.3.

**Figure 10.3: Real base metals and gold prices (1996-97 dollars)****Base metals****10.4 LEGISLATION AND LAND ACCESS**

Access to land is an important issue for exploration and mining. At this stage, the implications of the RFA for exploration and mining in the North East region are not yet known.

The nature of access for mineral exploration and mining has a large bearing on the level, and type of exploration and mining that occurs in a region. Transparent and well-defined access arrangements reduce uncertainty and facilitate exploration and mining activities. Access provisions of relevant legislation are outlined below.

More detailed discussion of resource access issues relating to exploration, mining and environment can be found in Industry Commission (1991), Cox, Beil and Waring (1994) and in Murray, Cox and Allen (1995).

**Legislation and Regulation relevant to Exploration, Mining and Extractives**

In Australia ownership of mineral resources and control of mineral exploration and development largely lies in the hands of the State and Territory governments. The Commonwealth government has control over mining and exploration activities outside three nautical miles offshore and over radioactive substances in the Northern Territory. It also exercises its constitutional powers to exert control over the way States and Territories access and use their mineral resources.

The principal legislation covering mining and exploration licences in Victoria is the *Mineral Resources Development Act 1990* (MRDA) which was amended in 1993 and 1994. This Act is the responsibility of the Minister for Agriculture and Resources and is administered by the Victorian Department of Natural Resources and Environment. It sets out the rules for granting licences and attaining approval to start operations.

All exploration and mining activities are subject to a range of environmental requirements before, during and after the life of the project, including:

- lodging a rehabilitation bond, before starting an exploration or mining program, to serve as a security should the company be unable to satisfy its rehabilitation liability;
- exploration and mining is subject to standard conditions, and where appropriate supplementary site-specific conditions;
- regular reporting of exploration activities;
- mining and exploration starting only after a work plan has been approved and other approvals obtained; and
- monitoring of environmental management activities by government officers.

Under the MRDA there are four main land types:

- private land;
- exempt Crown land (for example, National Parks, State Parks and Wilderness Areas);
- restricted Crown land (for example, flora and fauna reserves and historic reserves); and
- unrestricted Crown land (for example State forests).

No exploration or mining activities can be carried out on exempt Crown land, unless the licence was in place before the land became exempt. The approval of the Minister for Conservation and Land Management is required before exploration or mining can be carried out on restricted Crown land. On unrestricted Crown land the Minister for Conservation and Land Management's consent is not required, however the Minister must be consulted. Work can start on private land once the consent of the owner and occupier is obtained or compensation arrangements are made.

The principal legislation covering extractive industries in Victoria is the *Extractive Industry Development Act 1996* (EIDA), which provides for granting work authorities for extractive operations. The four main land types under the EIDA are the same as those in the MRDA. Land owner consent is required before extractive activities can be undertaken on freehold land and land manager consent for operations on Crown land.

Mining and exploration is currently excluded from approximately 15 per cent of the land in the North East region (Table 10.5). The consent of the Minister for Conservation and Land Management is required for exploration and mining to be carried out on restricted Crown land which is around four per cent of the region.

**Table 10.5: Land use categories as a proportion of total land area, North East Region**

Land use category	Area (ha)	Proportion of the North East Region (%)
Exempt Crown land	342 750	15
Restricted Crown land	93 300	4
Unrestricted Crown land	818 000	35
Freehold land	1 064 100	46
<b>Totals</b>	<b>2 318 150</b>	<b>100</b>

Source: NRE, Victoria.

### Nature of Exploration and Mining

Mineral exploration is the assessment of the earth's crust to determine if mineral deposits which can be commercially mined are present. Mining is the commercial extraction of mineral deposits from the earth's crust. Whilst there is often a close relationship between exploration and mining, they are effectively two quite separate activities.

In order to examine the implications of alternative land access arrangements for exploration and mining it is important to understand both the nature of exploration and its likely costs and benefits.

The potential benefits for a private firm from an exploration program derive from the economic returns that will accrue from the discovery of an economic deposit. Given that exploration is a high risk activity (that is, there is a small probability of any one venture being successful), companies will approach exploration in a sequential and systematic fashion. This enables the decision to abandon or keep exploring in the area to be made in an efficient manner.

The cost and duration of exploration programs vary from company to company and across commodities. Clark (1996) suggested that the development of a typical major deposit (worldwide) involves a five to twenty year lead time. This estimate results from a typical three to ten years exploration program before the mine development phase.

Exploration is primarily an information gathering process so it is necessarily dynamic, and most regions can never be regarded as 'completely explored'. Many recent Australian discoveries have occurred in known mineral provinces that have been the subject of exploration efforts for over 100 years. There are a number of reasons for continuing exploration in such areas. Technology and scientific understanding of geological processes continue to develop with time. These advances not only encourage exploration in areas where prospectivity was previously considered low, but also lower the costs and increase the efficiency of exploration (for example in highly prospective areas such as Kanowna Belle in Yilgarn, WA and Century in the Mount Isa Inlier, Qld or in areas not previously known to be of very high potential for example Olympic Dam on Stuart Shelf, SA). Further, changing economic conditions (for example, changes in metal prices or the costs of extraction) affect the expected returns from exploration and can significantly affect the level and type of exploration.

The exploration process starts with assessments of very large regions and is then systematically narrowed down as the exploration target becomes better defined. The direct costs facing explorers increase as the target area becomes smaller and exploration methods become more intense. The environmental impact associated with exploration also increases as the area being explored becomes smaller and the exploration methods used become more invasive (for example, drilling), unless special steps are taken to reduce such impacts.

Exploration methods used in the North East region include:

- Regional reconnaissance using remote sensing techniques such as satellite imagery, aerial photography and regional mapping. This exploration phase has little, if any, impact on the land. Activities may cover hundreds of square kilometres in order to identify areas of exploration interest. Geological mapping involves the search for and examination of rock outcrops and exposures in a licence area;
- Sampling in the field which usually involves taking small rock chip, soil or stream sediment samples. Samples are typically obtained by shovel, hand auger or hammer. More intensive sampling and localised mapping may also be carried out using trenches or small pits. All of the above may occur on a surveyed grid;
- Geophysics uses a range of techniques to look for anomalous physical properties indicating structures or mineralisation not visible at the surface. The geophysical properties being assessed include magnetism, electrical conductivity, resistivity or capacitance, gravity, natural radioactivity or seismic properties. Surveys can be airborne for regional surveys, or ground based. The impact of ground-based survey is generally very low, but will vary depending upon the extent of grid and track development required.

The above methods are broadscale in scope and provide information that builds up a picture of where mineralisation is most likely to occur. The most economical way to assess in detail the possible presence of an ore body is by drilling, which may be supplemented by bulk sampling:

- Drilling is usually carried out by truck mounted equipment to yield samples for mineralogical, chemical or metallurgical analysis. Drill holes are usually around 10 cm in diameter. Follow-up-

drilling may be required should earlier drilling show positive results. The impact of drilling on the environment depends on the openness of the vegetation and the topography. Usually drilling rigs are able to be manoeuvred around trees or the drill hole relocated to avoid disturbance of trees. A small level pad, typically around 6 metres square, may need to be constructed to accommodate the drilling rig;

- Bulk sampling gives another level of confidence in the drilling results particularly when gold is not evenly dispersed throughout the ore and coarsely grained. The 'nugget-effect' can give rise to misleading reserve assessments and large samples are needed to overcome it. Bulk samples are usually excavated from a site, typically less than 5 metres deep and 10 metres square.

Rehabilitation of areas disturbed by exploration is required in Victoria.

Compared with exploration, mining generally covers relatively small areas involves greater disturbance to the land surface in the immediate area of the mine, and may leave changed landforms when mining is finished. Mining is generally seen as posing greater difficulties in terms of compatibility with other land uses.

Many potential environmental effects of mining activities can be eliminated or mitigated, though at a cost to the mining company. Relatively limited areas of land are disturbed by the operation of a mine. However, off-site impacts such as water pollution may represent a potential threat to the environment and must be carefully managed. This can be controlled by using techniques such as impoundment and evaporation of tailings, sedimentation, filtration and pH neutralisation. Rehabilitation of mine sites is mandatory in Victoria. Modern site rehabilitation, at the completion of operations, can restore many features of the landscape that existed before mining began, substantially replacing and assisting the re-establishment of vegetation and reducing the potential for pollution from the former mine site.

All mining projects in Victoria require approval under local government planning controls or by preparation of an Environmental Effects Statement. Both processes provide for public input and independent scrutiny of projects. Detailed assessments of impacts on natural values is a routine aspect of mining approvals. Such assessments may include impacts on flora and fauna, water supply, catchment management and public safety.





## 11. SOCIAL ASSESSMENT

### 11.1 INTRODUCTION

Over the past decade, there has been a growing awareness by government, industry and the community of the importance of considering the social implications of decisions. Social assessment is a tool used to predict the future effects of policy decisions upon people, their physical and psychological health, well-being and welfare, their traditions, lifestyles, institutions and interpersonal relationships (D'Amore, 1978).

A social assessment provides a 'snapshot' of the people and communities that may be affected by planning and policy decisions. Detailed information is collected on the social and biophysical environment, the historical background of an area and its response to change, contemporary issues, political and social structures, culture, attitudes, social-psychological conditions, community vitality and population statistics. This information is then used to predict the likely impacts, both positive and negative, which may be experienced by individuals and groups within the community and to determine ways in which such impacts may be managed. As Armour (1990) has outlined, such impacts may include changes that occur in:

- people's way of life (how they live, work, play and interact with one another on a day-to-day basis);
- their culture (shared beliefs, customs and values); and/or
- their community (its cohesion, stability, character, services and facilities).

Social assessment is also a mechanism which can facilitate stakeholder and community participation in the decision making process. Through participatory techniques such as workshops and public meetings, people can become involved in the collection of social information relating to their area. This information is considered critical in the social assessment process, as people who may be directly affected by a particular policy proposal are in the best position to say how such events are experienced.

A variety of data collection methods and data sources have been used as part of the North East social assessment to strengthen the study design and validate the results. The methods included documentary analysis, secondary statistical analysis, mail and telephone surveys, personal interviews, participant observation, informal networking and workshop techniques.

Mail surveys were distributed to forest contractors, timber processing industries, forest user businesses (eg apiarists, seed collectors, firewood collectors, miners and graziers), and tourism operators. Separate questionnaires were distributed to the employees of such business: mill employees, employees of contractor businesses, and tourism guides/ hosts. A total of 1012 surveys were administered with an overall response rate of approximately 35 per cent (variations were evident across different forest user groups).

The community telephone survey undertaken as part of the social assessment work was based on a sample size of 1,100 households. The sample size allowed five sub-regional samples to be drawn from the total population of the North East RFA region, with each sample having a sample size of around 220 (See Map 11.1). The five sub-regional areas were defined on the basis of the percentage of the population within 1991 Census Collector Districts (CCDs) that were employed in forestry and agricultural industries. Contiguous areas with similar percentages of the population employed within forestry and agriculture were then used to define the five sub-regional sectors.

More detailed assessment work was undertaken in a series of case studies covering six communities across the region: Beechworth, Benalla, Corryong, Mansfield, Mt Beauty and Myrtleford. These communities differed in terms of their population size, dependence on forest uses and values, diversity of the local economy and geographic location.

This chapter documents the views of many people in the North East or those with an interest in the forests of the region. The views expressed are not necessarily those of the Steering Committee or the Commonwealth or Victorian Governments.

## **11.2 SOCIAL AND ECONOMIC PROFILE**

In 1996, the total population of the North East RFA region was 174,378 persons. The North East region has experienced consistent growth over the past 10 years (1.3 per cent per annum), and has a relatively high level of residential mobility, in comparison to Regional Victoria taken as a whole. The majority of this growth relates to retirees and the elderly.

North East residents exhibit strong levels of community attachment to the area and the sense of community within the region is generally high. Social infrastructure provision is generally good, though some contraction of services has occurred in recent years. Historically, the region has experienced high ethnic migration which has resulted in a culturally diverse population.

The labour force in the North East is composed of a slightly higher level of white collar employment than regional Victoria taken as a whole. This is consistent with relatively higher household incomes, and higher educational qualifications in the North East, compared to regional Victoria. In 1991, the unemployment rate in the North East (10.3 per cent) was below the regional average for Victoria (12.1 per cent).

The main industries in the North East include community services (16.8 per cent), wholesale industries (16.3 per cent), and manufacturing (11.9 per cent) concentrated in the major regional centres of Benalla, Wangaratta and Wodonga. The North East also has a traditional reliance upon the agriculture and forestry industries which continue to make a significant contribution to the present regional economy (10.5 per cent). The future of the region is seen to lie in the further development of tourism, manufacturing, agriculture and the softwood industry.

## **11.3 CHANGES IN FOREST LAND USE**

In the North East, changes in both Federal and State government policies have required some readjustment of the management of forest resources with subsequent implications for communities in the region. The continual updating of information concerning forest production, conservation, recreation, water, historic and cultural heritage and social values, and the need to balance the provision of these uses and values in management, has provided the impetus for policy change. In Victoria key policy changes have resulted from:

- Victoria's Timber Industry Strategy (1986);
- the Code of Forest Practices (1989);
- the State Plantations Impact Study (1990);
- the National Forest Policy Statement (1992)
- the implementation of former Land Conservation Council recommendations for the use of public land.

The Land Conservation Council conducted numerous inquiries into the protection of public land in the region over the last 25 years. Special investigations relating to plantations, alpine areas, rivers and streams, and wilderness values, addressed a range of issues associated with native forests.

Changes in land use have had some implications for the region. Such impacts include:

- employment loss in the timber industry, due to phase downs and industry contraction;
- reduced access to forest areas for uses such as apiary, cattle grazing and particular tourist operations;
- reduced access for exploration and mining;

- increased opportunities for cultural and nature-based tourism and recreation through the establishment of parks and reserves, historic areas and wilderness.

The LCC collected a large volume of social and economic information on a range of values and uses in the North East and took this into account in making its recommendations in the various studies. This information, for example, has been used to minimise the social and economic impacts of various recommendations on individual enterprises and local communities. The delineation of boundaries for conservation reserves of various kinds has also been undertaken by the LCC to protect significant values, taking into consideration potential adverse impacts on other uses and values.

In addition to documented changes, community perceptions of changes in land use were also examined as part of this assessment. Results of the telephone survey across the region, indicated that 25 per cent of respondents believed there had been some change in the use of forests within their area over the last two years which had affected the community in which they lived. This view was more pronounced in areas with a higher dependence upon timber and forest-related industries, such as those located in the eastern (32 per cent) and south western (29 per cent) sectors of the region. The most commonly reported changes occurring within communities were related to the closure of mills (11 per cent response) and the development of pine plantations (10 per cent response).

A total of 54 per cent of respondents also outlined that a decrease in the use of forests by the timber industry in the future would affect their community. Again, variation was evident across the region, with respondents in the eastern sector most likely to agree with the statement and those in the north west sector least likely to agree. The most significant and singularly important perceived change to the community from a decrease in future timber industry activity was the perceived increase in unemployment and associated financial hardship (83 per cent). An increase in unemployment and associated financial hardship was identified as the most important family impact due to a decrease in the future activity of the timber industry (62.9 per cent).

These findings highlight that timber industry issues are of foremost concern to a large number of people living in rural communities across the region, particularly in the eastern and south western sectors. Issues relating to employment and job certainty and the subsequent flow-on-effects to the local community such as loss of local business and relocation of youth from rural areas were raised as issues of particular importance. Impacts experienced because of limited access to sites were paramount for cattle graziers, apiarists, miners and prospectors.

#### **11.4 STAKEHOLDER VIEWS**

In recent years, there has been a growing interest in forest issues and a considerable increase in the number of groups wishing to influence forest use and management. These groups often bring quite different perspectives and values to particular issues. Often it is those groups in close proximity to the forest, those with pre-existing rights, local knowledge and high dependency that have less power or influence in the forest debate (Colfer, 1995). An analysis of the main issues and the response of different stakeholder groups is useful in predicting how individuals and groups may respond to different policy alternatives.

##### **Forest-related Industry (Timber, Apiary, Seed, Firewood, Grazing, Specialty timbers)**

Issues raised by these groups related predominantly to access to the forest and resource security. Those involved directly in the timber industry sought recognition for its achievements and a more sensitive portrayal of the industry. They desired a sustainable forestry approach, and expressed the desire for industry and employment certainty to allow them to pursue new business and market opportunities and facilitate job creation. Many outlined the desire to minimise conflict through balanced decision making.

Those involved in forest uses other than timber harvesting, questioned particular management practices in relation to their business. For example, apiarists believed that selective harvesting enabled better retention of trees valuable for honey, and there was support for regeneration and reforestation. Concerns were also expressed in regard to maximising the utilisation of wood, protection of flora and fauna and concern over feral animals and weed infestation. Access was a key issue for these groups and their dependence on licences to access and use forested land. Opportunities were seen to lie in continued access for multiple use and the expansion of new markets.

### **Conservation**

Those people particularly interested in conservation expressed concern about forest management practices and their environmental impacts. They expressed a desire for more areas to be placed in National and State parks and reserves. There was some concern expressed over whether they should participate in the RFA process and they questioned the scientific rigour of the work being undertaken, and the lack of external review. Stakeholders also raised issues in relation to loss of biodiversity, wilderness and old growth values, soil erosion, weed infestation, and water quality. Within the North East, major opportunities included expansion of tourism and recreational use of forest areas, further plantation development, support for future environmental protection initiatives (such as salinity works) and the further development of local environmental networks.

### **Tourism**

Tour operators were concerned about some forest management practices, particularly the impacts on biodiversity and the visual impact of harvesting on their operations. Access was identified as an issue and the need to be informed about forestry activities and restrictions on access to public forests due to harvesting activities. Safety issues were also outlined, particularly damage to roads and speed of trucks. Opportunities related to increased linkages between small tourist operators and larger ventures, further potential for the development of eco-tourism and better communication and education on forestry practices for visitors to the region.

### **Mining and Prospecting**

Access to public land was a prominent issue for miners and prospectors, who believed that uncertainty of access resulted in uncertainty for the industry and its workforce. It was expressed that a minimum network of maintained track access was required and that multiple use of forests was appropriate. Concerns were raised in relation to fire management practices. It was indicated that outcomes could be achieved which satisfied both industry and conservation goals.

### **Landholders**

Landholders discussed the need for shared use of forests by industry, tourism and recreational users. Concern was raised about the visual impact of harvesting and the need for adequate buffer zones to minimise the visual impacts of forestry activities. Landholders were concerned about weed infestation and water quality because of harvesting techniques and burning practices. Road damage and safety issues were also outlined. Opportunities for farm forestry and plantation development were considered important on both public and private land.

### **Forest Agencies**

Forest agency staff felt that there was a need to closely monitor water quality and revegetation post-harvest to ensure success and to review any impacts. Maintenance of access roads was considered important, as well as resources for the management of forest areas for both commercial and non-commercial uses. Opportunities relating to better management of forest areas both in parks and State forests were identified, as well as the need to protect natural values and provide for further tourism development.

### **Aboriginal Community**

Aboriginal groups expressed the need for areas of significance to be understood and considered in forest management plans, and the need to understand that Aboriginal groups did not want particular sites of cultural significance to be recorded. More direct dialogue between parties and further training of forestry workers in understanding cultural differences is required. Issues of foremost concern included native title and the use of forested areas for traditional cultural purposes. Concerns regarding the impact of management practices were also raised in relation to water quality. Opportunities focused upon employment for Aboriginal people in forest management and planning, regeneration of forested lands and as cultural officers, further development of Aboriginal cultural tourism and support for bush tucker and revegetation initiatives.

### **Local Government**

Local government representatives focused on planning controls and infrastructure provision, particularly concerning road maintenance and upgrading. Concerns were raised regarding water quality and environmental aesthetics. Opportunities were seen to exist in terms of increased support for farm forestry, improved relationships with the timber industry and the economic benefits of this partnership for local communities.

## **11.5 GENERAL COMMUNITY**

The views of the North East community were obtained through a telephone survey of the region. The results illustrate a range of attitudes and views towards the use and management of native forests across the region. Map 11.1 indicates the sub-regional sectors from which respondents were sampled.

The sample reflected variation in residents proximity to native forest and their level of involvement in forest management, planning and protection. An estimated 68 per cent of the sample indicated that native forest occurred within 10 kilometres of their home. Proximity to native forest areas was particularly high in the eastern (82 per cent) and the central sector (84 per cent). In relation to involvement in forest management, planning and protection, 18 per cent of the population in the North East considered themselves to have been actively involved. This involvement included tree planting (19 per cent), fire prevention (10.8 per cent) and membership of landcare or other similar environmental groups (10.1 per cent).

Thirty six per cent of the North East sample indicated that they, or their families, were employed in forest dependent industries (timber, tourism, mining, beekeeping, seed collection and grazing). A comparison of employment in forest related industries across the five sectors shows that the south west (76.3 per cent) and north west (66.7 per cent) sectors had the highest levels of respondents or family members employed in grazing industries. Employment in timber industries was highest in the central sector (38.8 per cent), while the highest percentage of employment in tourism industries occurred within the eastern Sector (31.4 per cent).

Within the last year an estimated 59 per cent of respondents to the telephone survey visited native forests in Victoria. Twenty two percent visited native forests 'once a month' or more. The visitation of native forests did not differ significantly across the five sub-regional sectors. The three most common native forest areas visited within the last year included: Mount Buffalo (15 per cent), Chiltern (11 per cent) and the Alpine National Park (6 per cent). Respondents reported a wide range of activities undertaken when visiting native forests. The three most popular activities nominated included: walking or bushwalking (52 per cent), picnics and barbeques (21 per cent) and sightseeing (15 per cent).

Thirty percent of respondents were concerned about changes to native forests in Victoria due to human use. The major issues raised by respondents in relation to their concern over the use of native forests included: logging (22 per cent), clear felling of native forests (16 per cent) and the destruction of native forests (7 per cent). When asked to identify the most important issues in relation to native forest

management, respondents nominated cattle grazing on the high plains (20 per cent), regeneration of native forests after logging (19 per cent) and the preservation and protection of native forests for future generations (17 per cent).

The telephone survey included eleven belief statements which were used to identify community views in relation to forest values and management. These belief statements are outlined in Table 11.1 below.

**Table 11.1: General Community Belief Statements**

<b>Belief Statements</b>	<b>Percentage agreement</b>
Forest conservation and protection directly threatens the economic well being of the Victorian community	44.7
Forest industries should have more say in how forests are managed	66.1
Laws to protect native forests limit my choices and personal freedom	27.3
Protecting native forests will threaten jobs for people like me	15.8
Better laws are needed to protect the use of native forests	75.2
I don't think we are managing our native forests very well	64.8
The balance of the forest ecosystem is delicate and easily upset	88.7
I sometimes feel torn between the need for jobs and the need to preserve native forests in Victoria	64.7
One of the main reasons I live in this area is the natural beauty of the forest	68.2
I am very interested in the management and use of native forests in Victoria	86.6
Trees are important for their own sake	96.8

Note: Respondents were asked to (1) strongly agree, (2) agree, (3) disagree, or (4) strongly disagree with each belief statement. Percentage agreement is the percentage of respondents indicating either strongly agree or agree. Source: EBC (1998).

The results indicate that people in the North East value the forests in their region, and are supportive of efforts to better protect native forests and sensitive ecosystems. Over eighty percent of respondents agreed that trees are important for their own sake and that the forest ecosystem is delicate and easily upset. In addition, many respondents identified the natural beauty of the regions forests as a key determinant for deciding to live in the area (68.2 per cent).

The results also indicate that people in the North East are very interested in forest management and planning. The majority of respondents expressed concern over the management of native forests (64.8 per cent) and were supportive of better laws to protect the use of native forests (75.2 per cent). There was also a high level of interest in the management and use of native forests (86.6 per cent), and a recognition that people with an economic dependence on the forest should be more involved in how forests are used and managed (66.1 per cent).

The results also highlighted that people are aware of the importance of forest industries to the region. Many respondents identified that they feel torn between conservation of forests and the need for

employment provided by forest industries (64.7 per cent). Forty five percent felt that the conservation of forest values posed a threat to the economic well being of the Victorian community. Fifteen percent of respondents believed that protecting native forests would directly threaten jobs in their industries.

## 11.6 FOREST INDUSTRY ACTIVITY AND LINKAGES

### The Timber Industry

While the following discussion relates to the hardwood sector of the timber industry, it is acknowledged that some mills receive a combination of both hardwood and softwood resources from the North East. These mills are clearly identified and discussed separately, where appropriate, from the hardwood sector as a whole.

There are ten major processors drawing hardwood resource from native forests within the North East region. Six of these mills are hardwood sawmills located within the region itself at Mansfield, Benalla, Corryong, Mt Beauty and Whitfield. Two other hardwood sawmills are located outside the region in Seymour/Murrindindi and Swifts Creek. These mills draw approximately 17 per cent and 29 per cent of their resource respectively from within the North East region. A further five processors receive a small volume of residual logs or sawmill residues only from the North East, including four sawmills and a woodchip processing facility located in Geelong (discussed in more detail in Chapter 5).

The North East region is comprised of three forest management areas. These areas have quite distinct township resource clusters (TRC), that is communities which are geographically distinct and which are reliant on hardwood resources drawn from these particular forest management areas (FMA). See TRC Map 11.2. For example, the townships of Mansfield, Benalla and Whitfield are townships linked to the Benalla-Mansfield FMA.

Within the Benalla-Mansfield TRC, the townships of Benalla and Mansfield are the primary locations of timber processing and contracting employees. Corryong is the primary location in the Wodonga TRC, and within the Wangaratta TRC, Mt Beauty is the primary workplace location of employees. It is suggested that change in resource availability within each FMA may directly affect specific townships within these particular township resource clusters.

Two mills located at Benalla and Myrtleford are predominantly softwood operations and draw less than 10 per cent of their total intake from hardwood resources from within the region. While these industries do not have a major or direct dependence on native hardwood resources, they are still significant in terms of the large number of workers they employ. The mill at Myrtleford has approximately 350 employees, while the mill at Benalla has 210 employees, these numbers are over four times that of all timber processing industries in the North East region with a direct reliance on the native hardwood resource.

### Forest Industries Employee Profile

An examination of the profiles of forest industry employees, indicates that the majority are employed on a full-time basis (88.2 per cent) and have worked within the industry for an average of 13.2 years, and for their current employer for an average of 10.6 years. Many employees (45.9 per cent) have not worked in other industries, and 28.7 per cent have had to relocate to retain their employment within the industry. The majority have a high school education or have attained TAFE/Trade certificates.

The average age of forest industry employees is 40, over 50 per cent are married and the average family size is three. In terms of community attachment, employees have resided within their respective communities for considerable periods of time (average of 17 years), and participate in about 2 community groups on average. Forty one percent own their own homes outright, 29 per cent are paying off mortgages, and 29 per cent rent their accommodation.

Forest industry families tend to be young to middle age families with approximately 13 per cent of family members being of primary school age. Within the Benalla-Mansfield TRC, primary aged children attend schools located in Mansfield, Benalla and Whitfield, and secondary schools in Mansfield and Benalla. Myrtleford is the main location for attendance at primary and secondary schools in the Wangaratta TRC, and Corryong is the main location for primary and secondary school attendance in the Wodonga TRC.

### **Timber Processing and Contracting Industry Employee Household Expenditure**

In relation to household expenditure, timber processing industries located in the region generate approximately \$20m in annual household expenditure. When all timber processing industries dependent on resources from the North East are considered across all townships (inside and outside of the region) this figure increases to approximately \$23m. Household expenditure from contracting businesses alone contributes an additional \$10m. However, it is important to separate those processing and contracting businesses with a limited dependence on hardwood resources from those industries which have a strong dependence on hardwood resources sourced from the region. The limited hardwood resource dependent processors and contractors, located mainly at Myrtleford and Benalla, generate approximately \$18m in annual household expenditure. Alternately, the main hardwood dependent industries generate approximately \$14m in annual household expenditure, mainly reflecting the expenditure patterns of hardwood sawmill employees.

Within the Benalla-Mansfield TRC, location of expenditure largely occurs in the townships of Mansfield and Benalla. Melbourne and Wangaratta are also important industry expenditure locations for legal and insurance purchases and the purchase of major equipment and vehicles. Within the Wangaratta TRC, the townships of Wodonga, Wangaratta, Myrtleford and Beechworth are primary expenditure townships. Corryong and Wodonga, to a lesser extent, are the main expenditure locations for townships located in the Wodonga TRC.

Overall, there are 3 262 employees and family dependants associated with the timber industry within the region. Of this total, there are approximately 1 336 employees and family dependants associated with those industries with a strong reliance on hardwood resources sourced from the region, with a further 1 926 employees and family dependants associated with limited hardwood resource dependent industries. These figures are likely to be an underestimate, as they do not include businesses and individuals that may be subcontracted or additional contractors and businesses that were not sampled in the survey. The timber industry (including contractors), reliant on resource from the North East region, makes a significant contribution to the local and regional economy with an estimated \$33m in employee household expenditure generated by these businesses each year, with the main hardwood resource dependent industries accounting for at least \$14m of this expenditure.

### **Other Forest-related Industries**

Other forest related industries within the region include apiary, cattle grazing, firewood collection, mining, prospecting, and tourism.

In relation to cattle grazing, there are a total of 610 licence holders across the North East region, including 10 seasonal bush grazing licences and 40 alpine grazing licences. The licensees are widely distributed across the region.

There are a total of 61 permanent bee sites and 145 temporary bee sites licenced in the North East. Two of the most valuable forest species for honey making are the Red Stringy Bark and the Red Box, though other species are used in non-seasonal months. Firewood and seed collection are also common activities within the region. NRE employ contractors to collect seed for regeneration purposes, however little other commercial activity is evident. Firewood is collected from State forests across the region, with the greatest demand for firewood existing in the townships of Benalla, Beechworth, Wodonga and Wangaratta. Collection areas include Mount Pilot Multipurpose Park, Barambogie State Forest, Moyhu Forest Reserve and the Reef Hills Park.



Prospecting is also a common activity across the region, particularly in the areas surrounding Beechworth due to the historic connection of the area with gold mining.

In relation to tourism, the rich heritage and natural features of the region make an important contribution to the economic, social and cultural life of the area. Tourism and recreation are important industries, with a particular emphasis on alpine recreation, water-based activities and cultural heritage. In 1995, the area attracted approximately 1.45 million visitors who spent approximately \$219m. Popular tourist destinations include the alpine resorts (Mount Buller, Falls Creek and Mount Hotham), and the surrounding townships of Bright, Mount Beauty, Mansfield, the historic township of Beechworth and the wine regions, including Rutherglen.

The main centres of Wangaratta and Albury/Wodonga also benefit from visitors to the region. There are a range of recreational and tourist activities associated with the region, these include: trail horse riding, bushwalking, wine tasting, historic sites and museum visits, snow skiing/snowboarding, dining, fishing, camping, four wheel driving and canoeing. Many of these activities are undertaken in both State Forests and National Parks within the region.

A total of 113 tourist operators have licences to use areas of forest within the region. Forty tourism businesses are based within the region itself; 25 of these operations are located in the Wangaratta TRC in townships such as Bright, Beechworth and Mt. Beauty; 10 operators are located in the Benalla-Mansfield TRC with 6 operators located in Mansfield; and there are 5 operators in the Wodonga TRC, 2 of which are located in the township of Corryong.

## **11.7 COMMUNITY CASE STUDIES**

As part of the social assessment process, detailed assessment was undertaken in six communities across the region (Refer to Map 11.3). A variety of methods was used to develop a detailed profile of each community. Information was obtained through secondary data sources such as ABS statistics, shire reports, government publications, and community service directories, and through community workshops and extensive fieldwork in each of the communities. This information was collected in order to provide an assessment of the socio-economic structure, historical response to change, community attachment and to identify forest values and attitudes towards forest use and management.

### **Benalla**

The township of Benalla is a major regional centre with an agricultural, administrative and manufacturing economic base. In Benalla, 2.61 per cent of the population are employed in agriculture and forestry, with a significant proportion of employees working for timber processing and manufacturing operations. Significant changes in Benalla include the shift from a predominantly white collar public sector employee base, to a manufacturing industry base, and the decline in farm profitability within the district. Benalla workshop participants indicated that the major forest issues for the region include water quality, forest management, and the restructuring of forest agencies.

### **Beechworth**

Beechworth is an historic goldmining town, located at the base of the Stanley Plateau. Although mining and timber have been important industries in the past, today the township's forest linkage is largely centred on tourism and recreation, and in particular cultural heritage. Workshop participants identified two key changes that have affected the community: an influx of new residents and the shift from an agricultural and government economic base, to tourism. The community believes it has benefited from an injection of new values, energy and ideas. Due to the increasing importance of tourism, there is concern for the protection of the Stanley Plateau and a need for recognition of non-economic values of the forest.

### **Corryong**

Corryong is a small community situated in the far north east corner of the region. It is a traditional agricultural district and was once a significant hydro-electricity town. Although the number of sawmills has declined in recent years, two hardwood sawmill businesses continue to contribute to the local economy. The community is characterised by strong social and familial ties. Such networks have been critical for the community in adapting to the cumulative impacts of economic contraction and service withdrawals from the region (e.g. closure of butter factory, closure of local railway service). The primary forest issues nominated by workshop participants were unemployment and population loss, due to reductions in timber resource availability.

### **Mansfield**

Mansfield is an agricultural district with a traditional focus on timber production and mining. In recent years, there has been an expansion in the local tourism industry, with a particular emphasis on the surrounding high country for both its heritage value and recreational potential. In Mansfield, 4.61 per cent of the population are employed in agriculture and forestry. Mansfield has experienced a decline in its timber industry base; the township now has only one sawmill operating, whereas in the 1970s there were six sawmills. Workshop participants identified this decline in the timber industry and the subsequent rise in tourism opportunities as the most significant change in the region. Mansfield residents were concerned that the availability of funding to forest agencies would not be sufficient to adequately address a range of forest management concerns, particularly in relation to nature based tourism (e.g. regulation of park visitors).

### **Mount Beauty**

Mount Beauty is located at the foot of Mt Bogong in Victoria's alpine region, and was established in the 1940s to house migrants who worked on the Kiewa hydro-electricity scheme. There is one sawmill in the district that provides significant local employment through production of a variety of value-added products. The most significant change identified by workshop participants has been the downsizing of the hydro-electricity operations. Although this led to significant employment loss, high community attachment to the area has encouraged people to stay and create new employment opportunities, particularly in relation to tourism. Workshop participants expressed a balanced approach to forest management and wanted to see improved forest management practices, multiple use regimes in place, and farm forestry opportunities encouraged.

### **Myrtleford**

Myrtleford is a mixed industrial, commercial and agricultural district, with excellent recreational opportunities and an ethnically diverse community. In Myrtleford, 7.39 per cent of the population are employed in agriculture and forestry (predominantly softwood operations). Workshop participants identified the development of tourism as the most significant change in the district. Promotion of tourism, particularly, the renaming of the Great Alpine Road, has assisted tourism development in Myrtleford. With this dual forest linkage through the softwood industry and tourism, workshop participants raised a spectrum of forest related issues relating to forest management, agriforestry, biodiversity, non-economic value of forests, local employment and ecotourism.

### **Forest Values and Usage**

Forest values and uses were also examined across the six case study areas. 'Representation of Place' maps generated by community workshop participants were used to capture the range and diversity of values people ascribe to their local environment.

It is evident from the community workshops that people living within the North East region participate in a variety of economic, recreational and cultural forest related activities and identify with a range of forest values. The following Table is a summary of the forest values and uses nominated by workshop participants across the six case study areas. Maps and further information from the community workshops are included in the North East Social Assessment report (VicRFASC, 1998c). This

information provides an insight into the variety of values and uses that people associate with the forests of the North East. However, given that it was derived from workshop participants it should not be viewed as a comprehensive assessment of the range of uses or the only locations where those activities or values occur.

<b>Forest Values and Usage</b>
<b>Historic</b> eg historical gold mines, sawmill history, cattlemen's festival, historic areas accessed by 4WD, Italian intern camps, memories of childhood, historic research, aboriginal, hut site, bush rangers, railway lines
<b>Aesthetic</b> eg sightseeing, scenic views from Powers Lookout, native wildflowers, Murmungee landscape, river and surrounds, photography (orchids, fungi), bird and mammal watching, wildflowers, landscape, visual amenity, waterfalls, scenic drives, pink granite rock
<b>Environment</b> eg National Park iron bark stand, environmental policy: Greening Delatite, blue algae at Lake Mokoan, water quality trials, salinity control, mammal surveys, regional parklands, landcare, gemstones, botany, wet sclerophyll forest, water catchments
<b>Recreation</b> eg river fly fishing, camping, horse riding, 4WD, water recreation, skiing, picnicking, boating, great mountain race, winter sports, canoeing, barbeques, swimming, rock climbing, orienteering, mountain bike riding, trail bike riding, deer/ duck hunting, bushwalking
<b>Economic</b> eg tourism, firewood collection, apiary, trail horse operators, farming, timber harvesting and milling, gold mining, vineyard/ wineries, olive production, summer tourism, cattle grazing, plantation development, geological activity, prospecting, ash eucalypt regrowth, blue gum logging, restaurants, experiential and eco-tourism
<b>Social/ Cultural</b> eg sheer enjoyment, Mansfield Country Festival, family ties, Tolmie Spots Day, arts and cultural activities, Mt Pilot full moon parties, visiting friends and family
<b>Education</b> eg nature study, school trips, school camps, timbertop school visits, youth skills development project (portable sawmills), forest interpretation, field naturalist activities, retreats
<b>Safety</b> eg SES/ Police search and rescue

## 11.8 CONCLUSION

The information collected as part of the social assessment process indicates there are a range of positive and negative impacts that may be associated with changes in forest policy within the North East region. These impacts will vary according to geographic location, regional/community context and by stakeholder group.

It is evident from the data collected in the telephone survey, that there is a perception among respondents, particularly those in the eastern and south-western sectors of the region, that a reduction in forest industry activity within the region could adversely impact on their communities. Such change could result in increased unemployment and associated financial hardship.

It is also evident that links exist between small rural communities and other localities within the region. Townships such as Myrtleford, Beechworth, Mount Beauty, Wangaratta and Albury comprise the primary catchment for forest industry expenditure. Many of these townships also constitute a secondary catchment, with the inclusion of townships such as Bright and Wodonga. The tertiary

catchment extends beyond the main centres of Wangaratta and Wodonga to Seymour and Melbourne. An understanding of the linkages between resource use, communities and other localities within and outside of the region is important in determining the extent and nature of positive and negative impacts likely to be experienced as a result of changing land use.

In summary, the North East region has a diverse economic base. The region is well serviced by the regional centres of Benalla, Wodonga and Wangaratta, and social infrastructure provision is good. The region is experiencing growth in particular industries such as tourism and recreation, though it is perceived that agriculture and plantation development also provide future regional economic opportunities.

While the data collected in the social assessment will be used to inform the RFA decision making process, it is hoped that this information may also be useful in facilitating future social and economic development within the North East region.

## 12. BIODIVERSITY

### 12.1 INTRODUCTION

Biological diversity is the variety of all life forms and is usually considered at three levels:

- ‘Genetic diversity’ refers to the variety of genetic information contained in all individual plants, animals and micro-organisms.
- ‘Species diversity’ refers to the variety of living species.
- ‘Ecosystem diversity’ refers to the variety of habitats, biotic communities and ecological processes.

The National Forest Reserve Criteria (JANIS 1997), jointly developed by the Commonwealth and States, identifies the following objectives of biodiversity conservation:

- to maintain ecological processes and the dynamics of forest ecosystems in their landscape context;
- to maintain viable examples of forest ecosystems throughout their natural ranges;
- to maintain viable populations of native forest species throughout their natural ranges; and
- to maintain the genetic diversity of native forest species.

To achieve these objectives, the National Forest Reserve Criteria include a number of biodiversity criteria for establishing a Comprehensive, Adequate and Representative (CAR) reserve system. These are outlined in the box below.

The strategy for conserving biodiversity relies not just on a CAR reserve system, but also on the application of ecologically sustainable forest management practices in off-reserve areas.

Both the Commonwealth and Victoria have a number of responsibilities in connection with the conservation of biodiversity. A list and description of key Commonwealth and State legislation relating to RFAs in Victoria is given in Appendix 1.

#### ***Summary of the biodiversity criteria***

1. As a general criterion, 15 per cent of the pre-1750 distribution of each forest ecosystem should be protected in the CAR reserve system.
2. Where forest ecosystems are recognised as vulnerable, then at least 60 per cent of their remaining extent should be reserved.
3. All remaining occurrences of rare and endangered forest ecosystems should be reserved or protected by other means as far as is practicable.
4. Reserved areas should be replicated across the geographic range of the forest ecosystem to decrease the likelihood that chance events such as wildfire or disease will cause the forest ecosystem to decline.
5. The reserve system should seek to maximise the area of high quality habitat for all known elements of biodiversity wherever practicable, but with particular reference to:
  - the special needs of rare, vulnerable or endangered species;
  - special groups of organisms, for example species with complex habitat requirements, or migratory or mobile species;
  - areas of high species diversity, natural refugia for flora and fauna, and centres of endemism; and
  - those species whose distributions and habitat requirements are not well correlated with any particular forest ecosystem.
6. Reserves should be large enough to sustain the viability, quality and integrity of populations.
7. To ensure representativeness, the reserve system should, as far as possible, sample the full range of biological variation within each forest ecosystem.
8. In fragmented landscapes, remnants that contribute to sampling the full range of biodiversity are vital parts of a forest reserve system and should be protected.

## 12.2 METHODS USED IN BIODIVERSITY ASSESSMENT

The Victorian and Commonwealth Governments have agreed that the North East biodiversity assessment should be undertaken at the species and ecosystem levels (see above) and should include reviews of the main threats to such biodiversity in the region. Because information about genetic variation within species is very limited and costly to obtain, genetic diversity was not assessed, although it is recognised that it does overlap with species and ecosystem diversity and these are addressed by the National Forest Reserve Criteria.

The biodiversity assessment has therefore been based on an analysis of information about forest ecosystems and communities, flora and fauna species and their habitats, and the threats to these in the region. This chapter is based on the findings of the North East Comprehensive Regional Assessment Biodiversity Assessment Report (VicRFASC 1998b). Additional references relating to the information provided in this chapter can be found in the Biodiversity Assessment Report.

### Data Review

Biodiversity assessment relies on having adequate information about the distribution of species. It is important to know whether or not surveys undertaken for species or groups of species have been adequately distributed across the range of environments represented within the region. As part of this assessment, analyses were undertaken to determine where surveys for biodiversity were undertaken in the North East region, which species were targeted, and whether survey sites are reasonably distributed to detect most species in most geographic or environmental components. The results of these analyses were used to highlight gaps in information and identify those areas which may require further survey work.

### Ecosystem Assessment

Ecological Vegetation Classes (EVCs) have been used as the basis of the forest ecosystem diversity assessment for the North East. EVCs are derived from a Statewide level of vegetation classification and are considered to be the most appropriate units for assessing biodiversity conservation at the landscape scale in Victoria (Comprehensive Regional Assessment, East Gippsland: Environment and Heritage Report - ref VicRFASC 1996a). The first part of the assessment involved determining and mapping the types of forest communities occurring in the North East today and the area occupied by each. An analysis and mapping exercise was also completed to determine how much of each forest type may have occurred prior to European settlement in order to provide an assessment of the extent to which each type is protected in proportion to its pre-1750 extent and how much of each type has been lost.

### Target Flora and Fauna Groups (Priority Species)

Species which are threatened (endangered or vulnerable to extinction), declining in numbers, patchy in distribution, migratory or mobile, good indicators, or unique to the region have been reviewed in this assessment. All nationally endangered or vulnerable forest species listed under the Commonwealth *Endangered Species Protection Act 1992* and known to occur in the region were considered a high priority, as were species listed under the Victorian *Flora and Fauna Guarantee Act 1988*.

### Vulnerability Assessment

The degree to which a species is vulnerable to extinction is influenced by a number of factors. These include characteristics or attributes of the species itself such as its habitat requirements, reproductive output and longevity. Other factors such as rarity and whether populations are increasing or decreasing (possibly due to extrinsic factors), are also important in determining the risk of decline or extinction. Vulnerability assessments were conducted for several North East flora and fauna species of conservation significance. This information assists in identifying and prioritising those species which are most in need of management actions to improve the prospects for their long-term survival.

### **Reservation Analysis**

Reservation analysis is another component of the Comprehensive Regional Assessment process. Essentially it is an analysis to identify the degree to which a species or vegetation community is known to be represented in reserves within the region. The results of such analyses can be used to assist in the identification of species and communities that require particular attention because of their special conservation needs. Conservation objectives can in some cases be met by increasing representation of populations and communities within reserves and/or minimising the impacts of threatening processes throughout the forested estate. Reservation analyses have been conducted for flora, fauna and EVCs.

### **Disturbances (Threatening Processes)**

The decline of species can be largely attributed to the impacts of disturbances, both directly on the species and indirectly on essential components of their habitat. For example, predation of Broad-toothed Rats by introduced species such as Foxes and feral Cats has a direct effect on population numbers, whereas grazing of its habitat by domestic stock can indirectly affect its chances of survival by altering essential components of its habitat such as food and shelter. Disturbances which can have negative effects (direct or indirect) on a species are referred to as potentially threatening processes. This assessment describes potentially threatening processes relevant to the North East and the management arrangements currently in place to address these.

## **12.3 DATA REVIEW FOR TERRESTRIAL SPECIES**

### **Introduction**

The data review process involves systematically working through databases to determine the adequacy of information about the distribution of species within the North East region. This information is important for understanding the distribution of flora and fauna and relating this to their habitat requirements. The data review relies on expert knowledge and professional judgement but is supplemented by explicit analyses where appropriate. The methods described here were used for terrestrial flora and fauna only - the data review for aquatic species is discussed in section 12.8.

The first step in the process is to select only those survey data which meet required standards of accuracy, precision and reliability. This allows a degree of confidence when analysing the distribution of species.

The next step involves assessing the extent to which the site records for flora and fauna are representative samples of the environmental and geographic variation of the region. This is achieved by dividing the region into units or “strata” which exhibit similar sets of environmental factors or variables. Although there are many variables to choose from (eg temperature, rainfall, elevation, slope), those which are considered to most influence the distribution of species in that region are selected to create the stratification. Each stratum may be represented by several discrete areas (or substrata) within a region.

These strata and substrata are then analysed to determine how well each has been surveyed for flora and fauna. That is, the density of survey sites is determined for each (such as number of survey sites per 10 000 ha). Calculations are also made for each stratum of the probability of encountering species that have not previously been recorded in surveys there.

### **Methods**

Analyses of the variation in annual rainfall, temperature extremes and rock types across the region were used to classify the major types of environments occurring in the North East. The classification analysis identified 133 different strata for the region, characterised by a combination of rainfall, temperature and rock type. They ranged in size from 3.4 to nearly 220 000 hectares. It is important to note that only forested areas were considered. Reassigning very small strata to larger strata which are spatially and environmentally similar resulted in the number of strata considered in the analysis being reduced to 97. Fourteen of the 97 strata had an area of less than 500 hectares each. These small strata

comprised only 0.2 per cent of the area under forest cover, and were not evaluated. This environmental stratification was subsequently used for the analyses of flora and fauna databases presented below.

### Flora

The dataset used for the assessment of the North East flora was derived from the Flora Information System of Victoria (NRE 1998a), and the Victorian Rare or Threatened Plant Population database (NRE 1998b). It comprises all available data from vegetation surveys and studies of the region and includes 1730 site records.

The distribution and density of site records (summarised in Table 12.1), together with cumulative species curve analysis (probability that the next species encountered for a stratum would not already have been encountered), were used to evaluate the adequacy of sampling of the environmental variation in the region.

**Table 12.1: Proportion of flora sampling density classes for the North East region**

Density class	Sampling density for flora sites/10 000 ha)	Number of strata	Total area (ha)	% of forest in the North East region
high	40-100	3	48 529	4%
moderate	10-40	20	219 872	16%
low	>0-10	40	1 040 668	77%
zero sites	0	20	42 088	3%

The flora survey coverage of the North East is not as comprehensive as that of the East Gippsland and Central Highlands RFA regions. The majority of the region (77 per cent of forested area) is considered to have a low flora survey intensity (26 of the 34 largest strata (>10 000 ha each) fall into this category). However, cumulative species curve analysis suggests a more adequate data coverage than the survey intensity analysis, with 65 per cent (20 strata) of the forested area of the region having probabilities of  $\leq 20$  per cent that the next species will be new.

This situation is partly explained by the historical pattern of flora survey. Some parts of the region, particularly the alpine and subalpine areas, have been intensively surveyed in the past. In preparation for the Ecological Vegetation Class mapping project for this assessment, 348 new sites were surveyed for flora, and while this significantly improved the spread of flora survey sites across the region, parts of the North East remain more intensively sampled than others.

### Fauna

In Victoria, much of the existing site data for fauna has come from incidental records, rather than systematic survey. Thus, a lack of surveyed sites in certain strata does not necessarily mean that the strata have not been sampled; rather, it means that the information may not have been appropriate for use in this analysis.

The site-based biological data sets used in the fauna assessment were drawn from the Atlas of Victorian Wildlife. Survey data were analysed for each of the species groups indicated in Table 12.2.

As was done for flora, the distribution and density of survey site records were used to evaluate the adequacy of sampling of the environmental variation in the region. The 83 strata larger than 500 hectares were included in the evaluation. Strata with low densities of sites were identified. The probability of the next species recorded for a particular stratum being new (i.e. not previously recorded in surveys for that fauna group in that stratum) was used as an indication of the adequacy of sampling effort. The analysis was confined to the 34 most extensive strata which range from 16 per cent to



0.8 per cent of the area (totalling 86 per cent of the area). A summary of results for these strata is given in Table 12.2.

**Table 12.2: Adequacy of terrestrial vertebrate fauna survey, by species group**

Faunal group	Arb- oreal Mamm.	Large Mamm.	Small Ground Mamm.	Bats	Diur- nal Birds	Noc- turnal Birds	Large Forest Owls	Rep- tiles	Amph- ibians
Number of sites surveyed	871	2173	2640	1324	1158	586	947	797	804
Number of the 83 strata with surveys	64	66	57	49	62	60	61	48	48
Number of the 34 largest strata with surveys	34	34	34	31	34	33	34	34	34
Number of the 34 largest strata with low probability ( $\leq 5$ per cent) of new species in next survey	11	11	18	24	14	13	4	5	4

Of the 34 largest strata generated by the stratification of the North East RFA region, between 31 and 34 contained surveyed sites for each of the fauna groups considered. Bats, diurnal birds and small ground mammals are the groups most comprehensively surveyed across the region, based on them having the most large strata with low probabilities of new species being detected. Arboreal mammals, large mammals and nocturnal birds have been moderately well surveyed. Additional surveys for reptiles are most likely to detect species not previously recorded in surveys. The reported figures are difficult to interpret for amphibians and large forest owls since these groups comprise very few species.

## 12.4 FOREST ECOSYSTEM ASSESSMENT

### Introduction

Assessment of forest ecosystems is important to determine whether representative examples of these ecosystems and the natural ecological processes that support them are maintained throughout their natural range. The assessment of forest ecosystems has involved describing, mapping and analysing the distribution and variation of these ecosystems in the North East.

Ecological vegetation classes (EVCs) are the basic mapping units used for biodiversity planning and conservation assessment at landscape, regional and broader scales in Victoria. They are derived from large-scale forest type and plant community mapping and are based on the following types of information:

- plant communities and forest types (including species and structural information);
- ecological information relevant to the species that comprise the communities (including life form and reproductive strategies); and
- information that describes variation in the physical environment (including aspect, elevation, geology and soils, landform, rainfall, salinity and climatic zones).

Each EVC represents one or more plant communities that occur in similar types of environments. The communities in each EVC tend to show similar ecological responses to environmental factors such as disturbance (for example, wildfire). As well as representing plant communities, the EVCs can be used as a guide to the distribution of individual species and groups of species, including animals, and lower plants such as mosses and liverworts.

Ecological Vegetation Classes have been accepted as robust and appropriate units for assessing forest ecosystem diversity and conservation at the landscape scale, provided that the variability within widely distributed EVCs is also considered as part of the assessment (EVC Methodology Paper, Appendix G, Comprehensive Regional Assessment, East Gippsland: Environment and Heritage Report - ref VicRFASC 1996a). A detailed description of the EVC concept can also be found in that report.

A total of 58 EVCs have been identified as currently occurring in the North East. These EVCs have been mapped across all land in the region at a scale of 1:100 000. The North East EVCs are listed in Table 12.3. A detailed description of each EVC is available in the North East Biodiversity Assessment Report for the CRA. It should be noted that half of the EVCs in the North East are described as mosaics or complexes (see Table 12.3 footnotes for definitions).

To allow a comparison of the current distribution of each EVC with its approximate distribution prior to European settlement, a map of the pre-1750 distribution of EVCs in the North East region has been constructed (see Map 3). The map is based on predictions derived from existing vegetation, a variety of physical environmental attributes, and expert knowledge.

EVCs which were not recorded in the public land vegetation mapping of the study area occur either on fertile lowland, riverine plains or rolling hills which have been largely cleared for agriculture, or occur on less fertile areas that have been cleared for urban development on the fringes of the larger towns.

### **Reservation Status of Ecological Vegetation Classes**

A reserve system that is comprehensive, adequate and representative in its regional coverage of forest ecosystems is an important component of the Regional Forest Agreement for the North East. The extent of representation of EVCs in conservation reserves has been used as the basis for evaluating the current reservation status of forest ecosystems in the region.

Table 12.3 shows the distribution of EVCs across all land tenures in the North East. Descriptions of some of the land tenure categories represented in the table are as follows:

**Conservation:** includes Wilderness Parks, National Parks, State Parks, Regional Parks (where timber harvesting does not occur), Flora Reserves and Fauna Reserves, Natural Features Reserves, Heritage Rivers and Essentially Natural Catchments established under the Heritage Rivers Act, and Remote and Natural Areas not available for timber harvesting.

**Other Parks and Reserves:** this category includes historic and cultural features reserves, where timber harvesting may be permitted.

**Other Public Land:** includes land managed by the Victorian Plantations Corporation and water supply authorities.

Thirty-one of the EVCs occur predominantly on private land, with the remaining 27 occurring mainly on public land. For those EVCs that are not considered endangered, vulnerable or rare, the national reserve criteria reservation target of 15 per cent of the pre-1750 extent has been met for all EVCs except Grassy Dry Forest.

For many of the EVCs which are endangered, vulnerable or rare as a result of depletion (Table 12.8), the only occurrence outside conservation reserves is on private land. This reflects the historic demarcation between public land and the selection of arable lands for farming associated with private land.

### **Sub-regional reservation of Ecological Vegetation Classes**

The North East region has been divided into 19 Geographic Representation Units (GRUs) based on variation in land form, geology, vegetation and climate across the region (Table 12.4). The GRUs reflect environmental change in the region at a landscape scale. These GRUs are shown on Map 1.

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**Table 12.3: Representative conservation (percentage reservation status) of EVCs in the North East region based on pre-1750s vegetation mapping**

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**Table 12.4: Geographic Representation Units in the North East region**

<b>Geographic Representation Unit (GRU)</b>	<b>Description</b>
Barry Mountains	Montane to sub-alpine steep sided dissected ranges dissected by broad, fertile river valleys. River valleys of Quaternary alluviums. Ranges dominated by Ordovician marine sediments with Devonian granites and other volcanics, Devonian sediments and Carboniferous sediments. Rainfall high to very high.
Big Ben Foothills	Dissected foothills and steep-sided low mountains. Devonian and Silurian granites and Silurian metamorphics with smaller areas of Ordovician sediments. Rainfall low to very high.
Big River Mountains	Steeply dissected mountain ranges dissected by broad, fertile valleys of major rivers. River valleys with Quaternary alluviums. Ranges dominated by Devonian and Ordovician sediments with Carboniferous sediments, Devonian granites and granodiorites, Devonian metamorphics and Tertiary basalts. Rainfall high to very high.
Bogong Mountains	Steeply dissected ranges and alpine/sub-alpine plateaux with complex faulting. Ordovician metamorphics with smaller areas of Silurian/Ordovician granite/granodiorite and plateaux outcrops of Tertiary basalt. Rainfall high to very high.
Buffalo Mountains	Steep sedimentary hills (Mt Buffalo granite massif the most dominant feature) and narrow river valleys with restricted flats. Ordovician sediments with Devonian granites. Rainfall low to very high.
Corryong Foothills	Three distinct mountain ranges of Devonian granite and Devonian acid volcanics interspersed by broad valleys of Quaternary sediments and older alluvial terraces no longer subject to flooding. Rainfall low to high.
Dartmouth Mountains	Steeply dissected ranges and sub-alpine areas. Dominated by Ordovician and Silurian sediments with substantial areas of Silurian acid volcanics and a small area of Ordovician granodiorite. Rainfall high to very high.
Delatite Valley	Undulating foothills and fertile plains and river flats to dissected mountain ranges in the east. Foothills and ranges predominantly Carboniferous sediments with Devonian sediments, Devonian metamorphics and Devonian volcanics. Broad river valleys of Quaternary alluviums. Rainfall moderate to high.
Granya Foothills	Low rolling hills of Silurian and Devonian granites to the east of the unit with Ordovician metamorphics west of Bullioh. Rainfall low to high.
Highlands Foothills	Kobyboyn and Callen Ranges, gently rolling hills of Devonian Granite with minor Devonian and Silurian sediments. Rainfall generally moderate.
King River Floodplain	Plain of recent Quaternary sediments (mostly alluvial) and low hills of Ordovician sediments. Rainfall low to high.

<b>Geographic Representation Unit (GRU)</b>	<b>Description</b>
Matlock Mountains	Steeply dissected ranges. Devonian and Silurian sediments. Rainfall low to moderate.
Mitta Foothills	Dissected hills. Equally dominated by Ordovician metamorphics and sediments with smaller areas of Silurian granite and granodiorite and Quaternary sediments along major streams. Rainfall high to very high.
Mt Pilot Foothills	Low, gentle foothills of Devonian granite and narrow plains of Quaternary alluvial sediments with substantial colluvial sediments on the footslopes above plains. Contains substantial areas of alluvial plains through which rise low Ordovician sedimentary hills (Chiltern area). Rainfall low to high.
Pinnibar Mountains	Steeply dissected ranges. Ordovician sediments and substantial Ordovician/Silurian granodiorites and smaller areas of Ordovician metamorphics. Rainfall generally very high.
Strathbogie Foothills	Steep hills rising from plains and broad granite plateaux. Devonian acid volcanics and granites. Rainfall moderate to high on the granite plateau of Strathbogie Ranges, with the decline running northwards.
Tallangatta Foothills	Moderately steep hills dominated by Silurian granite, granodiorites. Rainfall high to very high.
Toombullup Foothills	Low, rolling hills and steep-sided foothill plateaux and Quaternary alluvial plains. Geology/lithology is complex and includes Devonian granites, acid volcanics, Ordovician sediments, Carboniferous sediments, Tertiary volcanics and Cambrian greenstones. Rainfall low to high, declining northwards.
Upper King Mountains	Steeply dissected ranges and broad, fertile river valleys. Ranges predominantly Devonian volcanics and Ordovician sediments with Devonian metamorphics, Tertiary basalt volcanics, and Carboniferous sediments. River valleys quaternary alluviums. Rainfall high.

**Note:** Rainfall is classified as low (<700mm), moderate (700-1000mm), high (1000-1200mm) or very high (>1200mm).

An analysis of the percent reservation of pre-1750 EVCs within each GRU can assist in evaluating the extent to which the reserve system encompasses regional variation in forest ecosystems. The results of this analysis are presented in Table 12.5.

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**Table 12.5: Representative conservation ( per cent reservation status) of EVCs in the North East region by Geographic Representation Unit**

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### ***Reservation of floristic variation across EVCs***

The extent to which the reserve system includes a representative sample of the floristic communities within each EVC has also been assessed. This analysis also assists in evaluating the extent to which the reserve system encompasses regional variation in forest ecosystems.

Thirteen of the non-mosaic EVCs are comprised of more than one (mostly 2-5) floristic community in the North East region. Based on current information, three floristic communities, Foothill Grassy Woodland 1, Perched Boggy Shrubland and Riverine Escarpment Scrub, are not represented in reserves.

### ***Reservation status of Ecological Vegetation Class growth stages***

Forest disturbance categories have been used to represent the major growth stages that characterise the dynamics of forests in the region. The growth stage/disturbance categories used have been derived from Woodgate *et al.* (1994), and include:

1. Old-growth Forest - a definition may be found in the old-growth chapter of this report;
2. No Recorded Disturbance - forests which are not old-growth where no records of disturbance are found, mature forest with no recorded disturbance can be categorised as negligibly disturbed forest and regrowth forest with no recorded disturbance can be categorised as significantly disturbed forest;
3. Negligibly Disturbed Forest - forest which has less than 10 per cent of the oldest trees (senescing) growth stage and less than 10 per cent of its youngest (regrowth) growth stage in the upper canopy layer, and where the effects of any disturbance are negligible or non-existent;
4. Significantly Disturbed Forest - forest which has greater than 10 per cent of its youngest (regrowth) growth stage in the upper canopy layer, and has been subject to natural disturbance, for example, wildfire;
5. Temporary Significant Unnatural Disturbance - associated with a number of years since the last fire event, typically 1-10 years. Forests which are not old-growth and have been subject to temporary significant unnatural disturbance can be categorised as negligibly disturbed forest (mature forest) or significantly disturbed forest (regrowth forest).
6. Other Forest - non-forest EVCs.

The reservation status of EVCs on public land in the region has been assessed for each of the above forest disturbance categories (Table 12.6). The corresponding percent protection figure refers to the proportion of the total area protected in conservation reserves. The extent of reservation of the old-growth forest growth stage is between 26 per cent and 99 per cent for the EVCs examined (Table 12.6).

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**Table 12.6: Extent and level of protection for different forest growth stages and disturbance categories in the North East region**

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### Threatened Forest Ecosystems

The conservation status of EVCs in the North East has been assessed using the criteria derived from the National Forest Reserve Criteria (JANIS 1997) (see Table 12.7).

**Table 12.7: The National Forest Reserve (JANIS) criteria used to assess the conservation status of EVCs**

Status of EVC	Criteria
Rare	R1. Total range generally less than 10 000 ha. R2. Total area generally less than 1 000 ha. R3. Patch sizes generally less than 100 ha.
Vulnerable	V1. Approaching greater than 70 per cent lost (depletion). V2. Includes EVCs where threatening processes have caused: <ul style="list-style-type: none"> <li>• significant changes in species composition,</li> <li>• loss or significant decline in species that play a major role within the ecosystem, or</li> <li>• significant alteration to ecosystem processes.</li> </ul> V3. Subject to continuing threatening processes.
Endangered	E1. Distribution has contracted to less than 10 per cent of original range. E2. Less than 10 per cent of original area remaining. E3. 90 per cent of area is in small patches subjected to threatening processes.

A total of 46 EVCs from the North East have been classified as endangered, vulnerable or rare - these are listed in Table 12.8.

**Table 12.8: Endangered, vulnerable and rare Ecological Vegetation Classes in the North East, their percent reservation in the region, threatening processes, and current management mechanisms available to address threats**

EVC	Criteria	% Res. <sup>1</sup>	Threatening Processes <sup>2</sup>	Management Mechanisms <sup>3</sup>
Clay Heathland	R1, R2, R3	25.4	-	
Riparian Forest	R3, V2, V3	19.0	weed invasion, grazing, recreation, mining	Native Vegetation Retention Controls (NVR) Weed control Exclusion from timber harvesting through buffers
Riparian Shrubland	R3	56.5	-	
Heathy Dry Forest	V2, V3	29.9	inappropriate fire regimes (frequency, season of burn and intensity)	NVR Code of Practice for Fire Management on Public Land

<b>EVC</b>	<b>Criteria</b>	<b>% Res.<sup>1</sup></b>	<b>Threatening Processes<sup>2</sup></b>	<b>Management Mechanisms<sup>3</sup></b>
Valley Grassy Forest	V1, V2, V3	0.8	weed invasion, grazing, firewood and post and pole production	NVR <i>Land for Wildlife</i>
Heathy Woodland	R1, R2	-	-	
Plains Grassy Woodland	V2, V3, E2, E3	0.0	habitat loss, clearing, agriculture, fragmentation, grazing, weed invasion, road construction and maintenance	NVR <i>Land for Wildlife</i>
Floodplain Riparian Woodland	V2, V3, E2, E3	1.9	habitat loss, clearing, agriculture, fragmentation, alteration of flooding regimes, grazing	NVR <i>Land for Wildlife</i>
Swampy Riparian Woodland/Perched Boggy Shrubland Mosaic	R1, R2, R3, V1, V2, V3, E3	-	clearing for agriculture, grazing, weed invasion	NVR <i>Land for Wildlife</i>
Box Ironbark Forest	V1, V2, V3	15.0	timber harvesting, firewood and post and pole production, grazing, mining, habitat loss, fragmentation, weed invasion	NVR <i>Land for Wildlife</i>
Alluvial Terraces Herb-rich Woodland	R1, R2, V2, V3, E2, E3	3.8	firewood and post and pole production, grazing, clearing, habitat loss, fragmentation, weed invasion	NVR <i>Land for Wildlife</i>
Creekline Grassy Woodland	R3, V2, V3, E2, E3	0.3	firewood and post and pole production, grazing, clearing, habitat loss, fragmentation, weed invasion	NVR <i>Land for Wildlife</i>
Rocky Outcrop Shrubland/Herbland Mosaic	R3	67.4	-	
Wetland Formation	V2, V3, E2, E3	-	altered water /drainage regimes, grazing, weed invasion, habitat loss, salination	NVR Fencing <i>Land for Wildlife</i>
Alluvial Terraces Herb-rich Woodland/ Wetland/Heathy Dry Forest Mosaic	R1, R2	66.9	-	
Spring Soak Herbland	R1, R2, R3, V1, V2, V3, E3	0.3	grazing, timber harvesting, altered water regimes, weed invasion, agriculture	NVR <i>Land for Wildlife</i>
Alluvial Terraces Herb-rich Woodland/ Creekline Grassy Woodland Mosaic	R1, R2, R3, V2, V3, E2, E3	-	weed invasion, grazing, timber harvesting , agriculture, fragmentation, habitat loss	NVR <i>Land for Wildlife</i>
Riverine Escarpment Scrub	R1, R2	22.4	-	
Swampy Riparian Woodland	V2, V3	8.4	weed invasion, grazing, mining	Fencing Weed control <i>Land for Wildlife</i>
Riparian Mosaic - North East	R3, V2, V3	6.0	weed invasion, grazing, recreation, mining	
Valley Heathy Forest	R3, V2, V3, E2, E3	0.7	clearing, agriculture, habitat loss, weed invasion	NVR <i>Land for Wildlife</i>

<b>EVC</b>	<b>Criteria</b>	<b>% Res.<sup>1</sup></b>	<b>Threatening Processes<sup>2</sup></b>	<b>Management Mechanisms<sup>3</sup></b>
Alluvial Terraces Herb-rich Woodland/ Plains Grassy Woodland Complex	R1, R2, V2, V3, E2, E3	1.6	habitat loss, clearing, agriculture, fragmentation, grazing, weed invasion, road construction and maintenance, firewood collection and post and pole production	NVR <i>Land for Wildlife</i>
Alluvial Terraces Herb-rich Woodland/ Valley Grassy Forest Complex	R1, R2, V2, V3, E2, E3	0.2	firewood collection and post and pole production, grazing, clearing, habitat loss, fragmentation, weed invasion	NVR <i>Land for Wildlife</i>
Grassy Dry Forest/ Rocky Outcrop Shrubland/Herbland Mosaic	R1, R2, V1, V2, V3	-	weed invasion, grazing, agriculture, clearing	NVR <i>Land for Wildlife</i>
Grassy Woodland	V2, V3, E2, E3	0.2	grazing, weed invasion, habitat loss, fragmentation, clearing, agriculture, lack of fire	NVR <i>Land for Wildlife</i>
Perched Boggy Shrubland	V1, V2, V3, E3	-	clearing for agriculture and conifer plantations, altered water regimes, weed invasion, fragmentation, habitat loss, grazing	NVR <i>Land for Wildlife</i>
Plains Grassy Woodland/Floodplain Riparian Woodland Complex	V2, V3, E2, E3	-	habitat loss, clearing, agriculture, fragmentation, grazing, weed invasion, road construction and maintenance, alteration of flooding regimes	NVR <i>Land for Wildlife</i>
Plains Grassy Woodland/ Rainshadow Grassy Woodland Complex	R1, V2, V3, E2, E3	-	habitat loss, clearing, agriculture, fragmentation, grazing, weed invasion, road construction and maintenance, clearing, lack of fire	NVR <i>Land for Wildlife</i>
Plains Grassy Woodland/Valley Grassy Forest Complex	V2, V3, E2, E3	-	habitat loss, clearing, agriculture, fragmentation, grazing, weed invasion, road construction and maintenance, firewood collection and post and pole production	NVR <i>Land for Wildlife</i> Habitat tree prescriptions
Plains Grassy Woodland/Valley Grassy Forest/ Rainshadow Grassy Woodland Complex	R1, V2, V3, E2, E3	-	habitat loss, clearing, agriculture, fragmentation, grazing, weed invasion, road construction and maintenance, firewood collection and post and pole production, habitat loss, fragmentation, clearing, agriculture, lack of fire	NVR <i>Land for Wildlife</i>
Valley Grassy Forest/ Box Ironbark Forest Complex	R3, V2, V3, E2	-	weed invasion, grazing, firewood collection and post and pole production, mining, fragmentation, habitat loss	NVR <i>Land for Wildlife</i>
Gilgai Plain Woodland/Wetland Mosaic	R2, V2, V3, E2	2.8	altered flooding regime, weed invasion, clearing for agriculture, grazing, timber harvesting	NVR <i>Land for Wildlife</i>
Riparian Forest/ Swampy Riparian Woodland Mosaic	V2, V3, E2	0.2	weed invasion, grazing, recreation, mining	<i>Land for Wildlife</i>
Plains Grassy Woodland/Creekline Grassy Woodland/Floodplain Riparian Woodland Mosaic	R1, R3, V2, V3, E2, E3	-	habitat loss, clearing, agriculture, fragmentation, grazing, weed invasion, road construction and maintenance, firewood collection and post and pole production, alteration of flooding regimes	NVR <i>Land for Wildlife</i>

EVC	Criteria	% Res. <sup>1</sup>	Threatening Processes <sup>2</sup>	Management Mechanisms <sup>3</sup>
Plains Grassy Woodland/Creekline Grassy Woodland/Wetland Mosaic	V2, V3, E2, E3	-	habitat loss, clearing, agriculture, fragmentation, grazing, weed invasion, road construction and maintenance, firewood collection and post and pole production, altered water /drainage regimes, altered water /drainage regimes, salination	NVR <i>Land for Wildlife</i>
Valley Grassy Forest/ Plains Grassy Woodland Mosaic	R2, V2, V3, E2, E3	-	weed invasion, grazing, firewood collection and post and pole production, habitat loss, clearing, agriculture, fragmentation, road construction and maintenance	NVR <i>Land for Wildlife</i>
Grassy Dry Forest/ Shrubby Granitic-outwash Grassy Woodland Mosaic	R1, R2, R3, V2, V3, E2, E3	-	grazing, weed invasion, habitat loss, fragmentation, clearing, agriculture, lack of fire	NVR <i>Land for Wildlife</i>
Granitic Hills Woodland/Heathy Dry Forest Mosaic	R1, R2, R3	-	-	
Box Ironbark Forest/ Spring Soak Herbland Mosaic	R1, R2, V2, V3, E2, E3	-	grazing, timber harvesting, altered water regimes, weed invasion, agriculture, firewood collection and post and pole production, mining, habitat loss, fragmentation, clearing	NVR <i>Land for Wildlife</i>
Grassy Dry Forest/ Spring Soak Herbland Mosaic	R1, R2, R3, V1, V2, V3, , E3	-	grazing, altered water regimes, weed invasion, agriculture, clearing	NVR <i>Land for Wildlife</i>
Floodplain Riparian Woodland/Plains Grassy Woodland Mosaic	R1, V2, V3, E2, E3	0.1	habitat loss, clearing, agriculture, fragmentation, grazing, weed invasion, road construction and maintenance, alteration of flooding regimes	NVR <i>Land for Wildlife</i>
Rainshadow Grassy Woodland/Valley Grassy Forest Mosaic	R1, R2, V2, V3, E2, E3	-	weed invasion, grazing, firewood collection and post and pole production, habitat loss, fragmentation, clearing, agriculture, lack of fire	NVR <i>Land for Wildlife</i>
Shrubby Granitic-outwash Grassy Woodland/Valley Grassy Forest Mosaic	R2, V1, V2, V3, E3	-	weed invasion, grazing, firewood collection and post and pole production, habitat loss, fragmentation, clearing, agriculture, lack of fire	NVR <i>Land for Wildlife</i>
Riverine Grassy Woodland/Riverine Sedgy Forest Mosaic	V1, V2, V3, E3	0.7	clearing, agriculture, grazing, fragmentation, altered water regimes, weed invasion	NVR <i>Land for Wildlife</i>
Sand Ridge Woodland	R1, R2, R3, V2, V3, E2, E3	-	grazing, weed invasion, clearing, timber harvesting, habitat loss	NVR <i>Land for Wildlife</i>
Valley Grassy Forest/ Grassy Dry Forest Mosaic	R1, R2, R3, V2, V3	-	weed invasion, grazing, firewood collection and post and pole production	NVR <i>Land for Wildlife</i>

Notes: <sup>1</sup> Percent Reservation in Conservation Parks and Reserves is based on pre-1750 extent. <sup>2</sup> Threatening processes are those which have occurred in the past, and may or may not be current threatening processes for these EVCs. The references to firewood collection and post and pole production relate to private land. <sup>3</sup> Some areas containing these EVCs may already be protected under *Land for Wildlife*. The Program could also be applied to other areas in the future to protect these values and address threatening processes. Further information on disturbances and management actions is provided in section 12.7.

## 12.5 FLORA SPECIES ASSESSMENT

### Introduction

Assessment of the North East flora has involved analysing the distribution and viability of individual plant species and their populations in the region. The purpose of this assessment is to assist in determining whether:

- viable populations of all terrestrial and aquatic plant species are maintained throughout their natural range in the region;
- representative populations of each species are included in the reserve system; and
- populations and their habitats both within and outside the reserve system are subject to management appropriate for their long-term maintenance.

### Priority Species Information

A total of approximately 2 000 species of vascular plants have been recorded for the North East region, including 166 species of conservation significance and 400 exotic species. However, the amount and quality of information on particular species is highly variable. Twenty nine species of conservation significance are listed (or recommended for listing) as Threatened in Victoria under Schedule 2 of the *Flora and Fauna Guarantee Act 1988* (FFG Act) and/or listed as nationally Endangered or Vulnerable under Schedule 1 of the Commonwealth *Endangered Species Protection Act 1992* (ESP Act) (see Table 12.9). Complete lists and details of the 166 species of conservation significance are contained in the Biodiversity Assessment Report.

Both the ESP Act and the FFG Act include provisions for the preparation of management plans for listed taxa. Action Statements and Recovery Plans outline the actions necessary to maximise the long-term prospects for survival of the species in the wild. The status of Action Statements and Recovery Plans for FFG/ESP Act listed species is indicated in Table 12.9. It should be noted that the implementation of management actions is dependent on available resourcing and priorities within and between species.

The distribution of plants of conservation significance is often associated with particular habitats or other environmental factors. Some groupings have been identified for plants of conservation significance based on their abundance, distribution and habitats (Table 12.10).

### Species Vulnerability Assessment

A vulnerability assessment was undertaken for all plant species of conservation significance in the North East. It was designed to identify those rare or threatened plants that are at greatest risk of further significant decline and extinction as a result of activities, ongoing threatening processes and catastrophic events in the region. As the assessment is confined to each species' North East distribution, the results do not necessarily accord with the national or statewide status of species shown in Table 12.9.

Quantitative criteria such as those endorsed by the IUCN (IUCN 1994) provide an internationally recognised framework to assess the risk of extinction. Three categories of threatened taxa are defined; Critically Endangered (CR), Endangered (E) and Vulnerable (V). Categories are determined using rule sets based on population size, distributional range and rates of decline. A taxon is considered Lower Risk (LR) when it does not satisfy the criteria for any of the above categories, or Data Deficient (DD) when there is inadequate information to make an assessment. The IUCN criteria were developed primarily for fauna and there are several difficulties in applying them for flora. Recently Keith and Burgman (in press) critically reviewed the IUCN criteria and suggested modifications, developing a system called 'RARE' (Rules for the Assessment of the Risk of Extinction in vascular plants).

Both the IUCN and RARE rule sets were applied to 106 of the 166 rare or threatened plants considered in this assessment. The other 60 had insufficient information in the North East to make an

assessment of their risk of extinction using either rule set. Those species which were ranked as Critically Endangered or Endangered against the IUCN rule set are listed in Table 12.11. In the following discussion of the results, precedence is given to the IUCN rating as RARE is not yet published and has not been canvassed within the broader scientific community.

**Table 12.9: North East plant species listed (or recommended for listing) under the FFG Act and/or ESP Act**

Species Name	Common Name	FFG Act Listing	Action Statement (FFG)	ESP Act Status	Recovery Plan (ESP)
<i>Acacia deanei</i> ssp. <i>deanei</i>	Deane's wattle	Yes	No	-	-
<i>Acacia phasmoides</i>	Phantom Wattle	No	-	Vulnerable	No
<i>Allocasuarina luehmannii</i>	Buloke	Yes	No	-	-
<i>Almaleea capitata</i>	Slender Parrot-pea	Yes	No	-	-
<i>Baeckea crenatifolia</i>	Fern-leaf Baeckea	No	-	Vulnerable	No
<i>Brachyscome gracilis</i> ssp. <i>gracilis</i>	Dookie Daisy	Final rec.	-	-	-
<i>Brachyscome tenuiscapa</i>	Mountain Daisy	Yes	No	-	-
<i>Caladenia concolor</i>	Crimson Spider-orchid	Yes	No	Vulnerable	No
<i>Carex cephalotes</i>	Wire-head Sedge	Yes	No	-	-
<i>Carex paupera</i>	Dwarf Sedge	Yes	No	-	-
<i>Celmisia sericophylla</i>	Silky Daisy	Yes	No	-	-
<i>Dipodium hamiltonianum</i>	Yellow Hyacinth-orchid	Yes	Yes	-	-
<i>Diuris dendrobioides</i>	Wedge Diuris	Yes	Yes	-	-
<i>Diuris punctata</i> var. <i>punctata</i>	Purple Diuris	Yes	No	-	-
<i>Eucalyptus alligatrix</i> ssp. <i>limaensis</i>	Lima Stringybark	No	-	Vulnerable	No
<i>Eucalyptus cadens</i>	Warby Swamp Gum	Yes	Yes	Vulnerable	No
<i>Euchiton nitidulus</i>	Shining Cudweed	No	-	Vulnerable	No
<i>Euphrasia collina</i> ssp. <i>muelleri</i>	Purple Eyebright	Final rec.	In prep.	Endangered	No
<i>Euphrasia eichleri</i>	Bogong Eyebright	No	No	Vulnerable	No
<i>Euphrasia scabra</i>	Rough Eyebright	Yes	Yes	-	-
<i>Glycine latrobeana</i>	Clover Glycine	Yes	No	Vulnerable	No
<i>Goodenia macbarronii</i>	Narrow Goodenia	Yes	Yes	Vulnerable	No
<i>Kelleria laxa</i>	Kelleria	Yes	No	Vulnerable	No
<i>Poa saxicola</i>	Rock Poa	Yes	No	-	-
<i>Pomaderris subplicata</i>	Concave Pomaderris	Yes	Yes	Vulnerable	No
<i>Prasophyllum frenchii</i>	Maroon Leek-orchid	Final rec.	-	Vulnerable	No
<i>Pterostylis cucullata</i>	Leafy Greenhood	Yes	Yes	Vulnerable	No
<i>Santalum lanceolatum</i>	Northern Sandalwood	Yes	Yes	-	-
<i>Swainsona galegifolia</i>	Smooth Darling Pea	Yes	Yes	-	-
<i>Thelypteris confluens</i>	Swamp Fern	Yes	No	-	-



**Table 12.10: Plant groupings of conservation significance in the North East**

Plant Grouping	Species of conservation significance
Plants of restricted, highly localised and naturally rare habitat types	<p>Because the distribution of alpine and sub-alpine environments is highly restricted in Australia, many species occurring in such habitats are considered rare or threatened both within Victoria and nationally. In the North East, alpine and sub-alpine habitats occur mainly around the Alpine National Park.</p> <p>Although widespread, riparian environments have a narrow range of habitat requirements and as such are restricted in extent. Rare or threatened species occurring in riparian environments in the North East include Catkin Wattle <i>Acacia dallachiana</i>, Native Wintercress <i>Barbarea grayi</i>, Silky Daisy <i>Celmisia sericophylla</i>, Yellow Flat-sedge <i>Cyperus flavidus</i>, Showy willow-herb <i>Epilobium pallidiflorum</i>, Omeo Gum <i>Eucalyptus neglecta</i>, Cliff Cudweed <i>Euchiton umbricolus</i> and Hypsela <i>Hypsela tridens</i>.</p>
Plants of habitat types which are marginal to the North East	<p>Habitats such as grasslands, grassy woodlands and riverine plains occur within the North East Region, but are marginal to it, being more widespread beyond the region. Rare or threatened species occurring in these environments include Deane's Wattle <i>Acacia deanei</i> ssp. <i>deanei</i>, Buloke <i>Allocasuarina luehmannii</i>, Dark Wire-grass <i>Aristida calycina</i> var. <i>calycina</i>, Spurred spear-grass <i>Austrostipa gibbosa</i>, Bluish Bulbine-lily <i>Bulbine glauca</i>, Broom Bitter-pea <i>Daviesia genistifolia</i>, Wedge Diuris <i>Diuris dendrobioides</i>, Hydrilla <i>Hydrilla verticillata</i>, Northern Plains Leek-orchid <i>Prasophyllum campestre</i>, Glandular Early Nancy <i>Wurmbea biglandulosa</i> and Mugga <i>Eucalyptus sideroxylon</i> s.s..</p> <p>The foothills west of Burrowa-Pine National Park are a small extension of a habitat type more widely represented across the border in the New South Wales South Western Slopes. Rare or threatened species found in this area include <i>Dampiera purpurea</i>, Hairy Hop-bush <i>Dodonaea boronifolia</i>, <i>Dodonaea rhombifolia</i> and Warby Swamp Gum <i>Eucalyptus cadens</i>, <i>Acacia triptera</i>, Buloke <i>Allocasuarina luehmannii</i>, Crimson spider-orchid <i>Caladenia concolor</i>, White Cypress-pine <i>Callitris glaucophylla</i>, Naked Beard-orchid <i>Calochilus imberbis</i>, Yellow Hyacinth-orchid <i>Dipodium hamiltonianum</i> and Grey Rice-flower <i>Pimelea treyvaudii</i>.</p>
Plants of habitats which have been depleted in the North East	<p>Since European settlement, a range of woodland EVCs have been substantially cleared, or significantly disturbed in the North East Region. Rare or threatened species from these EVCs include Deane's Wattle <i>Acacia deanei</i> ssp. <i>deanei</i>, Broom Bitter-pea <i>Daviesia genistifolia</i>, Purple Diuris <i>Diuris punctata</i> var. <i>punctata</i>, Mugga <i>Eucalyptus sideroxylon</i> s.s., Purple Eyebright <i>Euphrasia collina</i> ssp. <i>muelleri</i>, Warby Swamp Gum <i>Eucalyptus cadens</i> and Euroa Guinea Flower <i>Hibbertia humifusa</i> ssp. <i>erigens</i>.</p>

**Table 12.11: Plants occurring in the North East which are rated as Critically Endangered or Endangered according to the IUCN and RARE rule sets**

SPECIES	IUCN	RARE	SPECIES	IUCN	RARE
<i>Acacia deanei</i> ssp. <i>deanei</i>	CR	CR	<i>Thelypteris confluens</i>	CR	CR
<i>Acacia triptera</i>	CR	CR	<i>Utricularia monanthos</i>	CR	LR
<i>Almaleea capitata</i>	CR	EN	<i>Viola calejana</i>	CR	EN
<i>Barbarea grayi</i>	CR	LR	<i>Abrotanella nivigena</i>	EN	EN
<i>Brachyscome obovata</i>	CR	EN	<i>Acacia ausfeldii</i>	EN	EN
<i>Carex paupera</i>	CR	EN	<i>Acacia dallachiana</i>	EN	EN
<i>Coprosma moorei</i>	CR	CR	<i>Acacia dawsonii</i>	EN	EN
<i>Coprosma nivalis</i>	CR	EN	<i>Allocasuarina luehmannii</i>	EN	VU
<i>Diuris dendrobioides</i>	CR	CR	<i>Brachyscome tadgellii</i>	EN	LR
<i>Diuris punctata</i> var. <i>punctata</i>	CR	CR	<i>Carex archeri</i>	EN	LR
<i>Eucalyptus cadens</i>	CR	EN	<i>Carex capillacea</i>	EN	VU
<i>Euphrasia collina</i> ssp. <i>muelleri</i>	CR	CR	<i>Carex raleighii</i>	EN	VU
<i>Euphrasia scabra</i>	CR	CR	<i>Dampiera purpurea</i>	EN	EN
<i>Hibbertia humifusa</i> ssp. <i>erigens</i>	CR	CR	<i>Daviesia genistifolia</i>	EN	CR
<i>Juncus antarcticus</i>	CR	LR	<i>Epilobium tasmanicum</i>	EN	EN
<i>Kelleria laxa</i>	CR	CR	<i>Euphrasia caudata</i>	EN	VU
<i>Oreomyrrhis pulvinifera</i>	CR	LR	<i>Hierochloa submutica</i>	EN	EN
<i>Prasophyllum campestre</i>	CR	CR	<i>Lycopodium scariosum</i>	EN	EN
<i>Pterostylis hamata</i>	CR	CR	<i>Oreomyrrhis brevipes</i>	EN	VU
<i>Taraxacum aristum</i>	CR	CR	<i>Pomaderris subplicata</i>	EN	EN
<i>Templetonia stenophylla</i>	CR	EN	<i>Schizeilema fragoseum</i>	EN	VU

CR = Critically Endangered, EN = Endangered, VU = Vulnerable, LR = Lower Risk

Of the 106 taxa assessed, 24 were rated as Critically Endangered under the IUCN criteria. This category signifies the highest risk of extinction in the wild. Most of these ratings were based on the very small extent of occurrence or area of occupancy and fragmented population or continuing decline in habitat for each species. Of these species, those with an important part of their distribution in the North East include *Acacia deanei* ssp. *deanei*, *Euphrasia collina* ssp. *muelleri*, *Euphrasia scabra*, *Hibbertia humifusa* ssp. *erigens*, *Thelypteris confluens* and *Eucalyptus cadens*.

The 'Endangered' category signifies that a taxon is facing a very high risk of extinction in the wild. Eighteen of the taxa were rated as Endangered under the IUCN criteria, based on their low population numbers or their low extent of occurrence with a continuing decline in habitat. For two of these species, *Acacia dallachiana* and *Pomaderris subplicata*, the North East forms a major part of their distribution.

In addition to the plants listed in Table 12.11, 46 taxa were rated as Vulnerable under the IUCN criteria. The 'Vulnerable' category signifies that a taxon is facing a high risk of extinction in the wild in the medium-term future. Most of the 46 were rated as Vulnerable based on their low population numbers or their low area of occupancy.

*Acacia phlebophylla*, *Brachyscome gracilis*, *Celmisia sericophylla* and *Scleranthus singuliflorus* were rated as Lower Risk under the IUCN criteria, based on having stable population numbers. These species can be considered secure in the North East and not at risk of extinction in the foreseeable future.

### Species Reservation Analysis

A reservation analysis has been undertaken to assess the extent to which plant species of conservation significance in the North East are protected in the reserve system. In this analysis the reserve system includes only conservation reserves. The assessment was based on a combination of expert opinion and site records and other information available in NRE databases and the scientific literature. Each species was evaluated according to the proportion of its Australian distribution that occurs within the

North East, and the proportion that occurs in conservation reserves (National Parks, State Parks, Wilderness Parks, Reference Areas, Flora Reserves, Flora and Fauna Reserves, Wilderness Reserves), other public land and private property (see Table 12.12 for ESP/FFG Act listed species, and see North East Biodiversity Assessment Report for other species).

**Table 12.12: Tenure in the North East of populations of plant species listed under the FFG Act and/or the ESP Act**

Species Name	Conservation Status		% of Aust range	Tenure of North East populations		
	ESP Act listing	FFG Act listing		conservation reserve (%)	other public land (%)	private land (%)
<i>Acacia deanei</i> ssp. <i>deanei</i>	no	yes	75 - 100	90	10	-
<i>Acacia phasmoides</i>	V	no	50 - 75	100	-	-
<i>Allocasuarina luehmannii</i>	no	yes	0 - 25	20	-	80
<i>Almaleea capitata</i>	no	yes	0 - 25	50	50	-
<i>Baeckea crenatifolia</i>	V	no	75 - 100	100	-	-
<i>Brachyscome gracilis</i> ssp. <i>gracilis</i>	no	final rec.	50 - 75	20	30	50
<i>Brachyscome tenuiscapa</i>	no	yes	25 - 50	60	40	-
<i>Caladenia concolor</i>	V	yes	0 - 25	50	-	50
<i>Carex cephalotes</i>	no	yes	50 - 75	100	-	-
<i>Carex paupera</i>	no	yes	25 - 50	100	-	-
<i>Celmisia sericophylla</i>	no	yes	75 - 100	80	20	-
<i>Dipodium hamiltonianum</i>	no	yes	0 - 25	50	50	-
<i>Diuris dendrobioides</i>	no	yes	0 - 25	-	100	-
<i>Diuris punctata</i> var. <i>punctata</i>	no	yes	0 - 25	-	20	80
<i>Eucalyptus alligatrix</i> ssp. <i>limaensis</i>	V	no	0 - 25	-	100	-
<i>Eucalyptus cadens</i>	V	yes	75 - 100	-	80	20
<i>Euchiton nitidulus</i>	V	no	50 - 75	90	10	-
<i>Euphrasia collina</i> ssp. <i>muelleri</i>	E	final rec	25 - 50	-	100	-
<i>Euphrasia eichleri</i>	V	no	75 - 100	100	-	-
<i>Euphrasia scabra</i>	no	yes	25 - 50	100	-	-
<i>Glycine latrobeana</i>	V	yes	0 - 25	-	100	-
<i>Goodenia macbarronii</i>	V	yes	0 - 25	10	10	80
<i>Kelleria laxa</i>	V	yes	75 - 100	100	-	-
<i>Poa saxicola</i>	no	yes	25 - 50	100	-	-
<i>Pomaderris subplicata</i>	V	yes	75 - 100	-	-	100
<i>Prasophyllum frenchii</i>	V	final rec	0 - 25	-	-	100
<i>Pterostylis cucullata</i>	V	yes	0 - 25	-	50	50
<i>Santalum lanceolatum</i>	no	yes	0 - 25	-	-	100
<i>Swainsona galegifolia</i>	no	yes	0 - 25	-	50	50
<i>Thelypteris confluent</i>	no	yes	50 - 75	-	-	100

Of the 166 rare or threatened plants in the North East, 74 have more than 25 per cent of their geographic range within the region - the subsequent discussion is based on these 74. For over

90 per cent of these taxa this forms an important part of their distribution and consequently effective conservation measures within the North East Region are critical for their long-term survival.

Of the 74 taxa, 54 have the largest proportion of their North East population within conservation reserves. Five of the seven taxa endemic to the North East fall into this category, with all known occurrences being within conservation reserves (*Acacia phlebophylla*, *Baeckea crenatifolia*, *Eucalyptus mitchelliana*, *Euphrasia crassiuscula* ssp. *eglandulosa* and *Euphrasia crassiuscula* ssp. *glandulifera*). There are also seven additional species which are endemic to Victoria which fall into this category. Of these, *Carex paupera*, *Euphrasia eichleri* and *Pratia gelida* occur solely within conservation reserves, while *Olearia frostii*, *Pultenaea williamsonii*, *Ranunculus eichlerianus* and *Olearia adenophora* have at least 30 per cent of their regional population outside conservation reserves.

Of the remaining 20 taxa, 13 have the largest proportion of their North East population on other public land. One species, *Euphrasia lasianthera*, is endemic to the region while *Poa hothamensis* var. *parviflora*, *Eucalyptus cadens* and *Pomaderris aurea* are endemic to Victoria. *Euphrasia lasianthera* is found only within Mount Buller Alpine Resort, and although only classified as rare in Victoria, is considered vulnerable in the North East Region (based on the vulnerability analysis) by virtue of the small number of populations. *Eucalyptus cadens* occurs in Mount Pilot Multi-Purpose Park and on private land around the Warby Range. All populations are potentially threatened with clearing and high levels of disturbance. This species is considered vulnerable in both Victoria and Australia and was ranked as Critically Endangered in the North East in the vulnerability analysis because of its low area of occupancy, severely fragmented population and suspected continuing decline.

*Pomaderris subplicata* occurs solely on private land. This North East endemic is currently known from only one site beside Hurdle Creek. The small population of about 150 plants is threatened by weed invasion, habitat disturbance and grazing by native species. This species is considered vulnerable in Victoria and Australia, and has been rated as Endangered in the North East in the vulnerability analysis based on its low population numbers.

### Priorities for Management

Species with a high priority for management in the North East region based on the above vulnerability assessment are listed in Table 12.13. Species have been included in this list if the region represents a major part of their distribution and they have been rated Critically Endangered, Endangered, or Vulnerable in the region.

For seven of the species listed in Table 12.13 at least 90 per cent of their population is within conservation reserves (*Acacia deanei* ssp. *deanei*, *Euphrasia scabra*, *Carex cephalotes*, *Carex echinata*, *Colobanthus affinis*, *Craspedia alba*, *Euchiton nitidulus*) and for three species the majority of the occurrence is on private land (*Thelypteris confluens*, *Pomaderris subplicata*, *Hibbertia humifusa* ssp. *erigens*). *Euphrasia collina* ssp. *muelleri* has 25-50 per cent of its range in the North East where it is known in the region only from State forest. For the remaining species at least 50 per cent of their occurrence is on other public land (*Eucalyptus cadens*, *Poa hothamensis* var. *parviflora*, *Acacia dallachiana*).

The Department of Natural Resources and Environment has developed a simple form and database for monitoring populations of rare and threatened plants, envisaged for widespread use in regularly monitoring major populations of all threatened plant species in Victoria. Active habitat management (environmental weed control, exclusion of predators or browsers, and ecological burning) is the most common form of management being implemented for species whose habitat is degrading or where direct external threats are operating. Where populations have declined to critical levels, active population management techniques (population reinforcement, reintroduction, translocation and artificial pollination) are sometimes recommended. Action Statements have been or are being prepared for four of the species in Table 12.13. Section 12.7 provides a more detailed discussion of potentially threatening processes affecting flora, including aspects of management.

**Table 12.13: Plant Species with high regional priority for management action**

TAXON	IUCN	RARE	FFG Act	Action Statement	ESP Act	Recovery Plan
<i>Acacia deanei</i> ssp. <i>deanei</i>	CR	CR	yes	no	-	-
<i>Euphrasia collina</i> ssp. <i>muelleri</i>	CR	CR	rec	in prep	E	no
<i>Euphrasia scabra</i>	CR	CR	yes	yes	-	-
<i>Hibbertia humifusa</i> ssp. <i>erigens</i>	CR	CR	no	-	-	-
<i>Thelypteris confluens</i>	CR	CR	yes	no	-	-
<i>Eucalyptus cadens</i>	CR	EN	yes	yes	V	no
<i>Acacia dallachiana</i>	EN	EN	no	-	-	-
<i>Pomaderris subplicata</i>	EN	EN	yes	yes	V	no
<i>Carex cephalotes</i>	VU	VU	yes	no	-	-
<i>Carex echinata</i>	VU	VU	no	-	-	-
<i>Colobanthus affinis</i>	VU	VU	no	-	-	-
<i>Craspedia alba</i>	VU	VU	no	-	-	-
<i>Euchiton nitidulus</i>	VU	VU	no	-	V	no
<i>Euphrasia crassiuscula</i> ssp. <i>eglandulosa</i>	VU	VU	no	-	-	-
<i>Poa hothamensis</i> var. <i>parviflora</i>	VU	VU	no	-	-	-

## 12.6 TERRESTRIAL FAUNA SPECIES ASSESSMENT

### Introduction

The purpose of this terrestrial fauna assessment is similar to that described earlier for flora. It provides information to be used in addressing the biodiversity criteria for the North East region.

The assessment of North East fauna has been handled separately for terrestrial and aquatic species (see section 12.8 for aquatic species assessment).

### Priority Species Information

The assessment of terrestrial fauna is based largely on a subset of species found in the North East which are considered high priority because their long-term survival is threatened in some way. Those which are threatened may be considered to be threatened nationally, or just in Victoria. They are listed under the Commonwealth *Endangered Species Protection Act 1992* (ESP Act) and/or the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act) and/or the *Threatened Fauna in Victoria* list (CNR 1995f). Indicator species were chosen to provide a broader assessment of fauna in the region and included species representative of taxa at risk from various management activities (eg in alpine environments), and not necessarily forestry related. All of these species are shown in Table 12.14. As well as showing the status (endangered, vulnerable etc) of each species under the FFG and ESP Acts, Table 12.14 also indicates whether an Action Statement and/or a Recovery Plan exists or is being prepared for that species.

**Table 12.14: Terrestrial fauna species included in the assessment**

Species Name	Common Name	TFV 1995	FFG Status	Action Statement (FFG)	ESP Status	Recovery Plan (ESP)	Secure in Other States
<b>Mammals</b>							
<b>Priority species</b>							
<i>Dasyurus maculatus</i>	Spot-tailed Quoll	V	L	Yes	V	No	No
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	R	L	In prep			No
<i>Potorous longipes</i>	Long-footed Potoroo	E	L	Yes	E	In prep.	No
<i>Burramys parvus</i>	Mountain Pygmy-possum	V	L	Yes	V	Yes	No
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	L	In prep			No
<i>Mastacomys fuscus</i>	Broad-toothed Rat	R					No
<i>Pseudomys fumeus</i>	Smoky Mouse	V					No
<i>Canis familiaris dingo</i>	Dingo	K					Yes
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe-bat	C	L	No			Yes
<i>Myotis macropus</i>	Large-footed Myotis	R					No
<i>Miniopterus schreibersii blepotis</i>	Common Bent-wing Bat	C	L	In prep			Yes
<b>Indicator species</b>							
<i>Scotorepens orion</i>	Eastern Broad-nosed Bat						Yes
<i>Perameles nasuta</i>	Long-nosed Bandicoot						Yes
<i>Petaurus australis</i>	Yellow-bellied Glider						No
<i>Antechinus flavipes</i>	Yellow-footed Antechinus						Yes
<b>Birds</b>							
<b>Priority species</b>							
<i>Struthidea cinerea</i>	Apostlebird	R					Yes
<i>Lathamus discolor</i>	Swift Parrot	E	L	In prep	V	Yes	No
<i>Neophema pulchella</i>	Turquoise Parrot	R	L	No			No
<i>Grantiella picta</i>	Painted Honeyeater	R	L	No			No
<i>Xanthomyza phrygia</i>	Regent Honeyeater	E	L	Yes	E	Yes	No
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	E	L	Yes			No
<i>Burhinus grallarius</i>	Bush Stone-curlew	V	L	In prep			No
<i>Lophoictinia isura</i>	Square-tailed Kite	V					No
<i>Accipiter novaehollandiae</i>	Grey Goshawk	R					No
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	R	L	Yes			No
<i>Ninox connivens</i>	Barking Owl	R	R	No			No
<i>Ninox strenua</i>	Powerful Owl	R	L	In prep			No
<i>Tyto novaehollandiae</i>	Masked Owl	R	L	In prep			No
<i>Tyto tenebricosa</i>	Sooty Owl	R	L	In prep			No
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V	L	In prep			No
<b>Indicator species</b>							
<i>Chthonicola sagittata</i>	Speckled Warbler						Yes
<i>Hylacola pyrrhopygia</i>	Chestnut-rumped Heathwren						Yes
<i>Callocephalon fimbriatum</i>	Gang-Gang Cockatoo						Yes
<i>Alecedo azurea</i>	Azure Kingfisher						No
<i>Petroica rodinogaster</i>	Pink Robin						No
<i>Eurystomus orientalis</i>	Dollarbird						Yes

Species Name	Common Name	TFV 1995	FFG Status	Action Statement (FFG)	ESP Status	Recovery Plan (ESP)	Secure in Other States
<i>Coracina tenuirostris</i>	Cicadabird						Yes
<b>Reptiles</b>							
<b>Priority species</b>							
<i>Pseudemoia cryodroma</i>	Alpine Bog Skink	V	R	No			No
<i>Cyclodomorphus praealtus</i>	Alpine She-oak Skink	V	L	No			Yes
<i>Eulamprus kosiuskoi</i>	Alpine Water Skink	V	L	In prep			Yes
<i>Morelia spilota variegata</i>	Carpet Python	V	L	In prep			Yes
<i>Vermicella annulata</i>	Bandy Bandy	V					Yes
<i>Ramphotyphlops proximus</i>	Woodland Blind Snake	R					Yes
<b>Indicator species</b>							
<i>Ramphotyphlops nigriscens</i>	Gray's Blind Snake						Yes
<i>Bassiana duprerreyi</i>	Red-throated Skink						Yes
<i>Egernia striolata</i>	Tree Skink						Yes
<i>Varanus varius</i>	Tree Goanna						Yes
<b>Amphibians</b>							
<b>Priority species</b>							
<i>Litoria spenceri</i>	Spotted Tree Frog	E	L	In prep	E	In prep	No
<i>Litoria verreauxii alpina</i>	Alpine Tree Frog	K					Yes

**Notes: Threatened Fauna in Victoria - 1995 (CNR 1995f)** - E-endangered, V-vulnerable, R-rare, K-insufficiently known, C-Restricted Colonial Breeding or Roosting. **Flora and Fauna Guarantee Act (FFG)**: L-Listed, R-recommended for listing. **Commonwealth Endangered Species Protection Act (ESP)**: E-endangered, V-vulnerable.

More information on each of the species listed in Table 12.14 is provided in the Biodiversity Assessment Report and in the sections which follow. Long-footed Potoroo and Spotted Tree Frog are listed as nationally endangered (ESP Act) and are frequently referred to later, particularly in the discussion of threatening processes. Some background on these species is provided here.

### ***Long-footed Potoroo***

The Long-footed Potoroo was discovered in the North East in 1995 after previously only being known from East Gippsland and south-eastern New South Wales. It inhabits wet to damp forests with a dense understorey vegetation, feeding largely on underground fungi. It is estimated that the range of the population in the North East is approximately 51 000 ha, about 60 per cent of which falls within the Alpine National Park, the remainder being in State forest.

### ***Spotted Tree Frog***

The Spotted Tree Frog is known to occur in only 13 discrete populations - 11 in Victoria and two in New South Wales. These are mainly on the north-west side of the Great Dividing Range between the Central Highlands in Victoria and Mt Kosciuszko in New South Wales. Survey results suggest the species has suffered a significant decline during the past 20 years. Tadpole development occurs in upland streams, with adjacent stream-side vegetation being used by adults for sheltering and basking.

### ***Terrestrial invertebrates***

There have been few systematic studies of terrestrial invertebrates in the region. A substantial number of the records arise from single specimens or localities.

Epigeal (above-ground) invertebrates were sampled as part of the CRA terrestrial fauna survey in the North-East using pitfall traps. Only ants were subjected to detailed analysis for the purpose of this CRA, as this group has been previously identified as containing useful 'indicator' taxa, responsive to environmental conditions and environmental change. Preliminary results reveal at least 131 different 'morpho-species' of ants in the Region. In general, between 20 and 25 'morpho-species' were detected at most sites, with some sites having a diversity of up to 40 'morpho-species'.

Knowledge of other invertebrate groups in the Region is generally rudimentary. Of note among existing records are the following:

### ***Other Insecta***

The cicada *Diemeniana neboisi* is known to be confined to a narrow band within the region. The Buprestid jewel beetles *Themognatha barbiventris* and *T. maculovenstris* were recorded last century from Beechworth and Wangaratta respectively, but have not appeared in more recent collections. Many insect species exhibit highly localised patterns of endemism, which presents a challenge to their effective conservation.

### ***Mollusca***

A number of species of land-snail occur in a broad arc from south-eastern New South Wales into north-east Victoria. Examples include *Elsothera sericatula*, *Pillomena nivea* and *Flammulops excelsior* (Charopidae). Others, such as *Allocharopa okeana* are effectively restricted to the mountains of eastern Victoria. *A. okeana* is typically found under litter near mountain peaks and alpine woodland.

### ***Onychophora***

Onychophorans or velvet-worms are inhabitants of leaf litter and decaying logs in damp forest environments. One species, *Planipapillus biacinaces*, is believed to be confined to the region (known only from Howman Gap).

### ***Oligochaeta***

At least one species, *Cryptodrilus willsiensis*, is believed to be restricted to the North East (known only from Mt Wills). In general, knowledge of this faunal group in the region is limited.

Experience elsewhere suggests that many invertebrate species are vulnerable to a range of disturbances including those which are likely to affect the maintenance of microclimates on which many depend (such as rotting logs and ground litter).

### **Species Vulnerability Assessment**

As for a similar assessment described earlier for plants, a vulnerability assessment was done for terrestrial vertebrate fauna to identify those species which are likely to be at higher risk of decline or extinction. The following characteristics of a species influence the likelihood of its decline or becoming extinct:

1. **Rarity** - based on the geographic range and abundance of populations, as well as how tightly they are restricted to specific habitat types. Species or populations most predisposed to extinction are those which have small geographic ranges, low abundance and narrow habitat specificity.
2. **Population dynamics** - whether a population is increasing, stable or decreasing.
3. **Spatial dynamics** - the way in which individual populations increase or decrease and their ability to disperse and hence interact with other populations. Populations most predisposed to extinction are those with high population variability and low powers of dispersal.



4. Life history parameters - aspects of a species' biology that may make it susceptible to extinction. Reproductive output and longevity are considered most important. Species most predisposed to extinction are those which are long-lived and those with low reproductive outputs (eg small litter or clutch sizes).

The above biological characteristics which may predispose species or populations to decline or extinction have been rated for priority and indicator terrestrial vertebrate species occurring in the North East (see Table 12.15). This information provides a basis for identifying and prioritising those species which are most in need of management actions to improve the prospects of their long-term survival. This assessment should also be considered in conjunction with the information relating to threatening processes discussed later.

**Table 12.15: Summary of life history and population dynamics information for fauna species**

Species	Population trend in the last 10 years	Rarity Ratings			Spatial Dynamics Ratings		Life History Parameter Ratings	
		Geographic Range	Abundance	Habitat Specificity	Population Variability	Powers of Dispersal	Reproductive Output	Longevity
Mammals								
Spot-tailed Quoll	declined	large	low	wide	low	high	medium	unknown
Brush-tailed Phascogale	*declined	medium	low	wide	high	high	high	short
Long-footed Potoroo	unknown	small	low	narrow	*low	low	low	long
Mountain Pygmy-possum	*stable	small	low	narrow	high	low	low	long
Squirrel Glider	*declined	medium	low	narrow	unknown	high	low	short
Broad-toothed Rat	unknown	small	low	narrow	*low	unknown	medium	short
Smoky Mouse	declined	small	low	narrow	high	*low	medium	short
Dingo	unknown	*large	low	wide	*low	high	low	long
Eastern Horseshoe Bat	unknown	small	low	narrow	low	low	low	long
Large-footed Myotis	unknown	small	low	narrow	low	unknown	low	long
Common Bent-wing Bat	*declined	small	low	narrow	low	high	low	long
Eastern Broad-nosed Bat🦇	unknown	small	low	wide	low	unknown	low	*long
Long-nosed Bandicoot🦛	*declined	large	medium	wide	unknown	unknown	high	*short
Yellow-bellied Glider🦇	unknown	large	low	wide	low	high	low	long
Yellow-footed Antechinus🦇	declined	medium	low	wide	high	unknown	high	short

Species	Population trend in the last 10 years	Rarity Ratings			Spatial Dynamics Ratings		Life History Parameter Ratings	
		Geogra- phic Range	Abun- dance	Habitat Specificity	Population Variability	Powers of Dispersal	Reprod- uctive Output	Longevity
Birds								
Apostlebird	*declined	small	low	narrow	low	low	low	unknown
Swift Parrot	declined	medium	low	narrow	high	high	high	*long
Turquoise Parrot	increased	small	medium	wide	high	high	high	unknown
Painted Honeyeater	*declined	small	low	narrow	high	high	high	unknown
Regent Honeyeater	declined	large	low	narrow	high	high	low	unknown
Grey-crowned Babbler	declined	small	low	wide	low	low	low	short
Bush Stone-curlew	declined	small	low	narrow	low	*low	low	long
Square-tailed Kite	unknown	small	low	wide	unknown	high	low	*long
Grey Goshawk	unknown	medium	low	narrow	unknown	high	low	*long
White-bellied Sea-Eagle	unknown	medium	low	wide	low	high	low	long
Barking Owl	*stable	medium	low	narrow	low	*high	low	*long
Powerful Owl	stable	large	low	wide	low	high	low	long
Masked Owl	*declined	small	low	medium	unknown	high	low	long
Sooty Owl	*declined	medium	low	narrow	low	high	low	long
Speckled Warbler❖	declined	small	medium	wide	high	low	medium	short
Chestnut-rumped Heathwren❖	unknown	small	low	narrow	unknown	low	low	short
Glossy Black-Cockatoo	*stable	small	low	narrow	*low	high	low	long
Gang-gang Cockatoo❖	*declined	large	medium	wide	unknown	high	low	*long
Azure Kingfisher❖	unknown	medium	low	narrow	high	unknown	medium	*long
Pink Robin❖	stable	large	medium	wide	low	high	low	short
Dollarbird❖	unknown	medium	medium	narrow	unknown	high	low	*long
Cicadabird❖	unknown	medium	medium	wide	unknown	high	low	long

Species	Population trend in the last 10 years	Rarity Ratings			Spatial Dynamics Ratings		Life History Parameter Ratings	
		Geographic Range	Abundance	Habitat Specificity	Population Variability	Powers of Dispersal	Reproductive Output	Longevity
Reptiles								
Tree Goanna	unknown	small	medium	wide	unknown	unknown	low	*long
Alpine Bog Skink	unknown	small	low	narrow	*low	low	low	short
Alpine She-oak Skink	declined	small	low	narrow	unknown	low	low	*short
Alpine Water Skink	declined	small	low	narrow	unknown	low	low	*short
Bandy Bandy	unknown	small	low	narrow	unknown	low	low	*short
Carpet Python	declined	large	low	narrow	unknown	unknown	low	unknown
Woodland Blind Snake	unknown	small	low	narrow	unknown	low	low	unknown
Gray’s Blind Snake❖	unknown	large	medium	narrow	unknown	low	low	short
Red-throated Skink❖	unknown	medium	medium	narrow	unknown	low	low	short
Tree Skink❖	unknown	small	low	wide	unknown	low	low	short
Amphibians								
Spotted Tree Frog	declined	small	low	narrow	high	low	low	long
Alpine Tree Frog	declined	small	low	narrow	unknown	low	low	unknown

\* Unknown, but most likely classification. ♦ Denotes indicator species.

Most of the species assessed have either small or medium geographic ranges within the North East. Species with a small geographic range (including all of the bats and amphibians considered here) are more vulnerable to regional extinction as a result of localised disturbance.

As expected for a group of species selected because there is some concern for their status, most species have a low abundance. Three of the threatened species with a low abundance, Dingo, Spot-tailed Quoll and Carpet Python, nevertheless have a large geographic range over the North East (based on small numbers of widely scattered records).

Many of the species covered by the review were rated as habitat specific. These species often depend on a combination of certain habitat components - for example, the Sooty Owl needs large tree hollows and prefers wet forests. Loss or reduction of a critical habitat component is likely to lead to population declines.

Nineteen of the 49 species listed in Table 12.15 have a combination of small geographic range size, low abundance and narrow habitat specificity. Many of them exist in small isolated populations, making them particularly vulnerable to disturbances, especially stochastic events such as wildfire which can cause local extinctions. Species in this group are more predisposed to the threat of decline

or extinction within the North East and should be given particular consideration in developing priorities for management action.

The chances of discrete populations of a species collapsing are reduced if the species has a good ability to disperse and if the size of populations are not highly variable (see spatial dynamics ratings). North East species in this group include the Spot-tailed Quoll, Yellow-bellied Glider, Common Bent-wing Bat and most of the large forest owls. At the other extreme are species whose spatial dynamics characteristics make them more vulnerable to extinction - these include the Mountain Pygmy-possum, Smoky Mouse, Speckled Warbler and Spotted Tree Frog. These latter four species also have either a low reproductive rate or low longevity, increasing their risk of decline.

Population trends are the clearest indicators of a species likelihood of decline or extinction. The majority of species are thought to have declined in abundance since European settlement, usually as a result of loss of habitat through clearing for agriculture and urban development. Of the species whose population trend in the past 10 years could be determined, the majority have decreased. An exception to this is the Turquoise Parrot, whose range appears to be expanding following a drastic decline during the early period of European settlement. Although Mountain Pygmy-possum, Barking Owl, Powerful Owl and Glossy Black-Cockatoo numbers are thought to have decreased since European settlement, they are thought to have stabilised over the past 10 years.

Unfortunately, the population trend in the past 10 years could not be determined for a range of species. This, together with other gaps in knowledge of species indicated in Table 12.15 highlights the need for further biological information on a number of the species assessed.

### **Species Reservation Analysis**

A reservation analysis has been undertaken to assess the extent to which terrestrial vertebrate species in the North East are protected in the reserve system.

Using data from the Atlas of Victorian Wildlife, both formal survey and incidental records were intersected with existing land tenure to calculate the total proportion of records for each species in each of the major land tenure categories - see Table 12.16. There are 13 species for which less than 20 per cent of records are in Reserves, however none of these species have their major occurrence in the North East Region.

The results should be considered in conjunction with the information on threatening processes. Many threatening processes operate across reserve and off-reserve areas and other measures are in place, in addition to reservation, to provide protection at the species level.

**Table 12.16: Reservation analysis of priority fauna species records in the North East**

Group/Species	Total Records	Conservation Parks and Reserves		State Forest and Other Public Land		Private Land		Water Bodies	
Mammals		No.	%	No.	%	No.	%	No.	%
Spot-tailed Quoll	1			5	38	8	62		
Brush-tailed Phascogale	6	20	33	5	8	36	59		
Long - footed Potoroo	60	24	40	36	60				
Mountain Pygmy-possum	62	35	56	26	42			1	2
Squirrel Glider	10	72	67	4	4	32	30		
Broad-toothed Rat	40	23	58	1	38			2	5
Smoky Mouse	38	1	39	23	61				
Dingo	6	3	50	1	17	2	33		
Eastern Horseshoe-bat	20			20	100				
Large-footed Myotis	1	2	18	8	73	1	9		
Common Bent-wing Bat	1			1	89	2	11		
Birds									
Apostlebird	1					1	100		
Swift Parrot	10	77	74	6	6	2	20		
Turquoise Parrot	320	19	60	3	10	98	31		
Painted Honeyeater	37	23	62			1	38		
Regent Honeyeater	17	80	46	9	5	83	48	2	1
Grey-crowned Babbler	84	4	5	2	2	78	93		
Bush Stone-curlew	58	3	5	3	5	52	90		
Square-tailed Kite	1	4	36	3	27	4	36		
Grey Goshawk	1	1	100						
White-bellied Sea-eagle	28	3	11	1	4	8	29	1	57
Barking Owl	57	20	35	1	23	24	42		
Powerful Owl	10	33	32	56	54	1	14		
Masked Owl	1			1	100				
Sooty Owl	37	1	32	25	68				
Glossy Black-Cockatoo	2			2	100				
Reptiles									
Alpine Bog Skink	1	1	100						
Alpine She-oak Skink	1	4	40	6	60				
Alpine Water Skink	4	4	100						
Bandy Bandy	1	5	50	1	10	4	40		
Carpet Python	2					2	100		
Woodland Blind Snake	2	1	50	1	50				
Amphibians									
Alpine Tree Frog	39	4	10	22	56			1	33
Spotted Tree Frog	10	36	33	73	67				

Only records post 1970 and with an accuracy of one minute or better were used in this analysis.

## 12.7 REVIEW OF DISTURBANCES AND IMPLICATIONS FOR FLORA AND FAUNA

### Introduction

The decline of species can be largely attributed to the impacts of disturbances, both direct—on species, and indirect—on essential components of their habitat. In this review, disturbances are defined as activities or events with associated environmental impacts. The environmental impacts may constitute potentially threatening processes for particular taxa. Such potentially threatening processes, as defined under the *Flora and Fauna Guarantee Act 1988* (FFG Act), could pose a significant threat to the survival, abundance and evolutionary development of native species or ecological communities of flora or fauna.

A range of mechanisms are in place in the North East to ensure that threatening processes which affect individual species are addressed. These include:

- a conservation reserve system which includes a sample of habitats on public land;
- requirements under the FFG Act and the *Endangered Species Protection Act 1992*;
- a range of provisions in the Code of Forest Practices for Timber Production (NRE 1996a) and the Code of Practice for Fire Management on Public Land (CNR 1995d) which address many of the threatening processes operating in the region.

Additional protection will be afforded by measures in the proposed North East Forest Management Plan (in prep), including specific threatened species strategies and Special Protection Zones

### Methods

Disturbances which impact on flora and fauna in the North East were identified as part of an assessment of vulnerability, population parameters and life history attributes of 261 vascular plants and 49 terrestrial vertebrates. These species were selected for analysis because they are either classified as rare or threatened in Victoria or considered to be indicators, representative of a suite of species which may be vulnerable to the continued action of threatening processes. The 49 fauna species are listed in Table 12.14. The full flora list appears in Appendix F of the Biodiversity Assessment Report.

Each disturbance was evaluated to determine the extent of its occurrence within the North East, the potentially threatening processes which are associated with it, the overall significance of the threat to native flora and fauna in the region, species attributes which might predispose taxa to negative impacts, and examples of the plants and animals that might therefore be susceptible to the disturbance. Management systems, including policies and processes, for the amelioration of the adverse biodiversity impacts of the disturbance were also summarised.

The significance of threats to flora and fauna were assessed through reference to the current literature and consultation with recognised experts in the biology of the species. Threatening processes which potentially affect more than one component of a species' life cycle or habitat scored higher ratings than threats which affect fewer life cycle or habitat components. For each disturbance identified, a score was assigned for each priority species being considered, indicating the level of threat.

Disturbances were scored for each species as follows:

- Effect unknown;
- 0** Processes not likely to be operating as a threat or there is no information to suggest that it is a threat;
- 1** Process is a minor threat, which by itself is unlikely to lead to broad scale decline of the species;
- 2** Process is a moderate threat, which is likely to lead to some decline of the species, especially if it operates in combination with other threatening processes; and
- 3** Process is a major threat, which if not checked poses a significant risk to the viability of the species in the North East.

The assessments were made recognising that practices on public land follow minimum prescriptions required under the Code of Forest Practices for Timber Production and various State Acts and Regulation and that practices on private land are in accord with the *Planning and Environment Act 1987* and the *Catchment and Land Protection Act 1994*. However, the assessments do not take account of additional protection afforded in various Action Statements, Park management plans, nor any additional measure that may be established in the North East Forest Management Plan which is currently in preparation. The following discussion applies only to the North East RFA region.

### Results and discussion

Because of the large number of species assessed, the results of the flora disturbance assessment have not been tabulated here but details for *Endangered Species Protection Act 1992*/FFG Act listed species are available in the Biodiversity Assessment Report. The results of the fauna disturbance assessment are presented in Table 12.17.

The combined score for each threatening process can provide an indication of the relative importance of different threatening processes affecting taxa in the North East (as shown in Table 12.17). Overall, clearing of native vegetation was the highest scoring threat for fauna, followed by timber harvesting and unplanned fire. Clearing of native vegetation was also identified as affecting the greatest number of fauna species.

An explanation of each threatening process follows, with a discussion of the key species and Ecological Vegetation Classes (EVCs) affected in the North East, and management arrangements that are in place to mitigate these threats.

### Timber Harvesting

As outlined in chapter 4, the net productive area of Ash type forest in the region is approximately 40 000 ha (3 per cent of the total forest areas in the region), while the net productive area of mixed species forest is 80 000 ha (6 per cent) of the forested area in the North East. Timber harvesting methods used in the North East include seed tree, selection and clearfell systems. The seed tree system involves the felling of all except five to nine well spaced trees per hectare with regeneration achieved through the release of seed from these retained trees onto a prepared seed bed. The selection system involves the harvesting of small patches or single mature trees while retaining habitat trees and minimising damage to the remaining trees. Clearfelling involves the removal of all standing timber except for designated habitat trees and seed trees. The choice of harvesting system is largely determined by the requirements of different eucalypt species for successful regeneration following harvesting.

Associated potentially threatening processes may affect individual plant species through direct impacts such as falling, snagging and loading and indirect impacts on the site and surrounding vegetation, and the impacts of a cycle of harvesting on forest structure and ecology. Potentially threatening processes directly associated with harvesting operations include damage or loss of individuals, disturbance to the superficial soil structure or soil-stored seedbanks and compaction of the soil surface on snig tracks and log landings. These processes are localised and of moderate overall significance to individual species. Potentially threatening processes indirectly associated with harvesting operations include habitat modification and loss of opportunity to develop habitat elements characteristic of mature and senescent forests on the coupe. This threatening process is considered to be of moderate overall significance but can have a major impact in certain vegetation types such as Wet Forest, Damp Forest, Riparian Forest and Montane Riparian Thicket. Edge effects are likely to be of greatest threat to EVCs that are linear and small (eg. Montane Riparian Thicket), and plant species which rely on stable, low light, high humidity, moderate temperature regimes. Species potentially affected by additional soil disturbance created by timber harvesting include small forest understorey plants and species of mountain stream margins. Frequency, intensity and length of a harvesting rotation appear to strongly influence species composition and different forest ecosystems respond differently to the various silvicultural systems applied.

**Table 12.17: Impacts of threatening processes on fauna species**

SPECIES	Clearing of Native Vegetation	Timber Harvesting	Fuel Reduction Burning	Firewood Collection	Unplanned Fire	Introduced Species	Grazing/Trampling	Pest Control	Road Construction/Maintenance	Mining/Quarrying	Tree Dieback	Recreation	Illegal Collecting/Harvesting	Vandalism	Dams/Impoundments	Interspecific Competition	Pasture Improvement	Climate Change	Loss of Genetic Diversity	Mineshaft Collapse	Rock Harvesting
<b>MAMMALS</b>																					
Broad-toothed Rat	1	1	2	0	2	2	2	0	-	0	-	1	0	0	1			2			
Brush-tailed Phascogale	3	2	1	2	2	2	1	1	1	1	1	0	0	0	0						
Dingo	1	2	1	0	2	2	1	2	-	0	-	0	0	1	1				2		
Common Bent-wing Bat	1	-	-	-	-	2	0	2	0	2	-	0	0	3	0					3	
Eastern Horseshoe Bat	-	-	-	-	-	2	0	2	0	2	-	0	0	3	0					3	
Large-footed Myotis	1	2	-	-	-	1	1	2	2	2	-	1	0	1	0						
Long-footed Potoroo	1	3	2	-	2	2	1	1	2	-	-	0	0	0	1						
Mountain Pygmy-possum	3	0	0	0	2	2	2	1	2	0	0	3	0	0	0			3			
Smoky Mouse	1	2	3	1	2	2	1	0	1	0	-	1	0	0	1						
Spot-tailed Quoll	2	3	2	2	2	2	1	3	1	1	1	1	0	2	1						
Squirrel Glider	3	2	2	2	2	1	2	1	2	-	2	1	0	0	0				1		
Eastern Broad-nosed Bat	1	2	-	-	-	1	0	2	-	-	-	0	0	1	0						
Long-nosed Bandicoot	2	2	2	0	2	2	1	1	-	1	-	1	0	0	1						
Yellow-bellied Glider	2	3	1	1	2	1	1	0	1	1	-	0	0	0	1						
Yellow-footed Antechinus	2	2	2	2	2	2	2	1	-	1	-	1	0	0	1						
<b>BIRDS</b>																					
Apostlebird	3	0	0	-	1	1	3	1	2	-	3	0	0	0	0		2				
Bush Stone-curlew	3	1	1	3	-	3	2	2	2	-	1	0	1	1	0		3				
Grey-crowned Babbler	3	0	2	2	-	2	3	1	3	0	2	0	0	0	0	1	3				
Masked Owl	3	2	2	2	2	1	2	3	1	1	2	0	0	0	0						
Barking Owl	3	2	2	2	2	1	2	2	-	-	2	0	0	0	0						
Powerful Owl	2	3	2	1	3	0	-	1	1	1	1	0	0	0	0						
Sooty Owl	2	3	2	1	3	0	-	1	1	1	1	0	0	0	0			2			
Painted Honeyeater	3	2	1	2	2	-	2	-	-	-	2	0	0	0	0	2					
Regent Honeyeater	3	2	-	2	2	1	2	-	1	-	3	-	0	-	0	1					
Square-tailed Kite	2	2	2	1	2	0	1	-	1	-	1	-	2	2	0						
Grey Goshawk	2	2	2	1	2	0	1	2	1	-	1	-	-	2	0						
Turquoise Parrot	2	2	2	2	2	3	2	0	1	1	2	0	1	0	0		3				
Swift Parrot	3	2	-	2	-	1	2	-	1	-	2	-	-	-	0	-					
White-bellied Sea-Eagle	2	2	-	1	-	0	-	1	2	1	1	2	-	1	0	-					
Glossy Black-Cockatoo	1	-	1	-	-	-	1	0	0	-	-	0	-	0	0						
Azure Kingfisher	1	1	-	-	-	2	1	-	-	-	-	-	0	0	3						
Chestnut-rumped Heathwren	2	-	2	2	2	-	1	0	0	0	0	0	0	0	0						
Cicadabird	2	2	-	0	1	0	0	0	0	0	1	0	0	0	0						
Dollarbird	2	1	1	2	2	-	1	1	-	-	1	-	0	0	0						
Gang-gang Cockatoo	2	2	1	-	2	0	-	0	-	-	-	0	-	0	0						
Pink Robin	1	1	1	0	1	-	1	0	-	0	-	0	0	0	0			2			
Speckled Warbler	2	2	1	2	1	1	2	0	0	-	1	0	0	0	0						



**Table 12.17: Impacts of threatening processes on fauna species cont'd.**

SPECIES	Clearing of Native Vegetation	Timber Harvesting	Fuel Reduction Burning	Firewood Collection	Unplanned Fire	Introduced Species	Grazing/Trampling	Pest Control	Road Construction/Maintenance	Mining/Quarrying	Tree Dieback	Recreation	Illegal Collecting/Harvesting	Vandalism	Dams/Impoundments	Interspecific Competition	Pasture Improvement	Climate Change	Loss of Genetic Diversity	Mineshaft Collapse	Rock Harvesting
<b>REPTILES</b>																					
Alpine Bog Skink	3	0	0	0	1	1	3	0	1	1	0	2	0	0	2			3			
Alpine She-oak Skink	3	0	2	1	2	1	3	0	1	1	0	3	1	0	1			3			
Alpine Water	2	0	0	0	1	1	3	0	1	1	0	3	0	0	2			3			
Bandy Bandy	3	2	2	2	2	1	2	2	1	1	0	0	0	0	0						1
Carpet Python	3	3	3	3	3	3	1	2	1	1	1	1	2	1	0						
Woodland Blind Snake	3	1	1	2	1	1	2	2	0	1	0	0	0	0	0						
Gray's Blind Snake	3	2	2	2	2	1	2	1	0	1	0	0	0	0	0						
Red-throated Skink	2	2	3	2	2	1	2	0	1	1	1	0	0	0	0						
Tree Goanna	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0						
Tree Skink	2	2	2	2	2	1	1	1	0	1	0	0	0	0	0						
<b>AMPHIBIANS</b>																					
Alpine Tree Frog	-	0	-	0	-	-	3	1	1	1	0	2	-	-	-			3			
Spotted Tree Frog	1	2	-	1	-	3	2	2	2	3	0	2	-	-	2			2			
<b>TOTAL SCORE</b>	<b>101</b>	<b>77</b>	<b>60</b>	<b>53</b>	<b>70</b>	<b>57</b>	<b>70</b>	<b>46</b>	<b>39</b>	<b>30</b>	<b>34</b>	<b>26</b>	<b>8</b>	<b>19</b>	<b>18</b>	<b>4</b>	<b>11</b>	<b>23</b>	<b>3</b>	<b>6</b>	<b>1</b>
<b>NO. OF SPECIES AFFECTED</b>																					
Major threat	18	7	3	2	3	4	6	2	1	1	2	3	0	2	1		3	5		2	
Moderate threat	18	25	20	19	27	13	17	12	8	3	7	4	2	3	3	1	1	4	1		
Minor threat	11	6	11	9	7	19	18	16	20	21	14	9	4	7	9	2			1		1
Not a threat	0	7	4	9	0	7	4	14	9	8	11	27	36	33	35						
Unknown threat	2	4	11	9	12	6	4	5	11	16	15	6	7	4	1	2					
<b>Total no. affected</b>	<b>47</b>	<b>38</b>	<b>34</b>	<b>30</b>	<b>37</b>	<b>36</b>	<b>41</b>	<b>30</b>	<b>29</b>	<b>25</b>	<b>23</b>	<b>16</b>	<b>6</b>	<b>12</b>	<b>13</b>	<b>3</b>	<b>4</b>	<b>9</b>	<b>2</b>	<b>2</b>	<b>1</b>

Timber harvesting impacts upon a range of fauna species through its short-term effect of habitat removal and medium and longer-term effect of producing even-aged regrowth forests that are less suitable for some species than older forests. Threatening process include the loss of hollow-bearing trees, the conversion of mature stands to young regrowth stands and fragmentation. Ecologically mature or old-growth forests are generally more structurally and floristically diverse than regrowth forests. In the North East timber harvesting is considered a major threat to the Long-footed Potoroo, Spot-tailed Quoll, Yellow-bellied Glider, Sooty Owl, Powerful Owl, Carpet Python and Tree Goanna.

Canopy loss and habitat fragmentation resulting from timber harvesting are potentially threatening processes for the Regent Honeyeater, Swift Parrot, Grey Goshawk, Square-tailed Kite and Cicadabird. Timber harvesting activities have the potential to reduce numbers of the Spotted Tree Frog by destroying sheltering sites, affecting prey abundance, altering micro-climates, fragmenting habitat and allowing the invasion of exotic weeds and predators. Altered stream conditions as a result of timber harvesting operations may indirectly impact on the Large-footed Myotis and Azure Kingfisher that feed on aquatic insects and fish. Soil disturbance and loss of litter during timber harvesting operations is a potential threat to the Woodland Blind Snake, Gray's Blind Snake, Bandy Bandy, Red-throated Skink and Speckled Warbler. The availability of hypogaeal (underground fruiting) fungi, an important food of the Long-footed Potoroo, may also be affected.

Timber harvesting and associated roading and burning activities are managed under the forest management planning process which includes the Code of Forest Practices for Timber Production, the Code of Practice for Fire Management on Public Land, the North East Forest Management Plan (NRE

in prep.), regional prescriptions and the annual Wood Utilisation Plans. The Code of Forest Practices for Timber Production and Forest Management Plans are subject to periodic review with formal public consultation, while regional prescriptions and Wood Utilisation Plans are prepared in consultation with regional flora and fauna staff and community input.

The Code of Forest Practices for Timber Production provides principles and guidelines and sets minimum standards for forest operations in State forests in Victoria. It aims to ensure that environmental values and water catchments are protected, by careful operation planning, reservation of appropriate areas and vegetation corridors. Such prescriptions particularly benefit certain forest ecosystems (such as riparian EVCs) and the flora and fauna associated with them.

Potentially threatening processes listed under the FFG Act which may be relevant to timber harvesting are *Degradation of native riparian vegetation*, *Increase in sediment input into Victorian rivers and streams due to human activities* and *The invasion of native vegetation by 'environmental weeds'*.

The North East RFA region encompasses the Wodonga, Wangaratta and Benalla/Mansfield Forest Management Areas (FMAs) and a forest management plan is currently being prepared. Management strategies for species and threatening processes listed under the FFG Act are detailed in Action Statements and incorporated into forest management plans where relevant. Direct and indirect taking of protected flora associated with timber harvesting requires authorisation under the FFG Act. In addition to the formal reserve system already in place, Special Protection Zones will be defined and managed for conservation with timber harvesting excluded. Current prescriptions set a minimum of 15 retained trees per 10 hectares harvested for all forest types for conservation of wildlife habitat within the timber production forest.

### **Clearing of native vegetation**

Clearing of native vegetation in the North East occurs as part of development for agricultural, industrial, urban and utility purposes. Historically areas particularly amenable to agriculture were on the more fertile soils and were dominated by overstorey species of Grey Box *Eucalyptus microcarpa*, White Box *E. albens*, Yellow Box *E. melliodora* and Yellow Gum *E. leucoxylon*. These EVCs were cleared extensively and now persist largely as scattered remnants on or adjacent to private land, or as linear strips along roadsides and watercourses.

Potentially threatening processes directly associated with clearing of native vegetation include damage or loss of individuals, disturbance to soil-stored seedbanks, changes to structure and composition and loss or modification of habitat. Within the North East, clearing of native vegetation is a particularly significant threat to species dependent on plains, woodland and sub-alpine habitats. Few if any native plants can survive broadscale clearance of vegetation where the result is conversion of the land to intensive human use for urban, industrial, tourism or other purposes.

Many of the threatening processes indirectly associated with this disturbance result from fragmentation and isolation of habitat. The Bandy Bandy and Woodland Blind Snake are particularly vulnerable to habitat isolation and loss and fragmentation of habitat are significant threats to the Turquoise Parrot, the large forest owls, Brush-tailed Phascogale and Tree Goanna. Remnant woodland habitats on fertile soils are important food sources for mobile bird species such as the Regent Honeyeater, Swift Parrot and Painted Honeyeater. Selective loss of these habitats may deplete a food resource at a critical time of year and contribute to local or regional population declines. For species which utilise woodland habitats as well as other forest types, (e.g. Speckled Warbler, Chestnut-rumped Heathwren, Cicadabird, Dollarbird) clearing for agriculture is considered a moderate threat.

Further clearing of native vegetation is significantly mitigated by the implementation of native vegetation retention controls under the *Planning and Environment Act 1987*. Land holders and public authorities must apply for a permit to clear native vegetation from land greater than 0.4 ha. Permits to clear native vegetation are generally only granted for small areas with little significance or slightly

larger areas of degraded native vegetation. Removal of protected flora associated with clearing requires authorisation under the FFG Act. The rate of clearing of private land is monitored by NRE through a database of clearing applications and satellite imagery which allows detailed comparison between current and past extent of tree clearance. Since the introduction of planning restrictions on the clearing of native vegetation on private land in 1989, the rate of vegetation loss has decreased tenfold in Victoria.

Clearing of native vegetation on public land requires Ministerial or Departmental approval and major developments are usually the subject of Environment Effects Statements in which any impacts on native flora and fauna are considered.

### **Fuel Reduction Burning**

The effects of fire on flora and fauna vary depending on the scale, frequency, intensity and season of burns. Most native terrestrial plants have evolved reproductive mechanisms in response to fire and many fauna species respond to fire with respect to shelter, food and behavioural patterns. Most fuel reduction burns are low intensity burns that aim to reduce the ground, understorey and bark fuel loadings. In the North East the lowest fuel reduction burning frequencies are usually 6-7 years apart. Fuel reduction burns are mainly carried out in Shrubby Dry Forest, Herb-rich Foothill Forest, Heathy Dry Forest and Grassy Dry Forest.

The direct impact of a fuel reduction burn is the damage or loss of fire sensitive species as a result of the fire itself. Indirect impacts of an imposed fire regime which may differ from the “natural” (pre-European) regime can result in changes to vegetation floristics and structure. For example, the frequency, intensity or season of fire may increase competition from other native or introduced species better suited to the fire regime. When burning frequency is too high species may fail to reproduce adequately before the next burn so that there are no propagules available for regeneration after subsequent burning event. This is a problem for a large number of EVCs such as Heathy Dry Forest and Granitic Hills Woodland.

Fuel reduction burning in the North East is regarded as a major threat to the Smoky Mouse, Carpet Python and Red-throated Skink and a threat to a further 32 fauna species considered in the assessment. The Smoky Mouse appears reliant on understorey vegetation components so inappropriate fire regimes that change floristics and structure represent a major threatening process for the species. Frequent low-intensity burns can simplify and eventually eliminate dense understorey reducing shelter and foraging sites for the Carpet Python, Spot-tailed Quoll, and Yellow-footed Antechinus. Loss of litter and logs threatens species that are dependent upon these habitats such as the Red-throated Skink, Bandy Bandy, Woodland Blind Snake and Grey’s Blind Snake. The effect of fire on hypogeal fungi is potentially severe for the Long-footed Potoroo.

Fire management in the North East is guided by the Code of Practice for Fire Management on Public Land which outlines general principles and guidelines for fuel reduction burning and Regional Fire Protection Plans. Each fuel reduction burn undertaken on Public land, must be the subject of an approved burn plan in accordance with the Code and Regional Fire Protection Plan. Such plans must take into account prescriptions developed for the protection of threatened species.

FFG Act Action Statements include fire management prescriptions for species which are threatened by this process. However, for the majority of species, the effect of fuel reduction burning, particularly the effect of burning frequencies, is largely unknown. NRE is undertaking long-term research on fuel reduction burns in the Wombat State Forest, which includes vegetation types found in the North East.

### **Regeneration burning**

Regeneration burning is a standard component of forest management in most harvesting operations in the North East and involves the burning of windrowed or heaped debris to create optimal conditions for the natural germination of eucalypt seed. The direct impact of regeneration burning on flora is the

damage or loss of fire sensitive species, on the coupe and in the surrounding vegetation (such as in gullies).

The longer-term, indirect impacts of regeneration burning include failure to reproduce adequately when intensity or season are unsuitable, absence of suitable conditions for establishment, and competition from native or introduced species better suited to the fire regime.

The Code of Forest Practices for Timber Production contains specific guidelines to prevent damage to retained (including streamside buffers, habitat trees and existing regrowth) and surrounding vegetation from regeneration burns, particularly in relation to fire sensitive riparian EVCs.

### **Planned Absence of Fire**

The deliberate exclusion of fire is a result of successful fire prevention and fire suppression activities directed towards the protection of life, property and other assets. It also may reflect management decisions, to exclude fire as much as possible (eg alpine communities). The threatening processes associated with the long-term absence of fire are the same as those indirect impacts of the types of planned fire discussed above.

The EVCs most prone to structural and floristic changes in the absence of fire include Granitic Hills Woodland and Heathy Dry Forest. Several species are dependent on fire for reproduction, or have their reproduction greatly enhanced by fire (eg. Wedge Diuris *Diuris dendrobioides*, Phantom Wattle *Acacia phasmoides* and Purple Eyebright *Euphrasia collina* ssp. *muelleri*). Some species killed by fire are also dependent on it to achieve or enhance reproduction by resprouting and/or seedling establishment including Mountain Banksia *Banksia canei*, Tree Hakea *Hakea eriantha* and Yellow Hakea *H. nodosa*.

Ecological burns are undertaken in accordance with management plans or Action Statements for specific species, communities or sites.

### **Unplanned Fire (Wildfire)**

Fire is a fundamental element of the Australian environment and is the major natural disturbance maintaining the mosaic of floristic and structural diversity within native vegetation. Wildfire may have both positive and negative outcomes for flora and fauna populations.

Effects of fire on vegetation are dependent on the frequency, intensity, and season of burn. They include changes in species composition, abundance, and physical and age structure. All species respond uniquely to the combination of fire regime, other disturbances and potentially threatening processes such as weed invasion. Low intensity fires generally leave more areas of un-burned vegetation but high intensity fires can also be restricted or patchy in extent. Vegetation in sub-alpine and alpine areas is especially sensitive to damage caused by wildfire because of a very limited growing season and slow growth rate.

Adverse affects of wildfire on animal species are related to mortality, subsequent loss of shelter and nest sites, reduction in prey availability and foraging substrate, and increased risk of predation by introduced species. Wildfire is regarded as a major threat to the Carpet Python, Powerful Owl, Sooty Owl and Turquoise Parrot and all species assessed were considered to be under some degree of threat from wildfire. Populations of species such as the Squirrel Glider which relies on understorey *Acacia* species may be locally disadvantaged by a fire which destroys this winter food source, but fire may also stimulate germination of the seed bank benefiting the local glider population. Smoky Mouse habitat appears to be fire-generated and the species exist in small isolated populations which may become locally extinct if a wildfire were to destroy all the suitable habitat in an area at the one time.

The Department of Natural Resources & Environment has the responsibility for prevention and suppression of fire in State forest, National Parks and reserves and all protected public land. The Code of Practice for Fire Management on Public Land and regional fire protection plans include strategies

for fire prevention, preparedness, fire suppression and recovery after wildfire. Significant and sensitive natural values can be taken into account by these plans.

### **Grazing**

Domestic stock and feral and naturalised exotic animals including rabbits, hares, deer, goats and brumbies are the main agents of grazing or browsing and trampling of native vegetation within the North East. On public land, licensed grazing is practised in State forest, parts of the Alpine National Park, roadside reserves and water frontages. Browsing by native herbivores is only considered as a disturbance in this review where it is significantly beyond the natural range of impact (over-browsing).

Grazing, browsing or trampling can result in direct damage to or loss of plants and reduced reproductive output. Less direct potentially threatening processes associated with grazing are habitat modification, reduction in the litter layer and soil disturbance, compaction or erosion. The ecological attributes which predispose plants to threat from grazing include palatability and occurrence in habitats which tend to be grazed more frequently or heavily, such as grassy habitats.

Habitats affected by grazing are principally the grassy and forb-rich EVCs such as Grassy Woodland, Box Ironbark Forest, Plains Grassy Woodland, Floodplain Riparian Woodland, Grassy Dry Forest, Herb-rich Foothill Forest, Treeless Sub-alpine Complex and Valley Grassy Forest. The historical combination of alienation, grazing and clearing has resulted in most of these ecological vegetation classes being scarce on public land and are often present as degraded remnants on private land.

Lack of regeneration as a result of grazing of remnant patches of native vegetation is a significant threat to species such as the Painted Honeyeater, Apostlebird, Regent Honeyeater, Swift Parrot, Bush Stone-curlew, Squirrel Glider, Grey-crowned Babbler, Swift Parrot and Bandy Bandy. Lack of regeneration resulting in loss of habitat in the long-term may also have a significant impact on species which utilise forest farmland edges such as the Masked Owl, Barking Owl and Turquoise Parrot. Soil disturbance resulting from grazing is likely to adversely affect subterranean species such as the Woodland Blind Snake, Gray's Blind Snake and Bandy Bandy. Elimination and simplification of understorey vegetation and trampling of litter accumulations as a result of grazing are threatening processes for a range of reptile species, particularly skinks, and ground-foraging birds. Alpine and sub-alpine vegetation is generally slow growing and seedling establishment is rare so it is particularly sensitive to physical disturbance and modification arising from grazing and trampling. Habitat loss and degradation is a significant threat to Alpine Bog Skink, Alpine She-oak Skink, Alpine Water Skink, and Mountain Pygmy-possum.

Grazing on public land including State forest is permitted under licence subject to regulation under relevant legislation. Licences are issued for seven years for parts of the Alpine National Park and specify the maximum number of stock that may be grazed on the licensed areas. Licences include conditions, which can include the exclusion of cattle from areas of special conservation significance or from areas requiring rehabilitation. For public roadsides managed by local government, development of roadside management plans which address issues such as grazing are critical to ensure habitat conservation for many species.

Two of the major impacts of grazing are listed as Potentially Threatening Processes under the FFG Act. These are *The Degradation of native riparian vegetation along Victorian rivers and streams* and *Soil erosion and vegetation damage and disturbance in the alpine regions of Victoria caused by cattle grazing*.

Coordinated public and private land rabbit control programs are ongoing.

### **Road construction and maintenance**

Potentially threatening processes include direct damage or loss of plants by machinery, habitat loss and/or fragmentation, altered micro-climatic and light conditions, erosion, sedimentation, introduction

of soil or gravel contaminated with weed seed or fungal spores and the facilitation of weed spread due to continual disturbance of road margins.

Indirect impacts of road construction and maintenance include potentially threatening processes that lead to habitat modification. These processes are most significant in the vicinity of gullies in the steeper, higher-rainfall, mountainous parts of the North East. Consequently species associated with gully and riparian environments are most likely to be affected, (e.g. Blanket-leaf *Bedfordia arborescens*, Southern Sassafaras *Atherosperma moschatum*, Hard Water-fern *Blechnum watsii*, Rough Tree-fern *Cyathea australis* and Veined Bristle-fern *Polyphlebium venosum*).

Roadside vegetation provides a significant proportion of the habitat of the Grey-crowned Babbler, Bush Stone-curlew, Apostlebird and Squirrel Glider. Road-widening and upgrading and installation of utilities degrade and can reduce habitat by removing and damaging mature trees, saplings and shrubs and may also result in weed invasion. Roads can create barriers to movement and fragment habitat. Species with limited mobility such as small mammals and skinks are particularly vulnerable. The establishment of roads through undisturbed forest may allow introduced predators to colonise new areas.

Construction of roads and tracks can result in increased sedimentation of streams and alteration of riparian habitats. Increases in sediment load can be detrimental to the Spotted Tree Frog by affecting growth and survival of eggs and tadpoles. Increased sedimentation and turbidity of streams may indirectly affect the Large-footed Myotis through reduced prey availability.

All new roads and tracks used for timber production in State forests must be built to comply with the Code of Forest Practices for Timber Production. However, many roads and tracks were built prior to introduction of the Code and do not meet today's standards. Action is underway to prioritise improvements to existing roads, based on a recent condition assessment. In State forest attention is paid to planning the road network to avoid threatened species habitat, minimise environmental damage and provide high standard stream crossings.

VicRoads (the Victorian Government agency responsible for main roads and highways throughout Victoria) has recently published an environmental strategy. Local municipalities are responsible for all other public roads (and roadsides) excluding those managed by NRE. Local Government Roadside Management Plans which incorporate guidelines for habitat management should assist in achieving conservation objectives for species dependent upon roadside vegetation in the agricultural landscape.

*Degradation of native riparian vegetation along Victorian rivers and streams, Increase in sediment input into Victorian rivers and streams due to human activities and The invasion of native vegetation by environmental weeds* are listed as Potentially Threatening Processes under the FFG Act.

## Recreation

A wide range of recreational pursuits take place in the North East, but the most significant, from a disturbance perspective, are vehicle based activities, fishing, hunting, camping, and skiing. At stream crossing points high levels of vehicle traffic can result in localised bank erosion and sedimentation. Vehicle use can also result in the transport of soil, potentially carrying plant diseases and weed propagules. Snow sport and associated development of facilities is a localised but significant form of recreation in the North East. Its impacts can include clearing, habitat fragmentation and habitat disturbance, pollution and the spread of environmental weeds.

The potentially threatening processes associated with recreation activities that directly impact on native vegetation are the direct damage or loss of individuals and habitat loss or modification. For flora restricted to alpine and sub-alpine habitats, clearing of native vegetation is potentially a major threat. Flora species threatened include Swamp Fern *Thelypteris confluens*, Dwarf Sedge *Carex paupera*, Kellaria *Kellaria laxa*, Mountain Daisy *Brachyscome tenuiscapa* and Silky Daisy *Celmisia sericophylla*.

Indirect impacts on vegetation result in overall habitat degradation which may involve disturbance to soil structure by compaction and erosion, the facilitation of spread of disease, pathogens or environmental weeds, altered soil or surface hydrology, the increase in sediment input into streams and pollution/eutrophication of subalpine wetlands and streams.

The EVCs likely to be at greatest risk from recreational activities are those associated with alpine or riparian environments where recreation activities are concentrated. Species at risk include those sensitive to weed invasion and plant pathogens and species of wet subalpine environments.

Within the North East, fauna species most vulnerable to threatening processes associated with recreational activities are those dependent on sensitive habitat types and whose distributions are restricted to areas where recreational activities are concentrated. Recreational activity is considered a major threat to the Mountain Pygmy-possum, Alpine She-oak Skink and Alpine Water Skink and a moderate threat to the Alpine Bog Skink, Alpine Tree Frog, Spotted Tree Frog and White-bellied Sea-Eagle.

Recreational activities occur at many of the sites from which the Spotted Tree Frog has disappeared including fishing and bait collection, which may be a significant cause of Spotted Tree Frog population declines. Records of the White-bellied Sea-Eagle and a number of nest sites are concentrated near several large permanent water bodies, protection of these sites from disturbance is recognised as a significant factor in the conservation of this species.

Vehicle-based activities on public land are managed through the relevant management planning process (Forest Management Plan or Park Management Plans). Effort is generally made to encourage activities in appropriate zones where these activities are compatible with overall management objectives, or where impacts can be minimised. Snow sport and associated resort development and management is required to take into account a range of legislation including provisions of the FFG Act and local planning requirements.

Year round recreational activities are allowed throughout much of the alpine area most of which is included in the Alpine National Park, although certain restrictions apply, for example, horse riding is allowed only during set periods of the year. The Park is divided into a number of zones, including areas set aside as Special Protection Zones, where stricter controls on recreation apply. Recreation activities are not permitted in Reference Areas, and Wilderness Zones cater only for non-mechanised recreation. Within the Bogong Unit of the Alpine National Park there are Special Protection Zones for the Mountain Pygmy-possum, Broad-toothed Rat, Alpine Water Skink and Spotted Tree Frog. These are areas of suitable habitat that are managed primarily to maintain, protect or enhance the special features they encompass.

### **Environmental weed invasion**

Environmental weeds are widespread throughout the North East, occurring in all habitats and areas, and their impact varies. The most destructive environmental weeds are those which out-compete native species to the extent that their habitat can become grossly modified, with particular niches being lost altogether.

Plant species likely to be at greatest risk from environmental weed invasion are those which occupy weed-prone habitats, such as riparian zones, relatively fertile soil types and fragmented habitats in close proximity to weed sources, such as waste disposal areas and agricultural lands. EVCs particularly susceptible to environmental weed invasion include Riparian Forest, Plains grassy woodland, Grassy Woodland and Grassy Dry Forest. Examples of species likely to be most affected include Slender Parrot-pea *Almaleea capitata*, Crimson Spider-orchid *Caladenia concolor*, Yellow Hyacinth-orchid *Dipodium hamiltonianum*, Warby Swamp Gum *Eucalyptus cadens*, Yarra Gum *E. yarraensis*, Smooth Darling Pea *Swainsona recta*, Dwarf Sedge *Carex paupera* and Dookie Daisy *Brachyscome gracilis* ssp. *gracilis*.

Invasion of habitats by introduced weeds contributes to habitat degradation, particularly for ground-foraging species such as the Apostlebird and Grey-crowned Babbler. These species are threatened by weed invasion as it reduces foraging habitat by limiting access to ground litter, and invasion of roadside habitats by introduced pasture species is an important cause of habitat loss for these birds. The Pink Robin may lose breeding habitat in stream-side gullies if these sites are invaded by Blackberry *Rubus fruticosus* spp. agg.

*The invasion of native vegetation by environmental weeds* is listed as a Potentially Threatening Process under the FFG Act. The management of environmental weed invasions is the responsibility of the land manager and on public land, environmental weeds and agricultural weeds are considered under the Victorian *Catchment and Land Protection Act 1992*.

The Victorian Parliament, through the Environment and Natural Resources Committee, has investigated the significance of the weed problem in general, including specific reference to environmental weeds. The Commonwealth, in consultation with State and Territory agencies, has recently completed the National Weeds Strategy (ARMCANZ & ANZECC 1997) which outlines strategies to address major issues including limited resources and a general lack of strategic planning, tactical planning, follow-up, monitoring and experimental management.

The distribution of environmental weeds is generally well understood as a result of their inclusion in floristic surveys conducted in the North East.

### **Introduced Fauna Species**

This disturbance relates to the impact of introduced fauna on native fauna and covers predation and competition by introduced species.

The Bush Stone-curlew, Carpet Python, Turquoise Parrot and Spotted Tree Frog (all ground-dwelling or ground-nesting) are particularly at risk in the North East from introduced carnivores. Fox predation is considered a major threat to the persistence of the Carpet Python and foxes are found to prey heavily on the Broad-toothed Rat in Kosciuszko National Park. Bird species that nest on or near the ground, such as the Bush Stone-curlew, Turquoise Parrot and Speckled Warbler, are vulnerable to predation by Foxes, Cats and Dogs with both individuals and eggs taken. The Common Bent-wing Bat and Eastern Horseshoe Bat are preyed upon by Cats as they leave their cave/mineshaft roosts. Predation of Spotted Tree Frog eggs and tadpoles by Trout represents a major threat to this species in the North East.

Competition by introduced species for food and nest hollows is recognised as a moderate threat to the Dingo and Spot-tailed Quoll and a minor threat to the Barking Owl, Masked Owl and Regent Honeyeater. There appears to be some dietary overlap between Cats, Foxes and the Spot-tailed Quoll, competition for prey items may potentially threaten the viability of this Quoll in the North East. Feral European Honey Bees are known to occupy hollow trees, and may compete for this resource and nectar with several native species such as the Brush-tailed Phascogale, the Regent Honeyeater and Swift Parrot. European Carp stir up water debris increasing water turbidity and may significantly impact on habitat quality for the Azure Kingfisher, which may have difficulty detecting prey in murky water.

*Predation by both Foxes and Cats* are listed as Potentially Threatening Processes under the FFG Act, with a published Action Statement for the Fox and an Action Statement currently under preparation for the Cat. Predation by the Cat and Fox are listed as Key Threatening Processes under the *Endangered Species Protection Act 1992* and Threat Abatement Plans are being prepared for each.

Pest animal control measures in the North East include programs coordinated with adjacent landowners (Good Neighbour Program) and, where feasible, targeted programs through the region. Management plans include strategies relating to pest animal control.



### **Pest Control**

Control of pest species potentially impacts on native fauna through non-target and secondary poisoning and food chain contamination by chemicals. This disturbance is a major threat to the Spot-tailed Quoll and Masked Owl, and a moderate threat to a number of other species.

The Spot-tailed Quoll is especially at risk from non-target poisoning as ingestion of 1080-poisoned baits meant for Foxes and Dogs can cause death of individual animals or local populations. Rabbits are probably a major prey item for the Masked Owl and Carpet Python and reduction in Rabbit numbers due to control programs, such as poisoned-baiting and the Calicivirus, is considered a major threat to these species. There is also a risk of secondary poisoning from consuming poisoned Rabbits or Rats to the Spot-tailed Quoll and the Grey Goshawk. The destruction of burrows and piles of logs and debris for Rabbit control are a potential threat for the Tree Goanna and Tree Skink. There is the potential risk that some mammals such as the Long-footed Potoroo may get caught in traps set for pest species. Pesticide poisoning and loss of prey are a potential threat to most of the bats in the North East.

Overall the ecological implications for native fauna of pesticide use is unknown but is potentially significant given the importance of insects and other invertebrates as prey; this issue requires investigation. It is important that pest control programs are closely monitored for any adverse impacts on native fauna and effectiveness on the target species.

### **Firewood Collection**

In Victoria, firewood represents one of the highest volume forest products. The direct impacts of firewood collection on flora include damage or loss of individuals, alteration of microclimatic conditions and the loss or modification of habitat. Indirect impacts of firewood collection include the facilitation of weed invasion, the spread of pathogens, fragmentation and isolation of habitat, increased erosion and sedimentation and disturbance to understorey by vehicles. EVCs directly affected by firewood collection include Valley Grassy Forest and Grassy Dry Forest.

Logs, litter and debris are important microhabitats for many species such as the Woodland Blind Snake, Grey's Blind Snake, Bandy Bandy, Tree Skink, Red-throated Skink, Bush Stone-curlew, Chestnut-rumped Heathwren and Speckled Warbler. Loss of large logs is thought to have contributed to the decline of the Carpet Python in parts of its range. The loss of old trees from woodland remnants on private land is a particularly significant threat to woodland species including the Barking Owl, Masked Owl, Brush-tailed Phascogale, Turquoise Parrot, Dollarbird, Tree Goanna, Regent Honeyeater, Swift Parrot, Painted Honeyeater and Squirrel Glider.

Harvesting of standing trees for firewood is not permitted on public land within the North East. On private land harvesting of firewood for domestic use and the cutting of standing dead trees is exempt under the Native Vegetation Retention Controls. One of the major impacts of firewood collection, *The loss of hollow-bearing trees*, is listed as a Potentially Threatening Process under the FFG Act.

Firewood collection for domestic use on public land is controlled by the issue of licences which stipulate the amount of timber to be collected. Firewood collection along roadsides requires local government permission and a licence. Some shires have roadside management plans which may control firewood collection on roadsides, prohibiting removal of timber from certain high conservation value sites. The number of licenses issued for commercial firewood operations on public land depends on an assessment of the amount of wood available in accordance with the Wood Utilisation Plan in each Forest Management Area. Commercial cutters must also hold a forest operators licence and operate in accordance with the Code of Forest Practices for Timber Production and local NRE prescriptions.

A large proportion of the firewood collected from within the North East region is from woodland remnants on private land. The FFG Act, *Conservation, Forests and Lands Act 1987* and the *Planning*

and Environment Act 1987 provide some controls for firewood collection. On private land commercial harvesting of firewood requires a permit issued by NRE.

### **Illegal collecting/harvesting**

This disturbance includes direct interference to plants and animals by humans in the form of collection or deliberate hunting, poisoning, or trapping. Deliberate collection is a significant disturbance or threat to the native orchids, particularly terrestrial orchids including *Caladenia* spp., *Diuris* spp., *Calochilus* spp. and *Prasophyllum* spp. Illegal collecting is considered a moderate threat to the Carpet Python which may be captured for the live pet trade.

*Collection of native orchids* is listed as a Potentially Threatening Process under the FFG Act. Removal of wildlife from the wild is prohibited under the *Wildlife Act 1975*, and the FFG Act requires a permit to take from the wild all listed species.

### **Dieback**

Dieback describes the protracted decline of health and vigour of plants and it is likely that many factors interact to lead to dieback. Possible contributing factors include insect defoliation, fungal diseases, drought, fire, altered water tables, increased salinity, nutrient imbalances as a result of applications of fertilisers, soil erosion and reduced soil aeration, land clearing, lack of regeneration and overgrazing.

The direct impact of dieback and related processes involves the damage or loss of plants. This can lead to changes in vegetation structure, composition and diversity, the alteration of microclimatic conditions and the loss or modification of habitat. Within the North East there have been few incidences of dieback in forest stands, generally associated with fungal pathogens or defoliation by phasmatid insects. Occurrences of both *Phytophthora cinnamomi* and *Armillaria* spp are isolated and there have been no major outbreaks of either pathogen. There have been minor incidences of insect attack but these remained isolated and did not cause significant problems.

Dieback is not a significant threat to fauna species which are mainly recorded from large blocks of forest. However for the fauna of remnant vegetation in agricultural land, it is a significant threat. Dieback is a threat for species such as Regent Honeyeater, Swift Parrot, Squirrel Glider, Grey-crowned Babbler, Turquoise Parrot and Masked Owl.

*Use of Phytophthora cinnamomi-infected gravel in construction of roads, bridges and reservoirs* is listed as a Potentially Threatening Process under the FFG Act. The Code of Forest Practices for Timber Production, management plans and conditions of exploration licences address this threatening process.

### **Mining/Quarrying**

Within the North East gold is the most commonly mined mineral. Rock, gravel, clay, sand and soil are also extracted from a number of quarries. Although mining/quarrying has the potential to impact a large number of species, due to the small scale and number of operations in the North East, this disturbance is currently considered only a minor threat to the majority of species covered by this review.

Quarrying involves direct loss of vegetation, habitat destruction, contributes to erosion and sedimentation and can alter the drainage characteristics of the soil. Species and EVCs directly affected by mining and quarrying include those associated with riparian habitats (eg. Riparian Forest), Box Ironbark Forest and Heathy Dry Forest. Grassy Dry Forest may be indirectly affected by weed invasion. Fauna species likely to be threatened by mining include the Spotted Tree Frog, Large-footed Myotis, Common Bent-wing Bat and Eastern Horseshoe Bat. Disappearances and declines of Spotted Tree Frog populations appear to be linked to past eductor dredging activities. Quarrying can

particularly impact on vegetation of alpine areas such as the sphagnum mossbed and bog communities which are slow growing and therefore sensitive to damage.

Mineral exploration, mining and extractive industries are not permitted in Reference Areas, National, State or Wilderness Parks, except where a tenement or application pre-dates the Park and the Minister responsible for the National Parks consents. Mining and exploration operations require a licence and work plan approved by Minerals and Petroleum Victoria before exploration or mining works can be undertaken. Similarly, extractive industries require a work plan and a consent of the relevant Minister for extractive operations. There is a requirement that the continued operation of the quarry at Basalt Hill in the Alpine National Park not adversely affect the viability of the local population of the Alpine She-oak Skink. The Chiltern Box-Ironbark National Park Draft Management Plan strategies require that gravel extraction leases are not extended and any exploration and mining is carried out in accordance with relevant consents.

### **Other disturbances**

#### ***Dams/Impoundments***

Potentially threatening processes associated with dam/impoundment construction and subsequent operation include increases in sediment input to rivers and streams, modifications to natural temperature fluctuations and flow rates, degradation of adjacent native riparian vegetation and loss and fragmentation of habitat is also a potentially threatening process associated with dams and impoundments. Altered flooding regimes can affect Floodplain Riparian Woodland which is adapted to and has a requirement for a natural flooding regime.

Changes in surrounding soil hydrology as a result of dam operations can contribute to degradation of the sensitive sphagnum mossbed/heath associations and other vegetation characteristic of the Bogong High Plains which provide important habitat for the Alpine Bog Skink, Alpine Water Skink and Alpine She-oak Skink. Siltation, alteration of stream flow and degradation of riparian vegetation are major threats to the Azure Kingfisher and Spotted Tree Frog. The environmental impacts of dams/impoundments have been subject to numerous studies. Processes to minimise impacts include environmental flow allocations, construction of fish ladders and regulating the temperature flowing out of storages.

#### ***Pasture Improvement***

Since the 1960s there has been substantial development in improved pastures on private land which involves the replacement of native grasses with exotic pasture species. EVCs predominantly affected by pasture improvement include Plains Grassy Woodland, Floodplain Riparian Woodland, Creekline Grassy Woodland and Valley Grassy Forest. Pasture improvement was considered to be the principal cause of population declines of the Bush Stone-curlew in north eastern Victoria between 1985 and 1991. Education programs which inform land managers of the ecological effects of intensified land use practices such as pasture improvement is a management issue identified by the Bush Stone-curlew Action Statement. A range of other actions undertaken through programs such as *Land for Wildlife* and Landcare in conjunction with land owners can also assist in mitigating impacts on native species.

#### ***Mineshaft Collapse***

Mineshaft collapse and mineshaft entrances becoming overgrown are recognised as major threats to the Eastern Horseshoe Bat and Common Bent-wing Bat. These species are dependent on caves and mineshafts for roosting and breeding. Restricted access to and loss of breeding habitat due to these processes is likely to lead to a decline of population numbers in the North East

#### ***Climate Change***

The Enhanced Greenhouse Effect refers to the increase of greenhouse gases caused by human activities and the resultant warming of the atmosphere. Species living in sub-alpine and alpine areas typically exist in small isolated populations and are particularly vulnerable to environmental change. Sub-alpine and alpine species under threat due to their limited habitat requirements include the Broad-

toothed Rat, Mountain Pygmy-possum, Alpine Bog Skink, Alpine She-oak Skink, Alpine Water Skink and Spotted Tree Frog. Increases in ultraviolet radiation is known to cause death of frog eggs and larvae, and it is thought that this has contributed to population declines of the Alpine Tree Frog. EVCs with narrow habitat requirements in these areas include those of alpine and sub-alpine environments.

### ***Loss of Genetic Diversity***

Loss of genetic diversity is a threat to small, fragmented or isolated populations or less mobile species. It is considered to be a potential threat to the Squirrel Glider.

Genetic pollution of natural populations of native flora is most likely to occur from garden escapees or as a result of the establishment of plantations of silvicultural or horticultural species closely related to native species within reproductive range. Although potentially significant, major impacts have not been revealed by research to date.

## **12.8 AQUATIC FAUNA SPECIES ASSESSMENT**

### **Introduction**

The quality of stream habitats, and their biota, can be greatly influenced by a wide range of activities within the catchment, including many that occur away from the stream system. The impact of these activities may also be felt far downstream from the actual site of disturbance, often outside the forest areas in which they occur. To reduce the impact of these activities, management prescriptions need to be based on accurate and adequate scientific information. This includes information on the distribution, biology and habitat requirements of individual species and communities, along with data on how successful ameliorative actions are at protecting those species and communities.

This section considers available information on fish and aquatic macroinvertebrates (crayfish, shrimps, large insects etc) occurring in the North East river systems, reviews the range of factors which are threats to the survival of important species and describes the management actions which are in place to mitigate those threats.

The region is generally bordered on its southern edge by the Great Dividing Range and all streams in the region flow into the Murray River, other than the Wongungarra River which flows south into the Wonnangatta River. There are five major catchments that comprise the region - the Upper Murray (including the Mitta Mitta River), Kiewa, Ovens, Broken and Goulburn Rivers.

Fourteen native freshwater fish species have been recorded from the North East, and four are known to migrate as part of their life cycle. The number of aquatic macroinvertebrate species in the region is unknown and adequate distributional information exists for only two of these.

### **Data Review**

As part of the assessment, a review was conducted of the number of sites surveyed for aquatic species in the North East, with information being taken from surveys dating back to 1973. Assessments were also made of the adequacy of the biological data obtained from sites during these surveys. This information can be used to identify priority areas and data gaps to be filled through additional survey work.

There is generally wide spatial coverage of sampling records across the region, though many sites fall into fairly restricted areas where survey intensity has been very high, due to intensive surveys for specific projects.

Intensive surveys of fish populations in the North East region have primarily been conducted by the Department of Natural Resources and Environment. Other investigations which incidentally recorded fish species were conducted by other government agencies, universities and private individuals.

Records were obtained for 746 sites in the region where surveys have been conducted for freshwater fish, with 439 of these considered to be full surveys of species present with adequate data quality for distributional analyses. Of the 746 surveyed sites, 8.4 per cent were in areas set aside for conservation purposes, 16.6 per cent in State forest, and the remaining 75 per cent on private land and other public land (eg. stream frontages). The majority of sites in State forest have been sampled as part of a research program established to support the development of an RFA for the region.

Surveys of aquatic macroinvertebrates in the North East have primarily been conducted by a number of Government departments, the Monash and La Trobe Universities and the Murray-Darling Freshwater Research Centre. As part of the national Monitoring River Health Initiative (MRHI), 39 sites are currently being monitored in the North East region. Additional sampling using the same methodology as the MRHI was undertaken at 61 sites as part of the RFA project.

There are no significant gaps in fish distributional data from the North East region following RFA research and survey programs. However, significant data gaps exist on life history and population characteristics for all priority fish species. There is also limited data on spawning behaviour, cues for migration and the reactions of priority fish species to disturbances, particularly increased sedimentation and turbidity.

Of the priority aquatic macroinvertebrates occurring in the North East, the distribution of most is not well known, although recent RFA surveys have improved our understanding of the distribution of species within the region. With some minor exceptions (eg. decapod crustacea, mayflies, stoneflies), the scientific classification and life histories of aquatic macroinvertebrates are poorly understood.

### **Priority Species Information**

Of the 14 native freshwater fish species recorded from the North East, eight are listed as threatened fauna in Victoria (CNR 1995f), including four which are listed under the *Flora and Fauna Guarantee Act 1988*, and two of these are also listed under the Commonwealth *Endangered Species Protection Act 1992* (Table 12.19).

Ten of the priority aquatic macroinvertebrate species known from the North East have been identified as threatened in Victoria (CNR 1995f), with six of them also being listed under the *Flora and Fauna Guarantee Act 1988*.

### **Threatening processes - Impacts and Management**

This section reviews the current state of knowledge of threatening processes affecting aquatic species in the North East and the management actions which are in place to mitigate those threats. It aims to provide information to assist in management, research and future surveys. It is based on existing scientific literature and expert opinion. The review covers priority aquatic species in the North East, taken as being those species listed in Table 12.18.

**Table 12.18: Priority aquatic fauna species occurring in the North East**

Species Name	Common Name	Conservation Status*	FFG/ESP Listing
<b>Fish</b>			
<i>Galaxias fuscus</i>	Barred Galaxias	Endangered	FFG and ESP
<i>Maccullochella macquariensis</i>	Trout Cod	Endangered	FFG and ESP
<i>Maccullochella peelii peelii</i>	Murray Cod	Vulnerable	FFG
<i>Macquaria australasica</i>	Macquarie Perch	Vulnerable	FFG
<i>Gadopsis marmoratus</i>	River Blackfish	Ins. Known	
<i>Galaxias olidus</i>	Mountain Galaxias	Ins. Known	
<i>Galaxias rostratus</i>	Flat-headed Galaxias	Rare	
<i>Macquaria ambigua</i>	Golden Perch	Rare	
<b>Crayfish</b>			
<i>Euastacus armatus</i>	Murray Spiny Cray	Ins. Known	
<i>Euastacus crassus</i>	Alpine Spiny Cray	Rare	
<i>Cherax sp. nov.</i>	Murray Swamp Yabby		
<i>Euastacus woiwuru</i>	Central Victorian Spiny Cray		
<b>Other invertebrates</b>			
<i>Thaumatoperla alpina</i>	Insecta, Plecoptera	Rare	FFG
<i>Thaumatoperla flaveola</i>	Insecta, Plecoptera	Vulnerable	FFG
<i>Riekoperla intermedia</i>	Insecta, Plecoptera	Vulnerable	FFG
<i>Riekoperla isosceles</i>	Insecta, Plecoptera	Vulnerable	FFG
<i>Archeophylax canarus</i>	Insecta, Trichoptera	Rare	FFG
<i>Tamasia furcilla</i>	Insecta, Trichoptera	Vulnerable	
<i>Hemiphysalis mirabilis</i>	Insecta, Odonata	Vulnerable	FFG
<i>Canthocamptus longipes</i>	Crustacea, Copepoda	Ins. Known	

\* Conservation status is based on *Threatened Fauna in Victoria - 1995*. **Ins. known** = Insufficiently known. **FFG** = Flora and Fauna Guarantee Act 1988, **ESP** = Endangered Species Protection Act 1992.

### Impacts

Based on studies conducted elsewhere, a number of activities have the potential for significant impacts on aquatic ecosystems, and therefore on aquatic species. A list of broad disturbance categories and their major impact on aquatic ecosystems is shown in Table 12.19.

By far the most common effect of most disturbances is the increase in sediment in rivers and streams. Increased levels of sediment can adversely affect all aspects of freshwater ecosystems by reducing water quality and degrading or destroying habitat. Increased turbidity can have adverse physical, physiological and behavioural effects on stream-dwelling plants and animals. In the North East, most of the priority fish species lay eggs which settle on the stream bed and could therefore be affected by increased sedimentation altering the substrate of egg deposition sites. Research in the region indicates that most of the priority stream-dwelling invertebrates would also suffer from increased levels of sedimentation and turbidity.

Dams represent a severe disturbance to aquatic systems, potentially affecting a number of priority aquatic species in the North East. Storage and release of water at different times also changes the natural flow regimes, most affecting those species such as the Murray Cod and Golden Perch which are known to require floods to trigger spawning. Dams and other barriers also hinder the movement of migratory fish species.

**Table 12.19: Broad disturbance category with potentially significant impacts on aquatic ecosystems**

Broad disturbance category	Potential impacts on aquatic ecosystems
Clearing	<ul style="list-style-type: none"> <li>• Stream bed and bank degradation</li> <li>• Increased sedimentation and turbidity</li> <li>• Increased nutrient concentrations in water</li> <li>• Increased pesticide concentrations in water</li> </ul>
Dams	<ul style="list-style-type: none"> <li>• Changed flow regimes</li> <li>• Increased sedimentation and turbidity</li> <li>• Decreased water temperature</li> <li>• Barriers to fish passage</li> </ul>
Fire	<ul style="list-style-type: none"> <li>• Increased sedimentation and turbidity</li> <li>• Increased nutrient concentrations in water</li> </ul>
Grazing	<ul style="list-style-type: none"> <li>• Stream bed and bank degradation</li> <li>• Increased sedimentation and turbidity</li> <li>• Increased nutrient concentrations in water</li> <li>• Reduction of swamp/headwater habitat</li> </ul>
Harvesting	<ul style="list-style-type: none"> <li>• Reduction in population numbers</li> </ul>
Introduced species	<ul style="list-style-type: none"> <li>• Competition with native species</li> <li>• Predation on native species</li> </ul>
Mining/Quarrying	<ul style="list-style-type: none"> <li>• Increased sedimentation and turbidity</li> <li>• Increased toxic chemical concentrations in water</li> </ul>
Pest control	<ul style="list-style-type: none"> <li>• Increased pesticide concentrations</li> </ul>
Recreation	<ul style="list-style-type: none"> <li>• Stream bed and bank degradation</li> <li>• Increased sedimentation and turbidity</li> </ul>
Roading	<ul style="list-style-type: none"> <li>• Stream bed and bank degradation</li> <li>• Increased sedimentation and turbidity</li> </ul>
Timber harvesting	<ul style="list-style-type: none"> <li>• Increased sedimentation and turbidity</li> <li>• Increased nutrient concentrations in water</li> </ul>
Waste disposal	<ul style="list-style-type: none"> <li>• Increased nutrient concentrations in water</li> <li>• Increased toxic chemical concentrations in water</li> </ul>

### **Management**

Following the Land Conservation Council's (LCC) Rivers and Streams Special Investigation (LCC 1991a), the corridors of the Howqua (above Lake Eildon) and Goulburn (below Eildon Weir) Rivers in the North East Region were designated as Heritage River Areas under the *Heritage Rivers Act 1992* because of their natural, scenic, cultural heritage and recreational values. Timber harvesting is excluded from the Heritage River corridor on the Goulburn River section in the North East, and is permitted in the Howqua River corridor.

General conservation measures to protect riparian and instream values are also key elements of the Code of Forest Practices for Timber Production and regional prescriptions. These contain a number of measures aimed at protecting water quality and instream values.

Under the provisions of the FFG Act and the ESP Act, and as part of Park and Forest Management Plans, conservation guidelines can be developed and implemented to protect individual species and their habitats from threatening processes. Where biological information is adequate, quite specific guidelines can be developed. Other priority aquatic species are afforded protection through the more general habitat protection measures of the Code of Forest Practices for Timber Production.

Recreational fish species are protected by a variety of fishing regulations, mainly bag and size limits and closed seasons during breeding. Fishing regulations also exist for Spiny Crayfish species in Victoria.



## 13. OLD-GROWTH FOREST

### 13.1 INTRODUCTION

Under the 1992 National Forest Policy Statement (NFPS), the Commonwealth and State Governments agreed to a strategy to conserve and manage areas of old-growth forest across Australia as a part of a comprehensive, adequate and representative forest reserve system. To clarify its objectives, national criteria have been established for the conservation of old-growth forests (JANIS 1997, Section 1.1.4). This chapter includes an assessment of the extent of old-growth forest in the North East and the application of the nationally agreed reserve criteria.

The first comprehensive regional assessment of old-growth forest in Australia was completed in East Gippsland by Woodgate *et al.* (1994) and it has become the benchmark for a series of regional old-growth forest studies in Victoria. The Woodgate study developed working definitions of old-growth forest and a standard methodology for assessing and mapping forest of different age classes and 'ecological vegetation classes' (EVC). Ecological vegetation classes are part of a hierarchy of floristic vegetation descriptions.

As part of the North East Comprehensive Regional Assessment (CRA) that is required to complete a Regional Forest Agreement (RFA), the Commonwealth and Victorian Governments agreed to jointly undertake an assessment of the extent of old-growth forest in the North East of Victoria. The technical report *Old-Growth Study of North East Victoria, 1998*, on which this chapter is based, provides greater detail and is available from the Department of Natural Resources and Environment (NRE).

#### The Characteristics of Old-growth Forest

Old-growth forests are significant to the Australian community because of their high nature conservation, aesthetic and cultural values, and lack of disturbance. The attributes of old-growth forest include:

- the presence of relatively large trees and other associated understorey species in the wetter forest types to stunted and gnarled trees in drier forest types;
- relatively old trees and other plants in terms of development stage;
- the presence of large crown gaps (in some forest types);
- presence of tree hollows and/or fallen trees;
- characteristic biotic composition;
- presence of certain growth forms for example epiphytes in some forest types;
- stable nutrient cycles and high litter (in some vegetation classes); and
- low rates of change in species, forest structure and ecosystem functioning.

#### Old-growth Forest Definitions

The old-growth forest study of East Gippsland (Woodgate *et al.* 1994) analysed a range of attributes and found that old-growth forests were characterised by having the oldest possible growth stage and are negligibly disturbed. The North East old-growth forest study (NRE 1998) uses the same definition:

*'Old-growth forest is forest which contains significant amounts of its oldest growth stage in the upper stratum - usually senescing trees - and has been subjected to any disturbance, the effect of which is now negligible.'*

This definition is consistent with the nationally agreed operational definition of old-growth forest for application in the RFA process, which is:

*Old-growth forest is ecologically mature forest where the effects of disturbances are now negligible* (JANIS 1997).

In applying this interpretation to a forest ecosystem within a region, the following principles will apply:

- ecological maturity is defined by the characteristics of the older growth stages;
- if data are available on the structural, floristic and functional qualities that would be expected to characterise an ecologically mature forest ecosystem, these data should be used in the assessment of the significance of disturbance effects; and
- negligible disturbance effects will be evident in most forests by a significant proportion of trees with age-related features and a species composition characteristic of the ecologically mature forest ecosystem.

### **Old-growth National Reserve Criteria**

The following National Reserve Criteria have been established for the conservation of old-growth forests (JANIS 1997).

Where old-growth forest is rare or depleted (generally less than 10 per cent of extant distribution) within a forest ecosystem, all viable examples should be protected, wherever possible. In practice, this would mean that most of the rare or depleted old-growth forest would be protected. Protection should be afforded through the range of mechanisms outlined in the National Reserve Criteria.

For other forest ecosystems, 60 per cent of the old-growth forest identified at the time of assessment would be protected, consistent with a flexible approach where appropriate, increasing to the levels of protection necessary to achieve the following objectives:

- the representation of old-growth forest across the geographic range of the forest ecosystem;
- the protection of high quality habitat for species identified under the biodiversity criterion;
- appropriate reserve design;
- protection of the largest and least fragmented areas of old-growth; and
- specific community needs for recreation and tourism.

## **13.2 ASSESSMENT METHODOLOGY**

The old-growth forest survey methodology for the North East essentially followed that developed by Woodgate *et al.* (1994) for East Gippsland and subsequently used for the Central Highlands study (NRE 1996d). This methodology was independently assessed by a joint Commonwealth/ State Scientific Advisory Group which considered that it is an appropriate and effective means of identifying old-growth stands in eucalypt forests.

Woodgate *et al.* (1994) identified attributes which contribute to the forest description, and disturbances which influence the state of old-growth forest. These are discussed in the following section. Further detail can be found in the North East old-growth report (NRE 1998).

The characteristics and extent of old-growth forest attributes in the North East were gathered using the following methods:

- assessing relative forest age from aerial photographs and field observation;
- analysing historic data within archival records;
- mapping and assessing the nature and degree of disturbance since European settlement; and
- describing the natural values of all forests in the study area using digital spatial analysis techniques.

All data collected for this project were captured digitally. Information such as floristic vegetation, forest type, land tenure, land systems, and land use including records on the occurrence of historic and contemporary timber harvesting, grazing and fire are stored in an NRE geographic information system (GIS) database.

Results of the old-growth analysis are reported only for public land. As most freehold land in the North East has been extensively disturbed through agricultural clearing, timber harvesting or fire, and

due to the lack of detailed records of these disturbances, freehold land was not considered as part of the North East old-growth study.

### **Ecological Vegetation Classes**

Vegetation in the region was classified using a system of ecological vegetation classes (EVC). EVCs consist of one or a number of floristic communities that appear to be associated with a recognisable environmental condition. Each EVC was described through a combination of floristics, lifeform and reproductive strategy profiles.

In the North East, 30 vegetation classes on public land were identified and of these, 24 were eucalypt dominated.

### **Forest Age**

#### ***Introduction***

For a particular site and vegetation class, old-growth forests are deemed to have attained their oldest, naturally achievable growth stage. Growth stage refers to the developmental stage of the tree based on its physical form. Distinctive features of tree crowns at different growth stages allow key growth stages to be identified from aerial photographs. The oldest growth stage is usually the senescing (irregular crown form) growth stage and to qualify as old-growth forest, this stage must be present as a substantial component of the stand.

The eucalypt forests, which are the dominant forest type in the North East, were assessed for the presence of senescing growth stage using aerial photograph-interpretation supported by field validation. Crown form characteristics of trees were used to establish growth stage categories for forest stands. The growth stage category was used as a surrogate for the age of forest stands.

#### ***Crown Form, Growth Stage and Crown Cover Projection***

Crown cover, crown form and stand height were mapped from aerial photographs and were used to determine the forest growth stages. Forest growth stage is a term initially described by Jacobs (1955) and is now related to the Statewide Forest Resource Inventory (SFRI) crown form (Figure 13.1).

The North East old-growth assessment considers that eucalypt forests pass through three growth stages:

- regrowth;
- mature; and
- senescing.

In forest stands with high environmental quality sites (fertile sites), the crown forms were consistent with the growth stages described by Jacobs and could be readily mapped from aerial photographs.

However, not all eucalypt and non-eucalypt species conform to the typical Jacobsian growth habit. For some species on low site quality, the characteristics of a senescing crown were not detectable from aerial photographs (for example Red Box and Long-leaved Box). For other species, the regular crown form is characterised by a healthy crown but represents the final growth stage before death (for example Red Stringybark and Broad-leaved Peppermint).

All eucalypt species were classified into Jacobsian and non-Jacobsian by using potential stand height and whether they occurred on high or low quality sites. This was defined at <28m for low site quality (non-Jacobsian) and >28m for high site quality (Jacobsian). The SFRI crown form and the forest growth stages used for the old-growth analysis is presented in Figure 13.1.

**Figure 13.1: Relationship between the typical eucalypt growth stages described by Jacobs (1955) and those considered by the North East Old-Growth Study**



Jacobs (1955) growth stages	Juvenile & Sapling	Pole	Mature (early)	Mature	Mature (late)	Overmature
SFRI * crown forms	Regeneration	Regrowth	Regular			Irregular
			Highly regular	Equally regular	Moderately regular	
Jacobsian Growth Stage (>28m)	Regrowth		Mature	Senescing		
Non-Jacobsian Growth Stage (<28m)	Regrowth		Senescing			

\* SFRI - Statewide Forest Resource Inventory

### Tree Ageing

Limited investigations were conducted to determine the ages of forest growth stages by using dating techniques. Ring counting studies on trees felled as a part of the Statewide Forest Resource Inventory (SFRI) growth and yield study provided age information for ash and mixed species eucalypt forests. The oldest *Eucalyptus delegatensis* sampled in the North East was 160 years old, with many trees in the range of 120 - 130 years. The oldest tree from mixed species forest was 172 years old. The SFRI study therefore concluded that trees with mature crown form in the North East may be aged up to 160 -170 years old.

These results are similar to those from *E. sieberi* in East Gippsland, where mature trees were aged from 158 to 171 years, and are not incompatible with findings in *E. regnans* in the Central Highlands where dating technique results exhibited a broad age range up to 500 years. No conclusion could be drawn about the age of the senescing crown form in North East Victoria, due to lack of sampling.

### Forest Disturbance

#### Introduction

Forest disturbance mapping was undertaken to identify the presence and scale of disturbance in the North East forests, and whether or not the effect of past and present disturbance events is now negligible.

The current distribution and condition of the native vegetation in the study area reflects the impacts of European settlement. Most clearing of the natural vegetation on the plains and foothills has been for agriculture, but some has also been cleared for urban and industrial purposes, roads, recreation and other uses. The landscape of private land is predominantly agricultural. Public land has generally retained a cover of native vegetation which has been disturbed to a greater or lesser extent.

Disturbance is a primary characteristic which diminishes, or detracts from, old-growth forest status. Significant disturbance renders a forest ineligible as old-growth. The many disturbances known to alter the primary attributes such as floristics, structure or growth stage, of the forests in the region were investigated and quantified. Disturbances were described according to their cause - either natural such as wildfire, or unnatural such as human induced agricultural clearing or timber harvesting. Disturbances through occupation by Indigenous people before European settlement were regarded as being natural.

Research covering historical and contemporary records was undertaken to delineate and map the extent and severity of these disturbances.

The effect of disturbance varied from one vegetation class to another. The significance of each disturbance was classified according to the following levels:

- areas with no record of disturbance were described as ‘undisturbed’
- ‘negligible disturbance’ was defined as a disturbance for which there is an authentic record, but which is unlikely to have altered the structure of the usual composition of species for that EVC; or, if a disturbance did occur in the past, its effect is no longer significant (temporarily significant)
- ‘significant disturbance’ was defined as a disturbance regime for which there is an authentic record and which is likely to have altered the growth stage ratios, crown cover projection of the usual floristic composition of that EVC, and which is detectable at the time of the survey.

### ***Agricultural Selection***

The commencement of agricultural clearing was closely linked to the early history of the North East during the gold rushes of the 1850s. It dramatically altered the landscape of the region. Information about those areas of agricultural clearing within the North East that are now classified as public land was extracted from archival files. Data on the location, extent and approximate period of clearing for each selection were recorded.

### ***Grazing***

Historical and current data on the location and extent of grazing licences were extracted from maps, parish plans, files and archival records. Data recorded included extent and period of licence. The earliest grazing licences, the pastoral (or squatting runs), were excluded from this study because of inconsistency of available information or poor quality of data relating to the location of the runs.

The impact of grazing varies for each vegetation class. It is unlikely to have an appreciable effect on EVCs with vegetation unpalatable to livestock, which tended only to be grazed during periods of severe drought. Unpalatable EVCs were considered negligibly disturbed. However, grazing in areas that contained ‘palatable’ vegetation classes was considered to be a significant disturbance. Eighteen palatable vegetation classes were identified in the North East including for example, Box-Ironbark Forest, Wetland Formation and Treeless Sub-alpine Complex. Therefore the grazed areas, palatability of the grazed EVC and the period over which it was grazed were key factors in determining the level of disturbance.

Furthermore, field inspections revealed that the intensity of grazing activities and the resultant disturbance appeared to be associated with a slope threshold of 20°. Slopes of less than 20° were considered to have significant un-natural disturbance, and areas with a slope of greater than 20° were considered to be negligibly disturbed.

### ***Wildfire***

Eucalypt forests are extremely fire-prone and major bushfires are a feature of the North East. Major fires occurred in the region in 1939, 1944, 1968, 1952, 1972, 1978 and 1985. In 1939, areas of Alpine Ash were burnt along the upper reaches of the Ovens, Kiewa and Mitta Mitta Rivers, close to towns including Whitfield, Bright, Mt Beauty, Mitta Mitta and Corryong, and also near Mansfield. Much of the Upper Murray district was burnt in 1952.

Since 1945, the Forests Commission of Victoria and subsequent forest management agencies, have mapped the outer boundaries of wildfires. The areal extent of contemporary and historic wildfires were recorded from existing documentation.

Where aerial photograph-interpretation confirmed significant disturbance to the growth stage or canopy within these areas, this was classified as significant natural disturbance.

### ***Fuel Reduction Burning***

Since the mid 1920s, fire has been used to reduce the amount of flammable material on the forest floor and reduce the risk of intense wildfire. Fuel reduction burns differ from wildfires. They are deliberately ignited on days that produce a cool burn.

Records of fuel reduction burning varied in quality, accuracy and completeness. Areas recorded for each fuel reduction burn were considered as an indication of its extent. In areas where crown cover and growth stage mapping from aerial photographs revealed no damage, fuel reduction burning was classified as a negligible unnatural disturbance.

### ***Mining***

The location and extent of disturbances associated with mining were identified from archival records and aerial photographs. Disturbance due to mining was determined by a buffer of differing sizes around particular mining activities, dependent on the assumed extent of the activity.

### ***Timber Harvesting***

Detailed information on the geographic extent of timber harvesting was obtained from historical records and maps and, for more recent harvesting, from aerial photographs. Sawlog allocation records of the Forests Commission covering the period 1936 to 1980 were also used to determine the extent of historic timber harvesting, both clearfelling and selective harvesting. When these mapped sources of disturbance were confirmed by the crown cover or growth stage mapping, the disturbance level was classified as significant and unnatural.

### ***Other Disturbances***

Conifer plantations, hardwood plantations and cleared/severely disturbed land (where weeds constituted >50 per cent of cover or 50 per cent of species by composition) were also identified. Native forest and other vegetation cleared or otherwise disturbed for the establishment of softwood and hardwood plantations were identified and mapped from plantation map records. Other disturbances including clearing of power easements were also mapped. Such areas were not included in the analysis to identify old-growth and were classified as significant un-natural disturbance.

## **13.3 ANALYSIS OF DATA AND RESULTS**

### **Introduction**

The objective was to identify areas of old-growth forest in the North East by using the data gathered from the assessment of growth stage, the collection of disturbance data, field assessment and expert knowledge. Through a process eliminating areas of forest with significant disturbances using these datasets, areas of undisturbed or insignificantly disturbed forest dominated by their older growth stages, or old-growth forest, were identified.

### **Old-growth Database**

Each forest stand was assessed and ranked for old-growth status. Crown cover projection, crown form, vegetation classes and disturbances were all compiled and entered into a GIS database. The resource data utilised were :

- EVCs grouped into Jacobsian or non-Jacobsian growth characteristics;
- forest growth stage grouped into three classes according to the proportions of crown form;
- structural vegetation based on tree height and grouped as above or below 28 metres; and
- disturbance level categories.

Wherever possible, datasets were validated against other datasets using rules to eliminate possible errors.

### **Assignment of Old-growth Forest Status**

Using the forest growth stage class, disturbance and EVC datasets, old-growth forest status was identified according to the old-growth forest definition. That is, old-growth forest was identified as forest which:

- contains senescing trees present in the upper canopy (at least 10 per cent of total crown cover for the stand);
- has regrowth present in sparse proportion (less than 10 per cent of crown cover); and
- has negligible or no disturbances identified.

For stands to be considered as old-growth forest, the senescing growth stage must have a crown cover of at least 10 per cent (dominant) and the regrowth growth stage must have a crown cover of less than 10 per cent, with negligible or no disturbances identified.

Younger forest dominated by mature growth stages with a lower proportion of old-growth forest structural characteristics, but which had negligible evidence of disturbance, was recognised as a separate class - 'negligibly disturbed forest'.

Disturbance data collected during the study did not account for the significant disturbance observed during field inspection along the public-private land interface. To take into account this disturbance, a buffer was applied to the public-private land interface, or to public land adjoining plantation or the Cleared/ Severely Disturbed EVC. The distance of this buffer was based on the presence or absence of forest on the private land and the steepness of slope (20° threshold) on the adjoining public land. Within the buffer, the vegetation classes were considered to be disturbed.

### **Extent of Old-growth Forest**

The North East region covers approximately 1.25 million hectares of public land, of which 261 000 hectares, or 21 per cent, has been identified as old-growth forest (Map 4).

Old-growth forest occurs in 14 EVCs within the region. Ninety-three per cent (242 000 ha) of all old-growth identified in the North East is within six EVCs in the region:

- Grassy Dry Forest
- Heathy Dry Forest
- Herb-rich Foothill Forest
- Montane Dry Woodland
- Shrubby Dry Forest
- Sub-alpine Woodland.

Information on the area of negligibly and significantly disturbed forest is provided in Chapter 12.

### **Old-growth Reservation Levels**

Table 13.1 provides information on the reservation status of the old-growth forest in each EVC. This Table shows the amount of old-growth in legislated parks and reserves (conservation reserves), State forest and other public land.

Table 13.2 sets out the area of old-growth forest in each of the Geographic Representation Units (GRUs). The area figure in this Table represents the total area of old-growth forest for each vegetation class in each GRU. The corresponding protection figure refers to the proportion of that area in dedicated conservation reserves.





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**Table 13.1: Representation and Reservation of Old Growth**

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**Table 13.2: Area of old-growth forest in each of the Geographic Representation Units**

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## 14. WILDERNESS

### 14.1 INTRODUCTION

The assessment of wilderness in the North East region has been undertaken in the wider regional context of the forests of Eastern Victoria, given their broad similarity. The report *Wilderness Assessment of the Eastern Victorian Forests* (VicRFASC 1996d) analyses wilderness quality across four CRA regions, namely Central Highlands, East Gippsland, North East and Gippsland. Reference should be made to this report if further detail is required.

### 14.2 DATA

The data used in the analysis were those used in the National Wilderness Inventory (NWI) and come from many sources. The distance related indicators (settlement, access and apparent naturalness) are essentially current AUSLIG digital mapping data updates with additional information in the detailed study areas. The disturbance information, that provides the base data for the biophysical naturalness indicator, is of variable quality and lineage across the region studied in this project.

In East Gippsland and the Central Highlands the disturbance information was that used in the detailed old-growth surveys of the region, with a currency of April 1993 and December 1993 respectively. For the North East, the best available systematic disturbance data at the time of the analysis was most recently updated in 1986 and this should be taken into account when interpreting the outputs.

### 14.3 METHODS

The concept of wilderness embraces measures of remoteness, naturalness and lack of disturbance. The National Forest Policy Statement (Commonwealth of Australia 1992b) states on page 11 that 'forested wilderness areas will be protected by means of reserves developed in the broader context of protecting wilderness values of all lands.' Consistent with this, non-forest vegetation types have been included where they form a mosaic within largely forested wilderness identified in this current assessment.

The approach taken in this assessment has been to first identify and delineate areas of high wilderness quality, and then calculate the percentage of these areas within the existing reserve system.

The NWI methodology developed by Lesslie and Maslen (1995), produces a database of 'wilderness quality' across the region. This is achieved by measuring the variation in wilderness quality across the landscape using four wilderness quality 'indicators' that represent the two essential attributes of wilderness: remoteness and naturalness. (See *Wilderness Assessment of the Eastern Victorian Forests* (VicRFASC 1996d)).

To identify areas with high wilderness quality, the criteria used in this assessment were areas with a NWI wilderness quality of at least 12 and an area larger than 8 000 hectares. In the East Gippsland and Central Highlands analyses, thresholds were also applied to the four wilderness quality indicators.

Boundaries were delineated around areas that satisfied these criteria. Wherever possible, the boundaries which were adopted followed catchment divides or other, topographic features. Where such features did not prove suitable, boundaries were drawn that reflected the influence of nearby features affecting wilderness quality, such as roads.

## 14.4 RESULTS

This assessment of the Eastern Victorian forests identified 18 areas that met the threshold requirements (see Table 14.1). Five of these areas (Dartmouth, Indi addition to Pilot and Davies Plain, Wabba, Yarrarabulla Creek and Razor/Viking) are located within the North East RFA region. Both the total area and the area included within the existing legislated reserve system were calculated and are presented in Table 14.1. Those areas included within the existing legislated dedicated reserve system were considered to be protected.

## 14.5 CONCLUSION

Five areas of high wilderness quality have been delineated within the North East region. Three of these areas are fully contained within the dedicated reserve system. The Dartmouth area is partially contained within the dedicated reserve system as is part of the Yarrarabulla Creek area with the remainder of the latter protected by an Order in Council as a Remote and Natural Area. In total, 95 per cent of the total area delineated as significant for high wilderness quality in the Eastern Victorian forests region is protected. The National Reserve criteria (JANIS 1997) specify that 90 per cent (or more, if practicable) of the area of high quality wilderness that meets the minimum area requirements should be protected in reserves.

**Table 14.1: Summary of Protection of Areas of High Wilderness Quality within the Eastern Victorian forests**

Area	Total ha	Reserve status	Reserved ha
Cape Howe	7 120	Full	7 120
Sandpatch	28 540	Part	17 150
Petrel	10 960	Full	10 960
Tamboon	5 000	Full	5 000
Coopracambra	28 050	Part	25 460
Upper-Brodribb	5 310	Part	4 850
Tingaringy	25 250	Part	25 060
Snowy	54 560	Full	54 560
Buchan	12 580	Full	12 580
Avon	39 650	Full	39 650
Mt Darling/Snowy Bluff	40 400	Full	40 400
Razor/Viking	15 700	Full	15 700
Wabba	19 700	Full	19 700
Indi Addition to Pilot & Davies Plain	24 300	Full	24 300
MacAlister	33 300	Full	33 300
Yarrarabulla Creek a)	13 000	Full	13 000
Dartmouth	26 950	Part	20 370
Wilsons Promontory	33 228	Full	33 228
<b>Totals</b>	<b>423 688</b>		<b>402 388</b>

- a) Yarrarabulla Creek Area. Part of this area is not included in a legislated reserve but is covered by an Order in Council requiring its protection as a Remote and Natural Area.

## 15. NATIONAL ESTATE

### 15.1 INTRODUCTION

#### Background

The Register of the National Estate is a national register of places in Australia which have national estate heritage value. Heritage values are features which have cultural or natural significance to the national, regional or local community as defined in section 4 of the *Australian Heritage Commission Act 1975*.

Many forest areas are listed in the Register of the National Estate. The Commonwealth Government, in making decisions concerning forests, such as the granting of licenses to export woodchips, must consider the possible effect of these decisions on the National Estate.

A regional assessment model for identifying the National Estate was developed in 1991-92 by the Australian Heritage Commission (AHC), in cooperation with the Western Australian Department of Conservation and Land Management (CALM), for the Southern Forest Region of south-west Western Australia, (AHC and CALM 1992). The model was refined and applied in the Victorian East Gippsland and the Central Highland Regional Forest Agreement (RFA) process. The RFA process is consistent with the statutory requirements of the *Australian Heritage Commission Act 1975*.

The North East National Estate assessment commenced in 1997 and is currently being finalised.

The objectives of the national estate study are to:

- assess the representation of national estate values in the existing nature conservation reserve system and other protective land tenures where appropriate;
- identify those areas in the North East which merit listing in the Register of the National Estate; and
- provide management guidelines on the protection and maintenance of national estate values.

The North East National Estate report will be released for public comment later this year.

The methodology used for the national estate assessment essentially followed the methods developed and reviewed for the East Gippsland, Central Highlands and Tasmanian RFAs. The methods are outlined in the reports:

*Method Papers: Central Highlands National Estate Assessment, Volume One - Natural Values.* (AHC and CNR 1994b);

*Method Papers: East Gippsland and Central Highlands Joint Forest Projects; Volume Two - Cultural Values.* (AHC and CNR 1994c); and

*Tasmania-Commonwealth Regional Forest Agreement, National Estate Report. Background Report Part H.* (Tasmanian Public Land Use Commission 1997).

#### Approach to the National Estate Assessment

The national estate study involves distinct phases: the identification phase; the protection analysis phase; and the development of conservation principles.

The **identification** phase involves assessing the available information against the National Estate sub-criteria to determine areas of value and delineate indicative national estate places. Details on the AHC's criteria and sub-criteria will be outlined in the forthcoming National Estate report. The major components of this phase were determining the appropriate methods; analysing existing data; undertaking further gap filling studies; applying the sub-criteria to the data available; and applying thresholds of significance.

The **protection analysis** phase involves an assessment of each national estate value and its sensitivity, resilience and/or robustness to various types of disturbance. Most cultural heritage places are sensitive

to disturbance, although for many cultural places their significance is linked with continuing human interaction. In contrast, old-growth forest values are considered sensitive to disturbance such as harvesting, roading or wildfire.

The **conservation principles** phase involves consideration of the sensitivity to disturbance of each value, as well as current international 'best practice' in natural and cultural heritage conservation and the design of nature conservation reserves.

Management and protection of many national estate values are undertaken through a range of mechanisms which can be included in the Forest Management Plan for the North East and as set out in the Code of Forest Practices for Timber Production (Rev No 2) (NRE 1996a). The proposed Forest Management Plan can address the conservation principles of many national estate values which will assist in their management on adoption of the plan. Statewide guidelines for the management of cultural heritage values in the forest, parks and reserves are to be prepared once all the Victorian RFAs are completed. Until such time as the statewide guidelines are completed, *Guidelines for the Management of Cultural Heritage Values in the Forests, Parks and Reserves of East Gippsland* (NRE 1997j) will function as an interim guide. The North East Aboriginal communities have considered and support the development of a package of measures to guide Aboriginal heritage protection and management.

## 15.2 DATA REVIEW

Much of the data for national estate analysis is derived from extensive data sets assembled by NRE over many years. These are analysed and supplemented by consultancies, special projects, and input from the community. Where possible, one source of data is used to complement or confirm, another to ensure that the most robust data sets were compiled.

Eight broad types of data and information are used in the assessment:

- existing scientific (natural and cultural heritage) studies and reports;
- site-specific data obtained from field research;
- data collected from mapping, usually aerial photo interpretation;
- existing databases of cultural heritage places;
- information derived from models, using limited ground data;
- studies conducted by consultants;
- community information; and
- information from experts.

The data being used in the national estate study include:

- ecological vegetation class mapping;
- disturbance mapping from old-growth assessment;
- National Wilderness Inventory database;
- the NRE Flora Information System;
- the Atlas of Victorian Wildlife;
- the forest growth stage data set;
- the NRE Historic Places Section Database;
- the NRE visual management system;
- the Register of the National Estate;
- Heritage Victoria Register;
- data assembled at heritage workshops conducted with local communities and major stakeholder groups;
- published and unpublished scientific data;
- specific historic thematic studies, including research and field surveys for sawmill and tramway sites, selected historic themes, and forest activity sites;
- aesthetic value assessment study;

- social value assessment study;
- the Aboriginal Affairs Victoria site register database;
- the Aboriginal Affairs Victoria Aboriginal historical places database; and
- geological and geomorphical data.

These data sources will be summarised in the forthcoming National Estate report.

### 15.3 CONSULTATION PROCESS FOR NATIONAL ESTATE ASSESSMENT

The main objectives of the consultation process are to:

- involve the community in the identification of its heritage;
- inform all sectors of the community about the national estate study (that is local people and organisations, recreation groups, industry groups, conservation organisations and unions);
- be open and transparent about process, methods and decisions;
- encourage a better understanding of heritage, the AHC's role and processes; and
- encourage a stronger understanding of management and conservation measures.

#### Key stakeholders

Peak conservation and industry groups were briefed on the national estate study as part of the public briefings, at the local community heritage workshops and at the stakeholders heritage workshop in Melbourne. Community heritage data were made available for review and comment. A further opportunity for comment will follow the release of the National Estate report.

#### Aboriginal communities

Four individual Aboriginal community organisations were identified as having responsibilities in the forests of the North East Region. These are Camp Jungai Cooperative Ltd, Wurundjeri Tribe Land Compensation and Cultural Heritage Council Inc, Shepparton Aboriginal Arts Council Ltd and Mungabareena Aboriginal Corporation. Meetings were held with the groups during 1997 and in 1998.

### 15.4 SUMMARY OF THE NATIONAL ESTATE ASSESSMENTS

The assessment of national estate natural and cultural values of the forests of the region will be summarised in the National Estate report. More detailed information on cultural value assessments is available in the following consultants reports:

Marshall, B. and Jones, R. 1997 *Victorian Cultural Heritage Data Audit and Analysis for the RFA Regions: the North East*

Graeme Butler & Associates 1997 *A Study of Places Relating to Selected Historic Forest Themes in the North East Forest Region Victoria*

Context Pty Ltd 1997 *Identification and Assessment of Community Heritage Values in the North East Forest Region, Victoria: Workshop Overview Report*

Context Pty Ltd 1997 *Identification and Assessment of Community Heritage Values in the North East Forest Region, Victoria: Social Value Assessment Report*

Context Pty Ltd 1997 *Identification and Assessment of Community Heritage Values in the North East Forest Region, Victoria: Inventory of Community Heritage Places*

Robin Crocker & Associates 1997 *Identification and Assessment of Aesthetic value in the North East Forest Region Victoria*

Bannear, D. 1997 *A Study of Historic Forest Activity Sites in the North East Forest Region, Victoria*

Evans, P. 1997 *A Study of Historic Sawmill and Tramway Sites in the North East Forest Region, Victoria*





## 16. WORLD HERITAGE

### 16.1 METHODOLOGY

In accordance with the Commonwealth/Victoria Scoping Agreement and the Commonwealth's obligations under the World Heritage Convention, there is a commitment by both governments to identify and assess World Heritage values in the North East region as part of the RFA.

Places on the World Heritage List are defined as those which have outstanding universal value. The methodology used to identify and assess places which may have this level of value is based on a thematic approach. This assesses significance by developing themes of outstanding universal value, and then testing places against these themes.

The methodology involves the use of an Expert Panel and provides a systematic means of identifying a list of places that meet the criteria and operational guidelines of the World Heritage Convention.

The first step (Step A) of the methodology involves the Expert Panel providing advice to Governments on themes of outstanding universal value relevant to Australia. These themes are then used in the second step (Step B) to develop a list of places that might include those that best represent the identified themes in a global context.

These potential places are then further examined against the Operational Guidelines for the World Heritage Convention to determine whether they have World Heritage value. They are tested using a series of sieves where the places identified at Step B are assessed for authenticity and integrity (Step C), and adequacy of management and legal protection (Step D), prior to formal assessment against the World Heritage criteria in the final step (Step E). Places that do not meet the tests are eliminated at each step of the assessment process.

Details of this methodology are included in the *East Gippsland Environment and Heritage Report* (VicRFASC 1996a).

### 16.2 ASSESSMENT

An Expert Panel was established to implement Step A and Step B of the methodology for Victoria. Members of the Expert Panel were drawn from amongst Australia's foremost specialists in disciplines relevant to the World Heritage natural and cultural criteria. The panel met in Melbourne on 13-14 June 1996.

Details of the membership of the panel and the formal record of its meeting are included in the *East Gippsland Environment and Heritage Report* (VicRFASC 1996a).

Step A of the methodology required the Expert Panel to:

- provide advice on the identification of significant themes relating to World Heritage natural values (flora, fauna, geological and geomorphological) or cultural values (Aboriginal and European) for all terrestrial areas of Australia;
- assess these themes in their global context in order to provide advice to Governments on which themes are of outstanding universal value; and
- identify those outstanding universal themes which are relevant to forested areas in Australia.

The Expert Panel was then asked to undertake Step B of the methodology for places in Victoria and to:

- determine which, if any, of the outstanding universal themes for forested areas identified in Step A are relevant to Victoria, as well as to Australia as a whole; and

- provide advice on whether there are places in Victoria which best express the themes and which therefore need to be further investigated as part of the CRA process.

### 16.3 OUTCOMES

The outcomes of the Expert Panel's work are summarised in Table 16.1 below.

The panel identified five potential sub-themes in Victoria which warrant further investigation. Two of these sub-themes are potentially relevant to the North East region. The relevant sub-themes are:

- areas with outstanding examples of *Eucalyptus*-dominated vegetation associated with the Eastern Forests of Victoria; and
- parts of the Australian marginal swells associated with the Eastern Highlands.

The Expert Panel in its deliberations on Victoria made the following statement clarifying the nature of the *Eucalyptus* theme:

“A strong nomination focussed on *Eucalyptus* evolution and diversity would include a wide variety of *Eucalyptus* types from a variety of environments. An excellent representative sample of these can be found in south east Australia, centred on East Gippsland, encompassing a range of habitats from the sea to the alpine herbland, and then to the inland plains. This sample would not be found in a single, contiguous area but would comprise several large areas, most of which could be expected to already have protected area status.”

The expression of these sub-themes is not contained entirely within the North East as they extend to other Victorian RFA regions and areas beyond Victoria. Any assessment of potential World Heritage values (Steps C-E of the methodology) would need to be undertaken in this broader context. The Commonwealth and Victoria remain committed to carrying out such an assessment in this broader context in co-operation with all states involved.

**Table 16.1: Summary of World Heritage themes, subthemes and places in Victoria warranting further investigation**

STEP A			STEP B	
AUSTRALIA			VICTORIA	
All Terrestrial Areas			Australian Forested Areas	Victorian Forested Areas
Australian Themes of Outstanding Universal Value	Australian Subthemes/ Exemplars	Explanatory Sentence	Australian Forest Subthemes/ Exemplars	Potential places in Victoria warranting further investigation

**NATURAL**

Ancient records of life and landforms	Ancient landforms and fossils	Australia has outstanding examples of the earliest known records of life and early physiographic features		
Origin and development of biota and landforms as a result of Gondwana plate tectonics and more recent stability and long isolation.	Passive continental margins	Marginal swells are characteristic of all passive continental margins. The Australian marginal swells are outstanding and exceptional in having volcanics to allow the process to be dated.	Passive continental margins	Parts of the Australian marginal swells associated with the Eastern Highlands (only partly represented in Victoria)
	Paleoplains	Australia has outstanding examples of ancient soil forms in its ancient laterites and duricrusts.		
	Paleo-drainage systems	Australia has outstanding examples of Mesozoic and older river systems extant in its landscapes.		
	Fossils	Cretaceous fossil sites in Victoria (particularly including fossil remnants of dinosaurs, fish and birds) are the best examples of southern high latitude Cretaceous faunas known.	Fossils	Fossil sites at the Otway Coast (Cape Otway), Koonwarra (Leongatha region) and the Bunurong Marine Park (Inverloch region).

STEP A				STEP B
Australian Themes of Outstanding Universal Value	Australian Subthemes/ Exemplars	Explanatory Sentence	Australian Forest Subthemes/ Exemplars	Potential places in Victoria warranting further investigation
	Refugia, Relicts	Australia has outstanding examples of relict biota reflecting ancient Gondwana biota.	Refugia, Relicts	
	Rainforest	Australian rainforests are an outstanding example of ecosystems from which modern biota are derived. These rainforests are exceptionally rich in primitive and relictual species, many of which are similar to fossils from Gondwanaland.	Rainforest	
Evolution of landforms, species and ecosystems under conditions of stress.	Scleromorphy	The Australian flora includes outstanding examples of the evolution of a diverse range of scleromorphic characteristics in response to low nutrient soils and a highly variable climate.	Scleromorphy	
	Arid landscapes and adaptations	Australia, as the most arid, non-polar continent on earth, has outstanding examples of arid landforms and arid-adapted biota in its sandy deserts, including the longest longitudinal dune systems in the world.		
	<i>Eucalyptus</i> -dominated vegetation	<i>Eucalyptus</i> -dominated vegetation in Australia is an outstanding example on a continental scale of forest and woodland vegetation dominated by a single genus. This vegetation has evolved under stress, including conditions of high climatic variability, nutrient deficiency, and high fire frequency.	<i>Eucalyptus</i> -dominated vegetation	
				Areas with outstanding relevant examples of <i>Eucalyptus</i> -dominated vegetation associated with the Eastern Forests of Victoria

STEP A				STEP B
Australian Themes of Outstanding Universal Value	Australian Subthemes/ Exemplars	Explanatory Sentence	Australian Forest Subthemes/ Exemplars	Potential places in Victoria warranting further investigation
(cont.) Evolution of landforms, species and ecosystems under conditions of stress.	Alpine	Australia has outstanding examples of globally unusual vegetation that has developed in response to maritime conditions and poor soils.		
Climate change and its impacts	Records of past climates	Australia has outstanding and globally significant records of past climates preserved in the sediments of a number of its lake systems.	Records of past climates	Lakes with climatic sequences in their sediments, including a number of Western Victorian volcanic lakes

**CULTURAL**

Traditional human settlement and land use	Complex persistence of a hunting- and-gathering society on a single continent	Australia provides the only example of where the hunting-and-gathering way of life has dominated an entire continent up until modern times. This way of life continues to play a significant role in the occupation of the continent, particularly in its northern and central sections.	Complex persistence of a hunting- and-gathering society on a single continent
Artistic expression	Rock art	Australia has Aboriginal art sites that represent a unique artistic achievement, as well as providing an outstanding record of human interaction with the environment over tens of thousands of years.	Rock art
Religious expression	Dreaming sites	Australia provides an outstanding example of where the religious system of hunting-and-gathering societies is embodied in the landscape.	Dreaming sites

STEP A				STEP B
Australian Themes of Outstanding Universal Value	Australian Subthemes/ Exemplars	Explanatory Sentence	Australian Forest Sub -themes/ Exemplars	Potential places in Victoria warranting further investigation
Encounter between cultures		Australia provides examples of the encounter between hunting-and-gathering societies and nineteenth century European societies.		
European expansion of the eighteenth and nineteenth centuries	Forced migration - a major way in which the expansion took place	Convict transportation to Australia is an outstanding example of how European powers initiated the occupation of an entire continent.	Forced migration - a major way in which the expansion took place	
	Integration of an economic system and the resources of a continent into the global economy	The Australian gold rushes are an outstanding example of the global migrations associated with the nineteenth century gold rushes.	Integration of an economic system and the resources of a continent into the global economy	Gold rush sites associated with the Central Goldfields of Victoria
Masterpiece of human creative genius				
Outstanding example of a type of building/ technological ensemble or landscape				

## 17. ECOLOGICALLY SUSTAINABLE FOREST MANAGEMENT

The following is a summary of an independently assessed report on ecologically sustainable forest management in Victoria.

The report is only part of the overall assessment of ecologically sustainable forest management and together with community input, it will provide a starting point for Commonwealth and State consideration and determination of sustainable forest management in subsequent Victorian Regional Forest Agreements.

The report examines and assesses the systems and processes underpinning the delivery of ecologically sustainable forest management in Victoria. The report adopts a 'systems' approach rather than seeking to catalogue specific on-ground practices. An analysis of the overall management system and the process elements was undertaken because there are no established performance indicators or benchmarks for ecologically sustainable forest management.

**Given that the report is based on the findings of an independent panel which completed a review and assessment of ESFM in East Gippsland, and an assessment of Statewide practices which was independently peer reviewed, the views contained in this summary and the full report are not necessarily those of the Victorian RFA Steering Committee or of the Commonwealth or Victorian Governments.**

### 17.1 INTRODUCTION

Ecologically sustainable management is a key element of current forest policy and underpins the objectives articulated in the National Forest Policy Statement. ESFM can be operationally defined as the management of forest on all land tenures to maintain the overall capacity of forests to provide goods, protect biodiversity, and protect the full suite of forest values at the regional level (VicRFASC 1996b).

The National Forest Policy Statement proposes to give effect to ecologically sustainable forest management through:

1. Integrated planning processes and management systems.
2. Codes of Practice and environmental prescriptions.
3. Management plans incorporating sustainable yield harvesting practices.
4. Management of native forests outside the reserve system complementing the objectives of nature conservation reserve management. (Commonwealth of Australia 1992b, p.12).

Following completion of the Independent Advisory Group's work on ESFM for East Gippsland, it was recognised that the information and assessments arising from that work related largely to management systems and processes that are relevant in a Statewide context, not just East Gippsland. Consequently, the Commonwealth and Victoria agreed to the development of a Statewide ESFM report and assessment, using as much of the information as possible from the East Gippsland work as a basis for the Statewide report, and to fill any gaps as required.

A brief description is provided below outlining:

1. the methodology used in the Statewide assessment;
2. a statement on ecologically sustainable forest management for the North East RFA Region. The complete Statewide assessment report is published as part of the Comprehensive Regional Assessments for Central Highlands (VicRFASC 1997a);
3. a summary of the outcomes of the assessment based on five environmental management system components in relation to the ecologically sustainable management criteria; and
4. an overall appraisal of Victoria's forest management systems and processes.

The Commonwealth and Victoria have considered the ESFM assessment and the comments made by the Expert Advisory Group and Professor Ferguson. The discussion in Appendix 4 outlines the response of the Commonwealth and Victoria to the ESFM assessment.

### **Method of Assessment of Statewide Forest Management Systems and Processes in Victoria**

The assessment focuses on the effectiveness of management systems and processes in delivering ecologically sustainable forest management according to a set of principles and criteria (Table 17.1).

Preparation of the Statewide report was undertaken by a Project Management Group consisting of Commonwealth and Victorian officials under the guidance of the Victorian RFA Steering Committee. Descriptions and assessment of Statewide management systems and processes were either adapted from systems and processes described for East Gippsland having relevance to the whole State or, in the case of systems and processes not covered in the East Gippsland Report, prepared by the Project Management Group.

The final report was independently reviewed by Professor Ian Ferguson, the chair of the East Gippsland Ecologically Sustainable Forest Management Expert Advisory Group in accordance with the following terms of reference:

*The consultant is required to review and report on a description and assessment of Ecologically Sustainable Forest Management systems and processes in Victoria in relation to ESFM principles and environmental management criteria with particular attention to:*

- 1. new descriptions and assessments of State-wide management systems and processes not covered in the East Gippsland Report;*
- 2. whether the assessments of Statewide management systems and processes properly reflect the East Gippsland Report; and*
- 3. an overall appraisal of the Statewide report and identification of the strengths and weaknesses of Victoria's forest management systems and processes.*

### **North East Forest Management Systems and Processes**

As part of the CRA for the North East a consideration of the forest management systems applicable to that region was undertaken, against the Statewide review of ESFM (VicRFASC 1997a) to identify any issues or systems that are specific to the North East. It is considered that the Statewide review of ESFM is applicable to the North East.

As noted in the Statewide review of ESFM a forest management plan is currently being prepared for North East Victoria. Where a forest management plan is not in place, such as in the North East, State forest is managed according to approved LCC recommendations and NRE policy and guidelines. A proposed North East Forest Management Plan will be released for public comment prior to its finalisation. It will be an integrated regional plan developed with assistance from the Forest Management Advisory Committee established in the region. The plan will propose a framework for the future management of the forests of the North East and will commit the Department of Natural Resources and Environment (NRE) to the completion of specific management actions to enhance the conservation and production roles of State forest.

### **Description of the Environmental Management System Framework used for the Assessment**

The ISO 14004 (Standards Australia 1995) environmental management system framework provided guidance for developing the structure for the assessment of Victoria's forest management systems and processes (Table 17.2). The ISO 14000 series environmental management system operates at an



organisation<sup>1</sup> level and has the potential to contribute to an internationally acceptable system for certification of forest management and labeling of forest products in the future. Victoria's forest management systems and processes were classified into five components for the assessment of ecologically sustainable forest management.

### ***Commitment and Policy Framework***

The commitment of the Commonwealth and Victorian Governments, their Departments and relevant business units to ecologically sustainable forest management was assessed in terms of the development and application of appropriate legislation, policies, conventions and agreements which contribute to achieving ecologically sustainable forest management. The process for coordination of Commonwealth and State forest-related policies and legislative requirements was also treated under this heading.

### ***Planning***

A major focus of the assessment was whether management practices were supported by principles of environmental care, guidelines and minimum standards, and the basis (quantitative, qualitative, expert opinion) for application of guidelines and minimum standards within codes for specific management practices, and transparency of the planning process. Focus was also given to legal requirements, environmental aspects of forest management practices, allocation of values to particular planning zones, planning processes for minimising environmental impacts of management practices, and appropriateness of plans and their scale and scope in relation to environmental objectives and targets.

### ***Implementation***

The capacity and capabilities of governments and their agencies to deliver ecologically sustainable forest management through adequate accountability and responsibility, resourcing, operational controls, documentation, records keeping and reporting, communication, education and knowledge, and skills and training was assessed.

### ***Forest information, monitoring and evaluation***

The assessment considered Victoria's systems for monitoring and evaluating environmental performance of the implementation of forest management plans and the condition of the forest in relation to requirements for ecologically sustainable forest management.

The process for auditing components of the management system and corrective actions to determine system performance was also assessed. Assessment of audit processes was based on their objectivity and impartiality, and whether they were conducted by properly trained personnel (Standards Australia 1995).

### ***Review and improvement***

Processes for review which lead to continuous improvement of the management system and environmental performance were assessed. These included:

- processes for improvement of the management system which can lead to improved performance;
- application of review findings and research and development at policy, management and planning levels; and
- effectiveness of research and development processes.

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<sup>1</sup> An organisation can be Commonwealth and State Government organisations or statutory authorities, Governments, private or non-government organisations. For the purpose of the ecologically sustainable forest management assessment, Governments and their administrative structures have been assessed. Private organisations are not included in this assessment.

## **Ecologically Sustainable Forest Management Assessment Criteria**

Ecologically Sustainable Forest Management has been assessed against nine principles for ecologically sustainable forest management and the five environmental management system criteria namely: public transparency; monitoring; compliance; scientific and technical basis; and review (Table 17.1).

The nine principles have been developed for national application from the Montreal Process, Forest Stewardship Council Principles and Australian Forestry Council Principles for Environmental Care in Native Hardwood Logging.

**Principle 1 Maintain the full suite of forest values for present and future generations.** This principle addresses the issue of intergenerational equity, that is, that forests be managed to meet present needs without compromising the ability of future generations to meet their own needs (Young 1993). It provides the context in which principles 2-9 must be considered.

**Principle 2 Maintain and enhance long-term multiple socio-economic benefits to meet the needs of societies.** The basis of this principle is the promotion of forest-related economic activity which is consistent with the maintenance of the environment and satisfaction of the socio-economic requirements for income, employment, goods and services. Implicit in this principle is the optimum use of the forest economy's capital stock (human, man-made and natural resource capital) through management so as to maximise the long-term welfare or benefit of society in terms of goods and services it requires. The forest economy covers timber and other forest products and uses, water supply, minerals, grazing, recreation and tourism.

**Principle 3 Protect and maintain biodiversity.** The maintenance of biodiversity is fundamental to achieving ecologically sustainable forest use (ESDWG 1991, Commonwealth of Australia 1992b). Incorporated into the concept of biodiversity is variation at the ecosystem, species and genetic levels.

**Principle 4 Maintain the productive capacity and sustainability of forest ecosystems.** Sustained production of biomass by forest ecosystems is essential to the well-being of all living things. The productive capacity of a forest can be influenced through the silvicultural regime and other management activities. Implicit in the term sustainability is the understanding that irreversible damage through resource use is not imposed on the capacity of the forest to supply goods or services to present and future generations (Ferguson *et al* 1996).

**Principle 5 Maintain forest ecosystem health and vitality.** This principle reflects the concept of ecological integrity whereby the health and vitality of an ecosystem is maintained under changing environmental conditions. Structural and functional changes can occur in ecosystems as a result of threatening processes, such as land clearing, fire, pollution, pests and diseases. These can cause significant shifts in species composition, loss of key biological components, or the degradation of ecosystem processes. Consideration of ecological integrity means determining thresholds of environmental change whereby each threshold results in a reorganisation of the ecosystem to a different but appropriate level. The properties and processes of forest ecosystems over management periods become important considerations for maintaining ecological integrity over time.

**Principle 6 Protect soil and water resources.** Forests contribute significantly to the maintenance and conservation of the soil resource; they afford water catchment protection, and maintain the quality and quantity of water.

**Principle 7 Maintain forest contribution to global carbon cycles.** Carbon is stored in Australian forests as living plant and animal biomass and dead organic matter in the form of forest debris. As a general rule, carbon is accumulated and stored in forests that are growing and which, as a consequence, contribute positively to carbon storage. Forests in which carbon is accumulated through photosynthesis but offset by the loss of carbon resulting from biomass, decomposition or death, are

carbon neutral. Generally, forests that make a negative contribution to carbon storage are those that are regularly burnt, harvested on short rotations, or subject to heavy soil disturbance.

**Principle 8 Maintain natural and cultural heritage values.** Heritage encompasses archaeological sites, historic places and customs (cultural heritage), and natural values or objects (natural heritage) that are of aesthetic and social value and passed down to the present generation from past generations.

**Principle 9 Utilise the precautionary principle for prevention of environmental degradation.** In applying the precautionary principle, public and private decisions should be guided by:

1. careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and
2. an assessment of the risk-weighted consequences of various options.

In interpreting this principle, particular attention was paid to processes based on ‘risk assessment’ and ‘risk management’ strategies. Such processes are important to minimise environmental impacts and avoid serious or irreversible damage to the environment.

## 17.2 SUMMARY OF ASSESSMENT

### Commitment and Policy Framework

Legislation and National and State policies for the forests of Victoria provide a comprehensive framework for ensuring that all forest values are considered, assessed and afforded protection. In general, all the principles of ecologically sustainable forest management are met. On public land, legislation requires strategic land-use planning at the State/regional level through to legally enforceable Codes of Practice at the operational level (e.g. Code of Forest Practices for Timber Production). On private land, the legislation requires regional level planning, adherence to the Code of Practice for Timber Production and control of, for example, the clearance of native vegetation. In a number of instances, these arrangements are reinforced by legislation designed to safeguard particular values (e.g. Flora and Fauna Guarantee Act).

Revision of Commonwealth Acts such as the *Australian Heritage Commission Act 1975* and the *Environment Protection (Impact of Proposals) Act 1974* should be considered in the light of current RFA processes to improve coordination of forest management, and especially to develop a jointly agreed approach to identifying and assessing heritage values that minimises the overlap and differences between Commonwealth and Victorian legislation. Duplication in the application of Commonwealth and State Acts relating to the protection of endangered flora and fauna should be addressed.

Statutory land-use planning and management processes for public land in Victoria involve a precautionary approach in determining the need, level and mechanisms for protecting important environmental values. On private land, environmental protection, including requirements for retention of native vegetation, is achieved through planning scheme provisions under the *Planning and Environment Act 1987* and is identified in Catchment Management Strategies under the *Catchment and Land Protection Act 1994*.

There is a legislative requirement to review sustainable sawlog yields every five years. The transparency of the review process could be improved. Yields are legislated and industry licence volumes are allocated on the basis of regional sustainable yield.

Potential socio-economic benefits are currently being foregone in Victoria by lack of utilisation of residual logs as a result of Commonwealth restrictions on export of woodchips. Harvest and export of

pulpwood throughout Victoria would also have benefits for silviculture and fire management provided environmental values are protected.

Legislation has recently been passed by the Victorian Parliament to replace the Land Conservation Council with a new body called the 'Environment Conservation Council' whose task will be to conduct investigations into the balanced use or development of public land within the State.

## **Planning**

### ***Principle 1      Maintain the full suite of forest values for present and future generations***

The planning processes in Victoria span all the levels required for achieving ecologically sustainable forest management. Land Conservation Council studies have collected and assessed available information thoroughly, provided significant opportunities for public input, and ensured a balanced allocation of forested public land between resource use and conservation on a broad regional scale. The allocation of public land achieved through Land Conservation Council processes addresses all assessment criteria and provides a sound basis for ecologically sustainable forest management.

Preparing effective strategic plans for ecologically sustainable forest management requires methods for dealing with the often complex trade-offs necessary between competing ecological and socio-economic values. There is a strong need for sophisticated modelling approaches and data for dealing with these trade-offs, and this is being addressed.

Forest Management Plans, the Code and associated prescriptions applied within the land use framework established by the Land Conservation Council, provide a strong basis for achieving ecologically sustainable forest management. The plans specifically address parks and State forests but take account of all tenures in their attempt to balance resource use with other conservation and management requirements. Where forest management plans are not in place, the forest is managed according to approved LCC recommendations and NRE policy and guidelines. In such areas, the preparation of the Wood Utilisation Plan assumes a more important role. Wood Utilisation Plans are prepared by a multi-disciplinary team and must take account of all available information on timber, flora, fauna, catchment, land protection and cultural values. The monitoring of implementation of Wood Utilisation Plans occurs, however this is hampered by the lack of an adequate coupe recording and tracking system.

The Department of Natural Resources and Environment needs to develop a system for monitoring implementation of plans, commence reporting on plan implementation, and make the information publicly available, along with actions intended to address any identified deficiencies. For national parks, major issues include setting clear and strategic goals for the conservation of biodiversity (or other express purposes of reservation) that are realistic in relation to available resources and against which the success of management can be judged, and consideration of the collective contribution of individual parks to regional conservation (or other express purposes of reservation) in the planning processes.

The Native Vegetation Retention Controls, Flora and Fauna Guarantee and the Code provide mechanisms for protecting environmental and other values on private land. Strategic regional plans which address flora and fauna conservation issues are required to ensure their implementation is coordinated and directed towards clear conservation goals or other relevant goals. Catchment Management Strategies may fulfil this role but are not yet well-developed.

The environmental effects statements (EES) and planning processes for assessing exploration and mining applications provide opportunities for consideration of socio-economic, environmental and cultural values and for public participation. The incorporation of the former Department of Minerals and Energy into NRE should facilitate communication between formerly separate agencies and help produce more timely and balanced outcomes. NRE is however still refining its internal processes for assessment of exploration and mining applications. Work Plans provide mechanisms for the setting of

suitable licence conditions. The local government planning process for assessment of mining applications is slow and often more adversarial than the EES process. The EES process is more objective and rigorous, providing better opportunities for consideration of scientific evidence and differing views on the relative merits of a proposal.

At the strategic planning level there are major opportunities for public input to forest management in Victoria. Public confidence in forest management planning could be increased by development of a more comprehensive set of performance indicators against which implementation of the plan can be assessed and setting of some more explicit targets against which the effectiveness of plans can be measured.

***Principle 2      Maintain and enhance long-term multiple socio-economic benefits to meet the needs of societies***

The Flora and Fauna Guarantee Act and the Land Conservation Act have clear requirements for involvement of scientific experts, community consultation and consideration of socio-economic issues. These issues could be considered more thoroughly in preparing forest management plans where necessary. Current policy and programs are principally directed at improving and extending the plantation estate on private land and the economic returns and environmental and social benefits provided by plantations and trees on farms.

There is a need for better links between forest management plans, local government planning and cross border regional planning for industry, tourism, recreation and catchment management. Significant changes in industry opportunity (e.g. value-adding, pulpwood utilisation, tourism) should trigger re-examination of forest management plans.

***Principle 3      Protect and maintain biodiversity***

Planning for protection of biodiversity in Victoria involves a hierarchy of strategic and operational plans which assess the need for reservation or special management at all scales from region to coupe, and puts in place regional and local prescriptions designed to limit the impacts of timber harvesting and other activities on flora and fauna and other values. The reserve system established by the Land Conservation Council land use planning process is supplemented by a complementary zoning scheme in State forests which provides special prescriptions for conservation of Ecological Vegetation Classes, old-growth forests, and threatened flora and fauna. Overall, these planning processes make a major contribution to meeting the requirements for protecting and maintaining biodiversity and complementary management of "off-reserve" areas. Once the boundaries of the National Reserve System are determined, mechanisms need to be developed to accommodate long-term changes in landscape dynamics through removal, exchange, or addition of areas on or near the boundaries. These mechanisms for periodic changes should seek to maintain adherence to the reserve criteria and the level of the sustainable yield but provide sufficient flexibility to accommodate new information.

The effectiveness of Action Statements and Recovery Plans for flora and fauna need to be better assessed, based on monitoring and research. While Action Statements and Recovery Plans have been completed for numerous species, they have not been completed for communities and threatening processes. Additionally the overarching Flora and Fauna Guarantee Strategy has yet to be completed. These elements of the Flora and Fauna Guarantee should be implemented to ensure a coordinated approach to flora and fauna conservation.

Strategic regional plans are required to ensure that mechanisms for protecting biodiversity on private land are coordinated and directed towards clear flora and fauna conservation goals.

***Principle 4      Maintain the productive capacity and sustainability of forest ecosystems***

The adequacy of the existing Statewide process for estimating sustainable yield in those areas with a forest management plan has been reviewed as part of the East Gippsland RFA process (VicRFASC

1996b). Procedures and data for achieving these estimates are coarse at present but uncertainties are accounted for by making conservative estimates of sustainable yield.

The process should continue to be as transparent as possible within restrictions relating to commercial confidentiality. It should continue to seek input of the best available specialist expertise from within and outside the Department of Natural Resources and Environment, and include regular reviews as legislated in relation to monitoring indicators of ecological sustainability.

The fact that formal review of sustainable yield is a separate process to preparation of Forest Management Plans is seen by some community groups as a potential impediment to achieving ecologically sustainable forest management. It should be recognised, however, that the five-yearly review of sustainable yield takes account of changes in the land base for timber production to meet conservation needs. Greater explanation of the procedure for estimating sustainable yield and making the methodology and data used publicly available at an earlier stage than has occurred previously would raise public confidence in this process. Sustainable yield and actual hardwood sawlog supply levels should be routinely reported and be publicly available.

#### ***Principle 5      Maintain forest ecosystem health and vitality***

Wildfires pose a significant threat to resources, property and forest values on both public and private lands. Potential losses are considered in planning. Clearly established planning guidelines under the Code of Practice for Management of Fire on Public Land and strategic and operational plans provide a sound basis for integrated and effective management and control of fire in Victoria. The current practice of ensuring that fauna and flora officers have input to fire management plans is an important part of minimising risks to biodiversity. On private lands, the processes and planning mechanisms adopted by the Country Fire Authority provide a logical and accountable basis for strategic and operational planning for prevention and control of wildfires. While most issues are appropriately dealt with through strategic and additional plans, the overall effectiveness of pest management is limited by the lack of strategic plans for pest plant and animal control that cover all tenures. Operational planning processes should provide continuing programs for training and updating field staff and access to support materials.

#### ***Principle 6      Protect soil and water resources***

For State forests, the Code of Forest Practices and supporting local management prescriptions provide guidelines for protection of soil and water values. The guidelines given in the Code are designed as State-wide minimum standards and therefore cannot address regional variation. The development of regional prescriptions that build on Code standards to take account of local factors such as soil types and climatic conditions is required and should continue, as should research into the development of indicators of soil damage caused by harvesting machinery.

Areas of high soil erosion risk are often excluded from harvesting and may be placed in the Special Protection Zone as part of a Forest Management Area plan. The management of these and other erosion-prone areas in reserves is based on exclusion or careful management of fire and other activities to maintain vegetation and litter cover. Inclusion of targets in forest management plans for soil and water quality should be considered.

Catchment Management Authorities have played an important role in analysing threats and beneficial uses and must continue to do so to provide appropriate strategies to protect soil and water at the sub-catchment level.

#### ***Principle 7      Maintain forest contribution to global carbon cycles***

Victoria aims to progressively increase its total forest cover through programs such as Landcare and the Tree Victoria Action Plan. There is a judgement by forest managers that conversion of mature forest to regrowth will maintain carbon storage, and that management burning will have a neutral

long-term effect on forest carbon budgets. Little information is available to test these judgements at a regional scale. The areas of greatest uncertainty are the pattern of carbon re-accumulation in forest biomass after harvesting, the effects of harvesting and fire regimes on changes in the soil carbon store, and the residence time of carbon in harvested forest products.

***Principle 8      Maintain natural and cultural heritage values***

A suite of legislation protects all archaeological sites (Aboriginal and historic), significant historic sites, and aesthetic values. They are recognised at the strategic forest management level and in a range of management plans. More detailed strategies for the identification and protection of cultural heritage values, including Aboriginal sites, are required.

Deficiencies at the operational planning level need to be addressed through improved liaison with Aboriginal Affairs Victoria to implement the Aboriginal and Archaeological Relics Act, and increased participation of Aboriginal communities in Aboriginal site identification and management. A systematic approach to Aboriginal site impact assessment through appropriate ongoing identification of values (through consultation with communities and field survey) is required.

***Principle 9      Use the precautionary principle for prevention of environmental degradation***

A precautionary approach to forest management is adopted through a range of planning processes including a conservation reserve and zoning system, reservation of Ecological Vegetation Classes based on rarity and other indicators of risk, application of management prescriptions to ameliorate threatening processes in forests managed for timber harvesting and in sustainable yield.

Areas for improvement include:

- recognition in Forest Management Plans of the contribution of all forest areas to regional conservation goals e.g. General Management Zone;
- development of a formal approach to risk assessment at the commencement of the planning process and at periodic reviews to give greater confidence in the measures taken to ameliorate risk and to better identify the need for research into new types of information;
- development of flexible corridor networks to accommodate changes in habitat where necessary.

**Implementation**

The accountabilities and responsibilities for delivery of each element of ecologically sustainable forest management are clearly established. The high level of public ownership and land management by one Department provides a good basis for a coordinated approach to ecologically sustainable forest management and minimises overlap and duplication between government agencies. Service delivery is facilitated by a departmental structure with both centralised control and strong decentralised components. The creation of Parks Victoria as a provider of park management services to NRE is new. It is unclear whether policy and regulatory functions can be clearly and effectively separated and maintained by the Parks Program within NRE, and whether the protocols and other planning measures concerning coordination across these and other bodies within NRE and Parks Victoria will be effective in fire and other management activities. These aspects merit review and continued improvement.

The program and budgeting process of NRE generally reflects National Forest Policy Statement initiatives to improve public forestry accounting systems. In this way, the performance of both commercial activities and community service obligations can be clearly evaluated. A strength of the business unit structure is that it should allow all costs and benefits relating to ecologically sustainable forest management to be fully identified. Uniform treatment of all business units and activities is acknowledged to be difficult and ongoing refinements are needed. Particular attention is needed to identify costs on a regional basis and to separate costs of commercial and non-commercial activities. The level of funding to an individual region should be linked to the requirements for effectively implementing the strategic and annual plans for ecologically sustainable forest management in that region. Maintenance of a strategic focus for research into ecologically sustainable forest management

also needs a continuing commitment to funding. For sustainable fire management, it is important to ensure that levels of skilled staff for fire-planning and suppression activities are maintained at least at current levels.

The process for control of forest operations to achieve compliance with the Code of Forest Practices and Coupe Plans is transparent and accountable. There is clear responsibility for control for each stage of timber harvesting from supervision of the implementation of the Coupe Plan to the signing of a Coupe Completion certificate following satisfactory compliance with the plan, including draining of major snig tracks and rehabilitation of landings. A major strength in managing timber harvesting operations is the Forest Operator Licensing System. The indicator point system provides a strong basis for the regulation of harvesting activities conducted by independent contractors to ensure they conform with the Code of Forest Practices. The process of control to achieve compliance with the Code of Fire Management on Public Lands is transparent and accountable. Country Fire Authority requirements for supervision by trained staff of all fire prevention and control operations, and a permit system for prescribed burning by private landholders provides an accountable basis for control of fire operations on private land. Improvement is needed in the forthcoming reviews of Fire Protection Plans to ensure that specialist peer review is generally undertaken. The lack of auditing processes for other Departmental operations is a weakness which should be addressed. In particular, there is a need to audit the extent of compliance of strategic and operational plans. An area for improvement is the supervision of forest operations where protection of archaeological or heritage values is important.

Statewide guidelines and procedures for parks and reserves provide guidance and a consistent approach across the State for a variety of field operations and park management issues. Supervision of contractors by field staff, ranger patrols to ensure visitor compliance with regulations, and leases and licences provide further operational control.

Private landholders are responsible for controlling activities on their land. Native Vegetation Retention Controls, Flora and Fauna Guarantee and the Code provide mechanisms for protecting environmental values on private land, however, their implementation lacks coordination. It is important to ensure this is coordinated and directed towards clear flora and fauna conservation goals. Development of further practical guides, and other information material describing good forest practice, especially to assist small plantation owners, would be helpful. Greater consistency in the interpretation of the Native Vegetation Retention Controls for plantation development is required.

Timber Harvesting Plans which conform to the Code and the S13 amendment to the planning scheme must be lodged for timber harvesting operations on private land with the responsible authority. This is usually local government which is then responsible for ensuring compliance with the provisions of the plan. These can be enforced through formal enforcement orders and subsequent recourse to the Administrative Appeals Tribunal. Local government often does not have the expertise to implement Native Vegetation Retention Controls, to assess cultural and heritage values, or to monitor compliance with permit conditions. Continued improvement in this area is necessary. Expansion of the trial in Gippsland using accredited forestry personnel to ensure harvesting plans comply with the Code, if successful, should be encouraged.

For exploration and mining, the on-ground presence of NRE staff is designed to ensure that monitoring of compliance with licence conditions occurs and that progressive rehabilitation of mine sites is satisfactory. Rehabilitation bonds provide a further incentive for compliance.

Most documents comprising the environmental management system are published or are made publicly available. Greater attention should be paid to ensuring that up-to-date copies of key documents, for example, management prescriptions, are readily available to staff and other relevant parties. There is a need for a computerised database system to record forest operations, in particular, timber harvesting. This is important to ensure that old-growth forest and forest resource inventory information is regularly updated. Archival material of particular interest to ecologically sustainable forest management including historical records of fire, storm, settlement, timber harvesting, is not



properly catalogued and stored. There is a need for retaining and transmitting the corporate knowledge base. This requires documentation of procedures, regular training and effective induction.

While NRE and Parks Victoria have training programs in place, there is room for improvement in a number of areas. Effective operational planning depends on, for example, identification of critical values at the local (coupe) scale (e.g. habitat requirements in Special Management Zones, soil erodibility). On-ground assessments are made by Forest Officers and Park Rangers and a wide range of skills are required to make competent professional judgements. Current planning processes need to better emphasise the importance of adequate technical training of field staff and access to support materials.

### **Forest Information, Monitoring and Evaluation**

The development of flora and fauna databases covering all land tenures and the development of data gathering programs directly linked to strategic planning requirements is a strength of NRE's planning process and also provides a basis for strategic long term monitoring of forest change. There are parallel databases for natural and cultural heritage places in forests. The joint Australian Heritage Commission/Department of Natural Resources and Environment studies have utilised existing databases and established new databases for many layers of site-based values. The Department's operational planning systems could be improved significantly through access to and regular updating of data concerned with Aboriginal sites.

Areas for improvement in forest information include:

- gathering and storage of socio-economic data for consideration in strategic plans;
- development of a State-wide computerised site, site management and visitor statistics database in national parks to improve the management process;
- systematic surveys of plant pest location and density and the development of a specific strategic plant and animal pest protection plan (similar to the fire protection plan) identifying priority control zones;
- making the GIS available to staff in the more remote areas of the State as well as Melbourne and major regional centres;
- implementation of the Integrated Forest Planning System as new data from SFRI becomes available electronically.

While recent strategic plans include mechanisms to monitor their implementation, this is a relatively new process and implementation reports are yet to become available. It is essential that NRE complete the system for monitoring implementation of park plans, commence reporting on plan implementation on all land tenures, and make the information publicly available, along with actions intended to address any identified deficiencies. Monitoring of implementation of Wood Utilisation Plans is hampered by the lack of an adequate coupe recording and tracking system. The Department's monitoring process provide a sound basis for ensuring forest regeneration, however, assessment of other sustainability indicators could be undertaken during regeneration assessments to monitor the effects of forest operations

NRE has a large body of information on the forest environment and a number of specific monitoring programs, however, the development of sustainability indicators is essential to assess whether stated forest management objectives are being met. While many indicators are implicit in current management plans, specific indicators and programs are required for monitoring biodiversity, health and vitality of forest ecosystems, soil and water resources, and social and cultural heritage values. Monitoring is required to assess whether prescriptions, such as habitat tree retention, linear reserves and streamside buffers achieve their desired objectives in the longer term. The monitoring of road and track condition on public land is inadequate, leading to risks to soil and water quality. This is especially the case for those pre-dating the Code of Forest Practices. Indicators need to be sensitive to, and representative of ecological change at strategic and operational scales. The applicability of presently held data for this purpose will need to be assessed.

Reference Areas have the potential to be valuable for monitoring long-term changes in forest ecosystems. A detailed inventory of the Reference Area system is required including an assessment of its representativeness, extent of replication, and the degree to which it provides reliable examples of forests unaffected by humans.

There are no formal processes for routine and regular audit of compliance with some Departmental policies and plans. Periodic audits are recommended. Auditing for compliance of components of Victoria's management system with the Code and exploration and mining licences is internally based and appropriate. Auditing applies to coupe planning, timber harvesting operations, log grading, fire operations, exploration and mining, and record-keeping. A strength of the auditing system in State forests is that a summary of results is made public and that substantial penalties are possible for breaches. NRE's internal audit of timber harvesting and log grading operations is an appropriate and effective means for assessing compliance with the Code and prescriptions. The use of staff from outside the region subject to audit is a strength of the process. Consideration should be given to increasing the transparency of audits by making the results of audit processes publicly available along with measures taken to address deficiencies and by increasing the independence of the audit teams. Log grade audit results should be published. Consideration should be given to independent log grading procedures, perhaps related to the audit of the Code outlined above. The number of coupes audited may be too small to adequately sample the full range of environmental conditions under which problems may occur. Code audits should cover both public and private land, including plantations.

Corrective actions result from reviews of operational prescriptions and procedures, audit findings and results of regeneration performance, reports on Annual Service Agreements, supervision of field operations, and enforcement patrols to detect unauthorised activities in Parks or State forest. To improve transparency, NRE should better document corrective actions taken.

### **Review and Improvement**

A process for reviewing the forest management system components has not been formally developed by NRE. A process with appropriate reporting mechanisms, such as a 'state of the forests report' is required to ensure continuous review and improvement of the management system. This would be in keeping with developments in forestry organisations throughout the world. The scientific basis of those parts of forest management which generate greatest environmental risk or are subject to contrary scientific interpretations, together with those where scientific knowledge is advancing rapidly should be subject to more frequent peer review.

NRE's research program clearly links to providing information for improving strategic planning and reducing environmental risks in forest management. A stronger commitment to the timely completion, appropriate peer review and publication of scientific research would improve public confidence and the scientific basis of forest management. A well defined long-term research and development program in which critical areas for research and development are identified is needed.

## **17.3 OVERALL APPRAISAL**

The appraisal below was prepared by Professor Ian Ferguson as part of his independent review of the Statewide ESFM report (terms of reference are given in 17.1). This appraisal was made in addition to a number of comments incorporated into the Statewide report, and it should be read in that context. Given that it was an independent peer review, the views contained in this appraisal are not necessarily those of the Victoria RFA Steering Committee or of the Commonwealth or Victorian Governments.

'Victoria has all of the major elements in place for appropriate systems and processes for ecologically sustainable forest management. Having said that, however, there is still considerable scope for further improvement. Forest-related legislation needs review to bring some aspects up-to-date and to make it more comprehensible to the public. Land use planning processes need refinement in the light of changes in bureaucratic structures and current needs. Closer attention needs to be paid to strategic

planning of the integration of reserve and off-reserve management. The purchasers of stumpage need to recognise the importance of competition in determining the price of publicly-owned native timber, and the role of contestable but renewable and transferable rights to timber supply from that forest. More training is needed to ensure that staff are adequately prepared for planning and management under ecologically sustainable forest management. More research is needed to assist in the resolution of various issues.'

'These are not major or exceptional requirements: they are the measures required for continuing improvement in management systems. The extent and rapidity of adoption will be dictated by

- the economic viability of the commercial activities and the capacity to fund improvements in forest management through productivity gains,
- the resources available for improvements in non-commercial management activities,
- the support that the public at large gives to the economic, environmental and social outcomes, and
- the commitment of Governments, the timber industry, and the bureaucracy to the process.'

'In an era when resources for non-commercial activities are becoming scarcer and more competitive, there are concerns about the capacity for the system to fund adequately the improvements needed for management of an extended National Reserve System and the better integration of reserve and off-reserve management for all forest values. The formation of Parks Victoria may provide a basis for improved productivity that will enable existing resources to stretch further but the division of responsibilities between it and the NRE is still unclear. The additional resources required should not be underestimated.'

'Victoria is in a good position to deal with these issues providing it remains adaptive and accepting that sustainable forest management is a goal to be pursued vigorously, not an antique to be admired.'

**Table 17.1: Management System Structure and Criteria for Assessment of Ecologically Sustainable Forest Management.**

Criteria for assessment of management system elements and sub elements	
ASSESSMENT CRITERIA	CRITERIA * DESCRIPTION
<b>System design to meet national principles of ecologically sustainable forest management</b>	<p>The planning and management of native forests should:</p> <ol style="list-style-type: none"> <li>1. Maintain the full suite of forest values for present and future generations.</li> <li>2. Maintain and enhance long -term multiple socio-economic benefits to meet the needs of societies.</li> <li>3. Protect and maintain biodiversity.</li> <li>4. Maintain the productive capacity and sustainability of forest ecosystems.</li> <li>5. Maintain forest ecosystem health and vitality.</li> <li>6. Protect soil and water resources.</li> <li>7. Maintain forest contribution to global carbon cycles.</li> <li>8. Maintain natural and cultural heritage values.</li> <li>9. Utilise the precautionary principle for prevention of environmental degradation.</li> </ol> <p><u>Notes</u></p> <ol style="list-style-type: none"> <li>1. These principles should be interpreted and applied in the context of the National Forest Policy Statement and other existing policy documents.</li> <li>2. Definitions contained in the National Forest Policy Statement apply to these principles.</li> <li>3. Planning and management of plantations should be consistent with the Ministerial Council for Forest Fisheries and Aquaculture document: Forest Practices Related to Wood Production in Plantations: National Principles.</li> </ol> <p>* These criteria need to be applied at the appropriate ecological scales.</p>
<b>Public transparency</b>	<p><b><u>Scrutiny</u></b>: Type and level of scrutiny - parliamentary, administrative.</p> <p><b><u>Consultation</u></b>: Opportunity for public comment, individual stakeholder and group submissions, advisory group involvement in the process, information exchange, provision for feedback in consultation process.</p> <p><b><u>Access to information</u></b>: Process for access to information.</p> <p><b><u>Public involvement</u></b>: Opportunity for individual stakeholder or community groups to be involved in the decision-making process.</p> <p><b><u>Reporting</u></b>: Mechanism for reporting of processes and outcomes for all system criteria.</p>
<b>Monitoring</b>	<p><b><u>Trend measurements</u></b>: Process for assessment of change.</p> <p><b><u>Monitoring regimes</u></b>: Process for regular monitoring of indicators.</p> <p><b><u>Standards</u></b>: Process for designation of quantifiable measures against which the quality or performance of a characteristic or attribute is assessed.</p> <p><b><u>Performance targets</u></b>: Process for designation of specified goals.</p> <p><b><u>Performance verification</u></b>: Process for ensuring achievement of standards and targets</p>
<b>Compliance</b>	<b><u>Audit arrangements, penalties, incentives</u></b> : Processes that ensure compliance with stated goals or objectives.
<b>Scientific and technical basis</b>	<b><u>Mechanism</u></b> for assessing adequacy of information (for example scientific/peer review); <b><u>Process</u></b> for incorporation of information into decision making process.
<b>Review</b>	<b><u>Mechanism</u></b> for review, feedback and continual improvement, internal/external, periodicity.

**Table 17.2: Forest Management Systems and Processes in Victoria**

<p><b>1. LEGISLATION AND POLICIES</b></p> <p>International Treaties, Conventions and Initiatives</p> <p>Commonwealth Government Legislation</p> <p>National Policies</p> <p>State Legislation</p> <p>State Policies</p> <p><b>2. PLANNING</b></p> <p><i>Strategic Planning</i></p> <p>Regional Forest Agreements</p> <p>Land Use Planning - Public land</p> <p><i>Forest management planning - public land</i></p> <p>Forest Management Plans (State forest)</p> <p>Victorian Code of Forest Practices</p> <p>Regional prescriptions</p> <p>Sustainable Yield</p> <p>Wood Utilisation plans</p> <p>Forest coupe plans</p> <p>Log grading</p> <p><i>Park planning</i></p> <p>Park Plans</p> <p><i>Private land</i></p> <p>Land Use Plans</p> <p>Education and cooperative programs</p> <p>Native Vegetation Retention Controls</p> <p>Code of Forest Practices for Private Land</p> <p>Waters of Victoria State Environment Protection Policy</p> <p>Flora and Fauna Guarantee</p> <p>Plantation Management</p> <p>Private forestry strategy</p> <p><i>Fire management planning</i></p> <p>Code of Practice for Fire Management</p> <p>Regional Fire Protection Plans</p> <p><i>Flora and Fauna planning</i></p> <p>Flora and Fauna Guarantee</p> <p>Recovery Plans</p>	<p><b>2. PLANNING (continued)</b></p> <p><i>Cultural values</i></p> <p>Aboriginal places</p> <p>Historic places</p> <p><i>Exploration and Mining</i></p> <p>Environmental Effects Statements</p> <p>Planning Permits</p> <p>Work Plans</p> <p>Environmental Review Committees</p> <p><i>Other Plans</i></p> <p><b>3. IMPLEMENTATION</b></p> <p><i>Accountabilities and Responsibilities</i></p> <p><i>Resourcing of Implementation Programs</i></p> <p><i>Operational Controls over implementation programs</i></p> <p>Control of timber harvesting in State forests</p> <p>Control of fire management operations</p> <p>Control of other activities in State forest</p> <p>Control of operations in National Parks</p> <p>Control of other operations on public land</p> <p>Control of activities on private land</p> <p><i>Documentation and Records Keeping</i></p> <p><i>Communication and Education</i></p> <p><i>Knowledge, skills and training</i></p> <p><b>4. INFORMATION MONITORING AND EVALUATION</b></p> <p><i>Forest information</i></p> <p><i>Monitoring implementation of plans and programs</i></p> <p><i>Monitoring and evaluating condition of the forest environment</i></p> <p><i>Auditing of compliance with regulations and controls</i></p> <p><i>Corrective action</i></p> <p><b>5. REVIEW AND IMPROVEMENT</b></p> <p>Review of the Environmental Management System</p> <p>Research and Development</p>
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## REFERENCES

- ABARE (1997a). 'Outlook for forest products in Australia', in *Outlook 97*, Proceedings of the National Agricultural and Resources Outlook Conference, Canberra, 4–6 February, vol. 1. Commodity Markets and Resource Management, ABARE, Canberra, p181.
- ABARE (1997b). *Australian Commodity Statistics 1997*, Canberra.
- ABARE (1998). *Australian Forest Products Statistics*, March Quarter, Canberra. Ausnewz 1996, *The Australian Forest Products Industry Review*, Dana Publishing, Hobart.
- Abbott, I., Lamb, K. and Roberts, B. (1993). *Statement of Resources, Uses and Values Central Gippsland Forest Management Area*. Department of Conservation and Natural Resources, Victoria.
- ABS (1996). *Australian National Accounts - State Account 1994-95*, cat. no. 5220.0, Australian Bureau of Statistics, Canberra.
- ABS (1997a). 1991 *Census of Population and Housing - Customized Matrices*, cat. no 2714.0, Australian Bureau of Statistics, Canberra.
- ABS (1997b). 1996 *Census of Population and Housing - Customised Matricies*, cat. no. 2714.0, Canberra.
- AHC and CALM (1992). *National Estate Values in the Southern Forest Region, South-west Western Australia*, Vol. 1-5. Australian Heritage Commission and Department of Conservation and Land Management, Western Australia. AGPS, Canberra.
- AHC and CNR (1994a). *National Estate Values in the Central Highlands of Victoria*. Draft Project Report. June 1994. Department of Conservation and Natural Resources, Victoria, East Melbourne.
- AHC and CNR (1994b). *Method Papers: Central Highlands Joint Forests Project, Volume One - Natural Values*. AHC Canberra.
- AHC and CNR (1994c). *Method Papers: East Gippsland and Central Highlands Joint Forest Projects, Volume 2 - Cultural Values*. AHC Canberra.
- Allan, J. and Lovett, S. (1996). *Impediments to Managing Environmental Water Provisions*. Bureau of Resource Sciences, Canberra.
- Allen, C. and Clarke, A. (1998). 'Outlook for gold', in *Outlook 98*, Proceedings of the National Agricultural and Resources Outlook Conference, Canberra, 3–5 February, vol. 3, *Minerals and Energy*, ABARE, Canberra, pp. 243–53.
- ANZECC (1992). *National Water Quality Management Strategy: Australian Water Quality Guidelines for Fresh and Marine Waters*. Australia and New Zealand Environment and Conservation Council.
- ARC (1998). *Regulatory Impact Statement - Alpine Resorts (Management) Regulations*. Alpine Resorts Commission / Department of Natural Resources and Environment, Victoria.
- ARMCANZ & ANZECC (1997). *The National Weeds Strategy: a strategic approach to weed problems of national significance*. Agriculture and Resource Management Council of Australia and New Zealand, and Australia and New Zealand Environment and Conservation Council, Barton, ACT.
- ARMCANZ (1995). *Water Allocations and Entitlements: A National Framework for the Implementation of Property Rights in Water*. Standing Committee on Agriculture and Resource Management, Canberra.
- ARMCANZ/ANZECC (1995). *National Water Quality Management Strategy: Draft Implementation Guidelines*. Agriculture and Resource Management Council of Australia and New Zealand/Australia and New Zealand Environment and Conservation Council.

- Armour, A. (1990). 'Integrating impact assessment into the planning process'. *Impact Assessment Bulletin*, 8 (1/2), 3-14.
- Ausnewz 1996, *The Australian Forest Products Industry Review*, Dana Publishing, Hobart.
- Bannear, D. (1997) A Study of Historic Forest Activity Sites in the North East Forest Region, Victoria.
- Birch, W.D., and Henry, D.A., (1997). Gem minerals of Victoria. The Mineralogical Society of Victoria Special Publication No.4.
- Borschmann, R. (1998). *Plantation productivity potential of blue gum and radiata pine for North East Victoria*. Consultants Report by Plantation Development Services Pty. Ltd. for Plantations North East Inc., Victoria. pp. 21.
- Bowen K.G., (1988a). Talc. In Douglas, J.G., & Ferguson, J.A., eds., *Geology of Victoria*, Geological Society of Australia: Melbourne, p.583.
- Bowen K.G., (1988b). Sand. In *Geology of Victoria* (Eds. JG Douglas and JA Ferguson). Victorian Division, Geological Society of Australia, p.583.
- Bowen, B., (1974). An analysis of gold production data for Victorian Reef and Deep Lead Mines, Unpublished report 1974-12, Geological Survey of Victoria, Melbourne.
- Brack, C. and Turner, B.J. (1995). *Review of the Statewide Forest Resource Inventory*, Unpublished Consultancy to the Department of Conservation and Natural Resources, Victoria.
- BRS (1997). *National Plantation Inventory of Australia*. Bureau of Resource Sciences, Canberra.
- BRS (1998). *National Forest Inventory of Australia*. Bureau of Resource Sciences, Canberra.
- Bush, D., Lamb, K., Tickle, P. and Pritchard, A. (1998) Central Highlands (Victoria) Plantation Potential Analysis: Methodology and results. Bureau of Resource Sciences (in press), pp. 45.
- Cameron, J. (1997). 'The potential for Australian pulpwood – opportunities, competitiveness and constraints', in *Outlook 97*, Proceedings of the National Agricultural and Resources Outlook Conference, Canberra, 4–6 February, vol. 1, *Commodity Markets and Resource Management*, ABARE, Canberra, pp. 209–16.
- Campbell, R.G. Chesterfield E.A., Craig F.G., Fagg P.C., Farrell P.W., Featherston G.R., Flinn D.W., Hopmans P., Kellas J.D., Leitch C.J., Loyn R.H., MacFarlane M.A., Pederick L.A., Squire R.O., Stewart H.T.L., and Suckling G.C. (1984) . *Silvicultural and Environmental Aspects of Harvesting Some Major Commercial Eucalypt Forests in Victoria*. Forests Commission Victoria, (unpublished).
- Centre for Farm Planning and Land Management (1989). *Consultant's Report to State Plantations Impact Study - Report prepared for the Steering Committee State Plantations Impact Study*, University of Melbourne, Victoria.
- CFL (1989). *Code of Forest Practices for Timber Production. Revision No. 1*. Conservation, Forests and Lands, Victoria.
- Chisholm T and Fraser I (1997). *An Economic Analysis of Victorian Alpine Cattle Grazing*. 1997 Annual Economics Conference of the Department of Natural Resources and Environment, Victoria. Marysville November 25 - 26 1997.
- Clark, A.L. (1996). 'Structural changes in global mineral supply – Australia's changing role', in *Outlook 96*, Proceedings of the National Agricultural and Resources Outlook Conference, Canberra, 6–8 February, vol. 3, *Minerals and Energy*, pp. 24–31, ABARE, Canberra.
- CNR (1995a). *Review of the Code of Forest Practices for Timber Production*. Prepared by CSIRO Division of Forestry for the Department of Conservation and Natural Resources, Melbourne.



- CNR (1995b). *Report on a Consultancy to Establish Private Forestry Issues Relevant to the Review of the Code of Forest Practices for Timber Production*. Department of Conservation and Natural Resources, Melbourne.
- CNR (1995c). *Review of the Code of Forest Practices for Timber Production*, Sources of Information and Literature Considered in the Review. Prepared by CSIRO Division of Forestry for the Department of Conservation and Natural Resources, Melbourne.
- CNR (1995d). *Code of Practice for Fire Management on Public Land*, Department of Conservation and Natural Resources, Melbourne.
- CNR (1995e). *Review of Sustainable Sawlog Yield. Midlands Forest Management Area*. Forests Service Technical Report 95-5. Department of Conservation and Natural Resources, Melbourne.
- CNR (1995f). *Threatened Fauna of Victoria*. Department of Conservation and Natural Resources, Victoria.
- COAG (1994). *Water Resources Policy - Communique and Report of the Working Group on Water Resource Policy*. Council of Australian Governments, Commonwealth of Australia.
- Colfer, C.P. (1995) Who counts most in sustainable forest management?, Working Paper No.7, *Centre for International Forestry Research*, Indonesia.
- Commonwealth of Australia (1992a). *Intergovernmental Agreement on the Environment*. Australian Government Publishing Service, Canberra.
- Commonwealth of Australia (1992b). *National Forest Policy Statement: A New focus for Australia's forests*. Advance Press, Perth.
- Commonwealth of Australia (1995). *Wood and Paper Industry Strategy*, AGPS, Canberra.
- Commonwealth of Australia (1998). *Reform of Commonwealth Environment Legislation Consultation Paper issued by Senator the Hon. Robert Hill Commonwealth Minister for the Environment*. AGPS, Canberra.
- Context Pty Ltd (1997). Identification and Assessment of Community Heritage Values in the North East Forest Region, Victoria: Workshop Overview Report.
- Context Pty Ltd (1997). Identification and Assessment of Community Heritage Values in the North East Forest Region, Victoria: Social Value Assessment Report.
- Context Pty Ltd (1997). Identification and Assessment of Community Heritage Values in the North East Forest Region, Victoria: Inventory of Community Heritage Places.
- Cornish, P.M. (1993). *The effects of logging and forest regeneration on water yields in a moist eucalypt forest in New South Wales, Australia*. Journal of Hydrology 150: 301-322.
- Cox, A., Beil, S. and Waring, T. (1994). *Exploration, mining and resource access policy, an economic perspective on environmental and native title issues*. Paper presented at the 6th Minerals and Energy Forum, Beijing, 16 March.
- Cunningham, T.M. (1960). *The natural regeneration of Eucalyptus regnans*. Bulletin 1, School of Forestry, University of Melbourne.
- D'Amore, L.J. (1978). 'An overview of SIA' In F.S. Tester and W. Mykes (Eds.). *In Social Impact Assessment: Theory, Method and Practice* (pp. 366-373). Calgary, Canada: Detselig.
- Dargavel, J., Hamilton, C. and O'Shaughnessy, P. (1995). *Logging and Water*. The Australia Institute Discussion Paper 5, Canberra.
- DCE (1991). *Strathbogie and Toombullup State forests. Mixed Species Timber Assessment*. D Dore 1991. Department of Conservation and Environment.
- DCFL (1987). *Alpine Area. Planning Proposals: a basis for management*. Department of Conservation, Forests and Lands. June 1987.

- Department of Finance (1991). *Handbook of Cost-Benefit Analysis.*, Australian Government Printing Service, Canberra.
- Department of Infrastructure (1997). *Regional Victoria and Future*, Melbourne.
- Dewitt, E., Redden, J. A., Wilson, A. B., and Buscher, D. (1986). *Mineral resource potential and geology of the Black Hills National Forest, South Dakota and Wyoming*. United States Geological Survey Bulletin 1580.
- Dore, D. (1994). 'Silvics and Silviculture of the Mixed Species Eucalypt Forests of North Eastern Victoria - a review'. North Eastern Mixed Species Silviculture Project. Report No. 1 Forests Service, CNR. (unpublished.)
- Dore, D. (1995). 'A survey of the regeneration of some mixed species coupes in North Eastern Victoria.' North Eastern Mixed Species Silviculture Project. Report No. 2. Forests Service, Department of Conservation and Natural Resources. (unpublished.)
- DWR (1989). *Water Victoria Resource Handbook*. Department of Water Resources, Victoria.
- EGCALP (1997). *East Gippsland Regional Catchment Strategy*. East Gippsland Catchment and Land Protection Board, Victoria.
- ESDWG (1991). *Ecologically Sustainable Development working Groups, Final Report - Forest Use*, November 1991. AGPS, Canberra.
- Evans, P. (1997). A Study of Historic Sawmill and Tramway Sites in the North East Forest Region, Victoria.
- Fagg, P.C. and Flinn, D. (1997). 'Research and Development Action Groups - what are they and what do they do?' *Forest News* No. 12: 22 - 23, NRE.
- FCV (1982a). *Forest Inventory Report No. 26. Review of Alpine Ash Resources, Mt Selwyn, Mt Murray, Tea Tree Range – Bright Forest District*. N Crabtree, 1982. Forests Commission of Victoria.
- FCV (1982b). *Forest Inventory Report No. 29. Inventory of Alpine Ash Regrowth Resources – Bright and Myrtleford Forest Districts*. R Penny, 1982. Forests Commission of Victoria.
- FCV (1982c). *Forest Inventory Report No. 30. Inventory of Alpine Ash Regrowth Resources – Mansfield Forest District*. R Penny, 1982. Forests Commission of Victoria.
- FCV (1982d). *Forest Inventory Report No. 33. Inventory of Alpine Ash Regrowth Resources – Tallangatta Forest District*. R Penny, 1982. Forests Commission of Victoria.
- Ferguson, I.S. (1995). *Timber production and streamflow benefits: a contrary analysis of options*. Australian Forestry, Vol 58, no. 3, pp. 142-146.
- Ferguson, I.S., LaFontaine B., Vinden, P., Bren, L., Hateley, R., Hermesec, B. (1996). *Environmental Properties of Timber*. P.4., Forest and Wood Products Research and development Corporation.
- Florence (1996). *Ecology and silviculture of eucalypt forests*. CSIRO Publishing, Collingwood, Victoria.
- Fraser, A., 1998. New base metal and gold play - Mount Wellington. In Competitive Victoria Conference Papers, Melbourne.
- GBCALP (1997). *The Goulburn-Broken Catchment and Land Protection Board : Catchment Strategy*. Goulburn-Broken Catchment and Land Protection Board, Victoria.
- Gibbs, D. and Muirhead, I. (1997). *The economic value and environmental impact of the Australian beekeeping industry: a report prepared for the national industry*. Federal Council of Australian Apiarists' Associations. October 1997.
- Graeme Butler & Associates (1997). A Study of Places Relating to Selected Historic Forest Themes in the North East Forest Region Victoria.

- Grayson, R.B.; Haydon, S.R.; Jayasuriya, M.D.A. and Finlayson, B.L. (1993). *Water quality in mountain ash forests - separating the impacts of roads from those of logging operations*. Journal of Hydrology 150: 459-480.
- Grose R.J. (1957). *A study of some factors associated with the natural regeneration of Alpine Ash, Eucalyptus delegatensis R.T. Baker syn. E. gigantea. F.* Forests Commission Victoria, Bulletin 4.
- Grose, R (1963). *The Silviculture of Eucalyptus delegatensis. Part I. Germination and seed dormancy*. Bulletin No 2. School of Forestry, University of Melbourne. Bulletin No 2.
- GWQWG (1996). *Draft Goulburn Broken Catchment Water Quality Strategy*. A component of the Goulburn Broken Regional Catchment Strategy. Goulburn Water Quality Working Group.
- Haine, I., (1998). 'Outlook for base metals', in *Outlook 98*, Proceedings of the National Agricultural and Resources Outlook Conference, Canberra, 3–5 February, vol. 3, *Minerals and Energy*, ABARE, Canberra, pp. 317–32.
- Harty and Bartlett (1996). *Recreation Surveys in Victoria's State Forests: North East Area*. DNRE.
- Haydon, S.R., Jayasuriya, M.D.A. and O'Shaughnessy, P.S. (1991). *The Effect of an Experiment*. Melbourne Water (Report No. MMBW-W-0018).
- Heislars, D. (1993). *Groundwater in the Central Victorian Highlands*, Victorian Water Division.
- Hughes, F.E. (1990). *Geology of the Mineral Deposits of Australia and Papua New Guinea*, Vol. 1-2, Australasian Institute of Mining and Metallurgy, Melbourne.
- Industry Commission (1991). 'Mining and Minerals Processing in Australia' vol 3, Issues in Detail, Report No. 7, AGPS, Canberra.
- IUCN (1994). *IUCN Red List Categories*. IUCN Species Survival Commission, Kew.
- Jaakko Pöyry (1993). *Cost Competitiveness of Australia's Wood Product Industries*, Report for the Industry Commission's Inquiry into Adding Value to Australia's Forest Product Industries, Melbourne.
- Jacobs, M.R. (1955). *Growth Habits of the Eucalypts*. Forestry and Timber Bureau.
- JANIS (1997). *Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative Reserve System for Forests in Australia*. Joint ANZECC/MCFFA National Forest Policy Statement Implementation Sub-committee, Canberra.
- Jeremiah, L. and Roob, R. (1992). *Statement of Resources, Uses and Values for the Central Forest Management Area*. Department of Conservation and Environment, Victoria.
- Johnson, S. (1997). 'The outlook for tropical forest products trade in the Pacific Rim', in *Outlook 97*, Proceedings of the National Agricultural and Resources Outlook Conference, Canberra, 4–6 February, vol. 1, *Commodity Markets and Resource Management*, ABARE, Canberra, pp. 182–90.
- Keith, D.A. and Burgman, M.A. (in prep). *An evaluation and modification of IUCN Red List criteria for classification of extinction risk in vascular plants*.
- Kerruish, C.M. and Rawlins, W.H.M. (1991). *The Young eucalypt report : some management options for Australia's regrowth forests*. CSIRO, East Melbourne.
- Kevin Wareing and Associates (1998). *A review of value-adding development opportunities for the wood and wood products industry in the North East RFA region of Victoria*, Kevin Wareing and Associates, A consultancy report to ABARE, Victoria.
- King, R., and Weston, K.S. (1997). *Dimension stone in Victoria*, Victorian Geological Survey Report No.112.
- Kuczera, F. (1985). *Prediction of water yield reduction following a bushfire in ash-mixed species eucalypt forest*. Report No. MMBW-W-0014, Melbourne and Metropolitan Board of Works.

- Laing, A.C.M., O'Shea, P.J., and Tickell, S.J., (1977). Explanatory notes on the Wangaratta 1:250,000 geological map. Geological Survey of Victoria Report 1977/4.
- Langford, K.J.; Moran, R.J. and O'Shaughnessy, P.J. (1982). *The Coranderrk Experiment - the effects of roading and timber harvesting in a mature mountain ash forest on streamflow yield and quality*. First National Symposium on Forest Hydrology, Melbourne, 92-102.
- Lanigan, V. (1998). *Upper North East Water Quality Status Report*. Department of Natural Resources and Environment, Victoria.
- Lau, J.A., Vandenberg, W. G., Willig, R.U., Chikumbo, O. and Siora, A. (1996). *Visual and Spatial Approach to Large-Scale Forest Modelling in Multiple-Use Forest Planning - Australian (Victorian) Experience*. (p 261) European Forest Institute Proceedings of the International Seminar and Summer School: Large-Scale Forestry Scenario Models: Experiences and Requirements. Joensuu, Finland.
- Lawrence, R. (1990). The interaction between the environment, land use and hydrology of the Bogong High Plains area from 1850 to 1985. Ph.D. Thesis, University of Melbourne. In O'Shaughnessy and Bren (1998). *A Report on Hydrology and Catchment Issues for the Victorian North East Regional Forest Agreement*.
- LCC (1973). *Final recommendations North Eastern Study Area District 1* Land Conservation Council, Victoria.
- LCC (1974). *Final recommendations North Eastern Study Area District 2* Land Conservation Council, Victoria.
- LCC (1977a). *Final recommendations North Eastern Study Area Districts 3,4 & 5*. Land Conservation Council, Victoria.
- LCC (1977b). *Report on the Alpine Study Area*. Land Conservation Council, Victoria.
- LCC (1979). *Final Recommendations Alpine Area*. Land Conservation Council, Victoria.
- LCC (1981). *Final recommendations Special Investigation North -Eastern Victoria Ovens Softwood Plantation Zone*. Land Conservation Council, Victoria.
- LCC (1982). *Report on the Alpine Study Area*. Land Conservation Council, Victoria. (Abridged reprint)
- LCC (1983). *Final recommendations Alpine Area Special Investigation*. Land Conservation Council, Victoria.
- LCC (1984). *Report on North-Eastern Area (Benalla - Upper Murray) Review*. Land Conservation Council, Victoria.
- LCC (1986). *Final recommendations North East (Benalla - Upper Murray) Review*. Land Conservation Council, Victoria.
- LCC (1988). *Statewide Assessment of Public Land Use*. Land Conservation Council, Victoria.
- LCC (1991a). *Final Recommendations special investigation - River and Streams*. Land Conservation Council, Victoria.
- LCC (1991b). *Final Recommendations. Wilderness Special Investigation*. Land Conservation Council, Victoria.
- LCC (1991c). *Melbourne Area District 2 Review - Descriptive Report*. Land Conservation Council, Victoria.
- Maher, S., Vandenberg, A.H.V., McDonald, P.A., and Sapurmas, P., (1997). The geology and prospectivity of the Wangaratta 1:250,000 sheet area. VIMP Report 46.
- Margules Groome Pöyry (1997). *Tasmanian Forest Industry Growth Potential to 2010 and 2020: Main Findings*, Consultancy Report prepared for ABARE, Canberra, March.

- Marsh, S.P., Kropschot, S.J., and Dickinson, R.G., (1984). Wilderness mineral potential. Professional Paper United States Geological Survey 1300.
- Marshall, B. and Jones, R. (1997). Victorian Cultural Heritage Data Audit and Analysis for the RFA Regions: the North East.
- Mathrick, J., (1998). Feldspar mine at Beechworth. Competitive Victoria Conference 18-19 March 1998, Melbourne, Victoria.
- MCFFA, SCF, PA, AFGA and NAFI (1997). *Plantations for Australia: The 2020 Vision* Plantation 2020 Vision Implementation Committee 1997 Canberra.
- McHaffie, I.W., and Buckley, R.W., (1995). *Industrial minerals and rocks of Victoria*, Geological Survey of Victoria Report 102, pp 209.
- Moran, R., (1988). *The effects of timber harvesting operations on streamflows in the Otway Ranges*. Water Resource Management Report Series, Report No. 47, Department of Water Resources, Victoria.
- Murphy, S. and Fagg, P.C. (1996). *Regeneration and reforestation stocking in native State forest (1989/90 - 92/93)*. Forests Service Technical Report 96-1, Department of Natural Resources and Environment, Victoria.
- Murray, R., Cox, A. and Allen, C. (1995). *Mining and the environment: issues in resource access*. Paper presented to the Northern Australian Regional Outlook Conference, Darwin, 12 October.
- MWEC (1997). Sharing the Murray. Proposal for defining people's entitlements to Victoria's water from the Murray. Murray Water Entitlement Committee, October 1997.
- Nandakumar, N. and Mein, R.G. (1993). *Analysis of paired catchment data to determine the hydrologic effects of change in vegetative cover on yield*. Final Technical Report for Land and Water Resources Research and Development Corporation and Department of Conservation and Natural Resources (Vic). Department of Civil Engineering, Monash University.
- National Institute of Economic and Industry Research (1985). *A Socio-Economic Study of East Gippsland*, Report prepared for the Land Conservation Council.
- NECALP (1996). *Draft North East Regional Catchment Strategy*. North East Catchment and Land Protection Board. September 1996.
- NECALP (1997). *North East Regional Catchment Strategy*. North East Catchment and Land Protection Board. June 1997
- Neck, M., Curtotti, R. and Sar, L. (1996) 'Outlook for forest products in Australia', in *Outlook 96*, Proceedings of the National Agricultural and Resources Outlook Conference, Canberra, 6-8 February, vol. 1, *Commodity Markets and Resource Management*, ABARE, Canberra, pp. 159-67.
- NRE (1996a). *Code of Forest Practices for Timber Production (Rev. No. 2)*. Department of Natural Resources and Environment, Victoria.
- NRE (1996b). *The "FFORNE" Project, Information Kit* Department of Natural Resources and Environment, Victoria.
- NRE (1996c). *State Water Quality Monitoring Annual Report: Victoria 1996*. - Volume II (Appendices). Report prepared for NRE by WATER ECOscience.
- NRE (1996d). *Study of Old-growth Forest in Victoria's Central Highlands*. Forests Service Technical Reports 96-3, Department of Natural Resources and Environment, Victoria.
- NRE (1996e). *Review of Sustainable Sawlog Yield. East Gippsland Forest Management Area*. Forests Service Technical Reports 96-3. Department of Natural Resources and Environment, Victoria.
- NRE (1997a). *Management prescriptions for harvesting and regeneration in native forests - Benalla/Mansfield & North East Forest Management Areas*. Department of Natural Resources and Environment, Victoria.

- NRE (1997b). *Guideline on Thinning of Mixed Species Regrowth*. Department of Natural Resources and Environment, Victoria.
- NRE (1997c). *Audit of Compliance with the Code of Forest Practices for Timber Production (and Associated Prescriptions) in State Forests of Victoria 1996-97*. Department of Natural Resources and Environment, Victoria.
- NRE (1997d). *SFRI Victoria's Statewide Forest Resource Inventory : Program Review*. Forests Service Technical Report 97-1. Department of Natural Resources and Environment, Victoria.
- NRE (1997e). Forests Service Technical Reports 97-2. *Review of sustainable yield rates from hardwood sawlogs from State forest, 1997*. Department of Natural Resources and the Environment.
- NRE (1997g). *Private Forestry - Investing in Victoria Australia*. Department of Natural Resources and Environment, Victoria.
- NRE (1997h). *Heritage Rivers and Natural Catchment Areas. Draft Management Plans Vol 2 - North-East Victoria*. Department of Natural Resources and Environment, Victoria.
- NRE (1997i). *Know your catchments*. Victoria. Department of Natural Resources and Environment, Victoria.
- NRE (1997j). *Guidelines for the management of cultural heritage values in the forests, parks and reserves of East Gippsland*. Department of Natural Resources and Environment, Victoria.
- NRE (1997k). *East Gippsland Forest Management Plan Amendment*. Department of Natural Resources and Environment, East Melbourne.
- NRE (1997l). *Victoria's Biodiversity Strategy*, Department of Natural Resources and Environment, Victoria.
- NRE (1998). *Study of Old-growth Forest in Victoria's North East*. Forests Service Technical Reports 98-1, Department of Natural Resources and Environment, Victoria.
- NRE (1998a) (unpublished). *Flora Information System*. Victorian Department of Conservation and Natural Resources: Melbourne.
- NRE (1998b). *Victorian Rare or Threatened Plant Database*. Microsoft Access database maintained by the Flora Branch, Department of Natural Resources and Environment: Melbourne.
- NRHP (1993). *The National Health Program Leaflet*. Land and Water Resources Research and Development Corporation.
- O'Shaughnessy P.J. (1995a). *Survey into user perceptions of Codes of Forest Practices*. Cooperative Research Centre for Catchment Hydrology. (Report 95/2).
- O'Shaughnessy P.J. and Associates (1995b). *Water Quality Protection Measures for the Conservation of the Spotted Tree Frog*.
- O'Shaughnessy, P. and Bren, L.J. (1998). *A Report on Hydrology and Catchment Issues for the Victorian North East Regional Forest Agreement*. Unpublished consultancy to the Commonwealth and Victorian Regional Forest Agreement Steering Committee, Canberra.
- O'Shaughnessy, P.J. and Jayasuriya, D. (1987). *Managing the ash-type forests for water production in Victoria*. Proceeding of the Institute of Foresters of Australia 1987 Biennial Conference, Perth.
- O'Shaughnessy, P.J. and Jayasuriya, M.D.A. (1991). *Water supply catchment hydrology research, status report 1991*. Melbourne Water, Victoria.
- O'Shaughnessy, P.J., Benyon, R. and Lucas A. (1993). *The Crotty Creek report: the effects of strip thinning Eucalyptus regnans on forest growth and water yield*. MMBW-W-0020/Forest Service Research Report No 358. Melbourne Water/Department of Conservation and Natural Resources, Victoria.

- O'Shaughnessy, P.J.; Fletcher, T. and Bren, L. (1995). *A report on the effects of forest harvesting on water yield and quality in the Lerderderg Catchment*. Department of Conservation and Natural Resources, Research Report, Victoria.
- O'Shea, P.J., Whitehead, M., Buckley, R., and Lanzer, L.A. (1992). Primary Gold Mineralisation Potential in the Melbourne Zone of the Lachlan Fold Belt, Central Victoria. Energy and Minerals Victoria, Unpublished report 1992/31.
- Office for the Commissioner of the Environment (1988). *Victoria's Inland Waters*. State of the Environment Report 1988.
- ONT (1998a). *Forecast*. Office of National Tourism.
- ONT (1998b). *Ecotourism Snapshot - a focus on recent market research*. Office of National Tourism.
- Oppy, I.D., Cayley, R.A., and Caluzzi, J., (1995). The Geology and Prospectivity of the Tallangatta 1:250 000 sheet. *Victorian Initiative for Minerals and Petroleum Report 10*. Department of Agriculture, Energy & Minerals.
- Pannell Kerr Forster (1997) *A Tourism Development Plan for Legends Wine and High Country*. Regional Tourism Development Plan (with Dain Simpson Associates). Tourism Victoria, Victoria.
- PFC-VIC (1997). *Private Forestry in Victoria: Strategy towards 2020* Private Forestry Council - Victoria, Victoria.
- PMSEC (1996). Prime Minister's Science and Engineering Council. *Managing Australia's Inland Waters*. Department of Industry, Science and Tourism, Canberra.
- Ramsay, W.R.H., (1995). Gold Prospectivity in Victoria – structural controls and mineralising environments. *In Gold in Central Victoria – 125<sup>th</sup> Anniversary Symposium*, University of Ballarat. Geology Department, University of Ballarat, p31-35.
- Ramsay, W.R.H., and Wilman, C.E. (1988). *Gold in Douglas*, J. G., & Ferguson, J. A., eds., *Geology of Victoria*, Geological Society of Australia: Melbourne, pp. 454- 482.
- Read Sturgess and Associates (1994a). *Phase Two of the Study into Economic Evaluation of Wood and Water for the Thomson Catchment*. Prepared for Melbourne Water and DCNR, Victoria.
- Read Sturgess and Associates (1994b). *The economic significance of the Grampians National Park*. Melbourne.
- Read Sturgess and Associates (1995). *Recreational Use of Victoria's state forest*. Unpublished Report prepared for the Department of Conservation and Natural Resources, Victoria.
- Register of Australian Mining 1991/92 - 97/98. Resource Information Unit, Subiaco, Western Australia.
- RIRDC (1996). *Commercial Farm Forestry in Australia Development of a Strategy Framework A Resource Book* Rural Industries Research & Development Corporation, Canberra.
- Robin Crocker & Associates (1997). Identification and Assessment of Aesthetic value in the North East Forest Region Victoria.
- Ryan, M.F. (1997). *Silviculture Guideline for the Mixed Species Forests of the North East Area. North Eastern Mixed Species Silviculture Project*. Report No. 6 Forests Service, NRE. (unpublished.)
- Sinclair, E. (1991). *The Nagambie Gold Mine: A Case Study of Regional Effects*, Department of Manufacturing and Industry Development, Melbourne.
- Spencer, R.D. and Jellinek, L.O. (1995) Public concerns about pine plantations in Victoria *Australian Forestry* 58(3):99-106.
- SPIS (1990). *State Plantations Impact Study: Report and Recommendations*. Published by State Plantations Impact Study Steering Committee, East Melbourne.

- Standards Australia (1995). *Interim Australian/New Zealand Standard Environmental management systems - General guidelines on principles, systems and supporting techniques*. AS/NZS 14004 (Int):1995. Published jointly by Standards Australia and Standards New Zealand.
- Tan, S.H., & Atkinson, P.L., (1988). Feldspar, in Douglas, J. G., & Ferguson, J. A., eds., *Geology of Victoria*, Geological Society of Australia: Melbourne, pp. 567-568.
- Tasmanian Public Land Use Commission, (1997). *Tasmania-Commonwealth Regional Forest Agreement, National Estate Report*. Background Report Part H.
- Taylor, R.B., and Steven, T.A., (1983). Definition of mineral resource potential: *Economic Geology*, v.ol. 78, pp. 1268–1270.
- TFC (1997). Short, Sharp Shock or Lower Growth Outlook? The Potential Impact of Emerging Economic Difficulties in Asia on Inbound Tourism to Australia. Tourism Forecasting Council. December 1997.
- TIRES (1996). *Timber industry road evaluation study: A strategic plan for roads servicing the timber industry of North East Victoria* TIRES Steering Committee, pp. 21.
- Tonkin M. (1986). *Ryans Creek Land Use Determination*. Soil Conservation Authority. (Check title of reference)
- Tourism Victoria (1996a). *Victorian Regional Travel and Tourism Survey. Main Overnight Report*. Tourism Victoria, June 1996.
- Tourism Victoria (1996b). *Victorian Regional Travel and Tourism Survey. Day Trip Report*. Tourism Victoria, June 1996.
- Trapnell, L.N. and Lavery, P.B. (1989). *The Economics of Diversifying from Grazing to Pines - An Analysis for Farms in North Eastern Victoria*. Department of Agriculture and Rural Affairs and Department of Conservation, Forests and Lands, Victoria.
- Turner, B.J. and Church, R. (1995). *Review of the use of the FORPLAN (FOREst PLANning) Model*. Department of Conservation and Natural Resources, Melbourne.
- VicRFASC (1996a). *Comprehensive Regional Assessment East Gippsland: Environment and Heritage Report*. Commonwealth and Victorian Regional Forest Agreement Steering Committee, Canberra.
- VicRFASC (1996b). *Comprehensive Regional Assessment East Gippsland: Independent advisory Group Report on Ecologically Sustainable Forest Management : Systems and Processes*. Commonwealth and Victorian Regional Forest Agreement Steering Committee, Canberra.
- VicRFASC (1996c). *Comprehensive Regional Assessment East Gippsland: Resource and Economics Report*. Commonwealth and Victorian Regional Forest Agreement Steering Committee, Canberra.
- VicRFASC (1996d). *Comprehensive Regional Assessment East Gippsland: Wilderness Assessment of the Eastern Victorian Forests*. Commonwealth and Victorian Regional Forest Agreement Steering Committee, Canberra.
- VicRFASC (1997a). *Victorian Statewide Assessment of Ecologically Sustainable Forest Management*. Commonwealth and Victorian Regional Forest Agreement Steering Committee, Canberra.
- VicRFASC (1997b). *Comprehensive Regional Assessment Report Central Highlands*. Commonwealth and Victorian Regional Forest Agreement Steering Committee.
- VicRFASC (1997c). *Directions Report Central Highlands*. Commonwealth and Victorian Regional Forest Agreement Steering Committee.
- VicRFASC (1998a). *Comprehensive Regional Assessment North East: Mineral Assessment*. Commonwealth and Victorian Regional Forest Agreement Steering Committee.



- VicRFASC (1998b). *Comprehensive Regional Assessment North East: Biodiversity Assessment*. Commonwealth and Victorian Regional Forest Agreement Steering Committee.
- VicRFASC (1998c). *Comprehensive Regional Assessment North East: Social Assessment*. Commonwealth and Victorian Regional Forest Agreement Steering Committee.
- VicRFASC (1998d). *Compendium of Forest Research in Victoria*. Commonwealth and Victorian Regional Forest Agreement Steering Committee.
- Victoria Auditor-General Office (1993). *Timber Industry Strategy Special Report No 22*.
- Victoria Government (1986). *Victoria Timber Industry Strategy*, Government Printer, Melbourne.
- VPC (1996). *Annual Report 1996*. Victorian Plantations Corporation, Victoria.
- VPC (1997). *Annual Report 1997*. Victorian Plantations Corporation, Victoria.
- Wareing, K. and Baker, R. (1998) *Opportunities for plantation expansion in the Victorian North East CRA/RFA Region*. Consultants report to the Bureau of Resource Sciences, pp. 39.
- Washusen, R & Reid, R. (1996). *Agroforestry and Farm Forestry - Productive trees for shelter and land protection in North East Victoria*. Benalla Landcare Farm Forestry Group, Benalla.
- Webb, A.W. (1966). *The effect of thinning on the growth of Mountain Ash in Victoria*. M.Sc Forestry Thesis, University of Melbourne.
- Woodgate, P., Peel, W., Ritman, K., Coram, J., Brady, A., Rule, A. and Banks, J. (1994). *A Study of the Old-Growth Forests of East Gippsland*. Department of Conservation and Natural Resources, Victoria.
- Young, M.D. (1993). *For our children's children, some practical implications of inter-generational equity and the precautionary principal*. Published by the Resource Assessment Commission, Occasional Publication No. 6, November 1993, A.G.P.S., Canberra.



## APPENDIX 1. KEY LEGISLATION

The following list describes major legislation relevant to the Regional Forest Agreement. It is not intended to be an exhaustive list. A full list of legislation and international conventions relating to the RFA process is contained in the Victoria statewide assessment of ecologically sustainable forest management (VicRFASC 1997a).

### COMMONWEALTH LEGISLATION

#### *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*

This Act has a 1987 amendment which applies directly to Victoria. It stipulates that all places of significance to Aboriginal communities, including places covered by the Victorian Archaeological and Aboriginal Relics Preservation Act, are to be protected. Such places may only be damaged or destroyed with the express permission of the relevant local Aboriginal communities.

#### *Australian Heritage Commission Act 1975*

The Australian Heritage Commission has a statutory obligation under this Act to identify the National Estate. The Commonwealth has an obligation to take into account the effect of its actions on the National Estate.

#### *Endangered Species Protection Act 1992*

This Act provides a legislative basis for Commonwealth responsibilities with regard to the conservation of endangered and vulnerable species and endangered ecological communities, and the amelioration of the processes that threaten them.

#### *Environment Protection (Impact of Proposals) Act 1974*

All Governments in Australia have statutory requirements for environment impact assessments. This Act requires Commonwealth decision makers to refer to the Minister for the Environment decisions or actions likely to affect the environment to a significant extent.

#### *Export Control Act 1982*

Regulations under this Act provide the Commonwealth with a mechanism with which to impose environmental conditions on harvesting operations for the export of unprocessed wood and woodchips. In addition, it allows for the assessment of the potential for domestic processing.

#### *World Heritage Properties Conservation Act 1983*

This Act provides for the protection and conservation of those properties in Australia and its external territories that are of outstanding universal natural or cultural value. Such properties are those which:

- are inscribed in the World Heritage List; or
- are nominated for inscription on the World Heritage List; or
- are subject to an inquiry established by a law of the Commonwealth whose purpose is to consider whether the property forms part of the natural or cultural heritage; or
- form part of the natural or cultural heritage, and are declared so by regulation.

The Act authorises the Commonwealth to prevent the damage or destruction of a property through the prohibition by regulation of prescribed activities. It does not enable the Commonwealth Government to assume responsibility for the management of a property.

## VICTORIAN LEGISLATION

### ***Archaeological and Aboriginal Relics Preservation Act 1972***

This Act requires that all Aboriginal, archaeological and historic sites are protected. It is administered by Aboriginal Affairs Victoria, which maintains a register of known sites within Victoria.

### ***Catchment and Land Protection Act 1994***

This Act establishes an administrative framework for advising Government on the integrated management and protection of catchments on all land tenures across the State. It establishes processes to encourage and support community participation in the management of land and water resources through the establishment of a State-wide Catchment and Land Protection Board, ten regional Catchment and Land Protection Boards, and a Pest Animal Advisory Committee. The Act consolidates functions relating to the identification, proclamation and management of water supply catchments previously performed under the Land Conservation Act and its predecessor, the *Soil Conservation and Land Utilisation Act 1958*.

### ***Conservation, Forests and Lands Act 1987***

This Act formally transferred the responsibilities of a number of former statutory bodies to the (then) new Department of Conservation, Forests and Lands resulting from machinery of Government changes. This single, integrated public land management agency (and its successors) is responsible for the management and protection of the State's public lands including State forests (both native and exotic), National Parks and reserves, wildlife (including commercial fisheries) and other public lands, in addition to private land catchment protection functions.

The Act provides legislative backing for Codes of Practice which govern activities on public and private lands, under which the Code of Forest Practices for Timber Production and Code of Practice for Fire Management on Public Land have been developed. It also provides for the establishment of 'conservation covenants' on private land titles in order to protect important environmental values.

### ***Country Fire Authority Act 1958***

This Act consolidates the law relating to the Country Fire Authority and confers on the Authority a responsibility to prevent and suppress fire on all land (urban and rural), other than unoccupied Crown Land, outside the Melbourne Metropolitan Fire District.

### ***Crown Land (Reserves) Act 1978***

This Act provides for the reservation of Crown land for a variety of public purposes including flora and fauna conservation.

### ***Environment Conservation Council Act 1997***

The *Environment Conservation Council Act 1997* came into operation on 1 July 1997. This Act established the new Environment Conservation Council (ECC) and replaced the *Land Conservation Act 1970* and the Land Conservation Council (LCC).

The role of the ECC is to advise the Government on public land use planning and the balanced use or development of public land or any flora, fauna or minerals on, above or under that land or water flowing over that land. The new Council has a wider role than the former LCC, being able to advise on all natural resource matters, taking into account relevant issues that may impact on use of resources.

Previous recommendations made by the Land Conservation Council, most of which were approved by government, continue to have effect under the new Act.

***Environment Effects Act 1978***

This Act provides for the assessment of potential environmental impacts of proposed developments on land of all tenures. Major instruments and control mechanisms are Environment Effects Statements and ministerial Assessment Reports.

***Environment Protection Act 1970***

This Act establishes the Environment Protection Authority as an independent statutory body and provides it with powers, duties and functions on lands of all tenures concerning the protection of receiving environments (air, land and water), control of noise and pollution.

***Extractive Industries Development Act 1995***

The aim of this Act is to facilitate and streamline the planning and approvals processes on public and private lands for the removal of extractive materials (eg stone). Specifically, the purpose of the Act includes providing for a co-ordinated assessment and approvals process for extractive industries, and ensuring that operations are carried out with safe operating standards and in a manner that ensures the rehabilitation of quarried land to a safe and stable landform.

***Fisheries Act 1995***

The *Fisheries Act 1995* was fully proclaimed on 1 April 1998 and repeals the 1968 Act. This Act covers the Commonwealth/State management of fisheries, fishery management plans, regulation of commercial and recreational fishing, aquaculture, protected aquatic biota, noxious aquatic species, fisheries reserves, fisheries co-management, enforcement and legal proceedings. Under this Act, a licence is required to fish in inland waters including within forested catchments; and all public authorities must have regard to fishery management plans.

***Flora and Fauna Guarantee Act 1988***

This Act provides a legislative basis for the conservation of Victoria's flora and fauna on all land tenures. Major instruments include the listing of threatened species and communities and threatening processes, the development of Action Statements, controls over the taking, trading and keeping of native species, and the use of Interim Conservation Orders for the urgent protection of areas facing immediate threats.

***Forests Act 1958***

This Act provides for the management of State forests, protection of these and other public and private lands from fire, development of working plans and the licensed sale of forest produce. Through its licensing provisions and regulations, the Act also provides for control of the use of State forest. Under its powers for the making of regulations, the Timber Harvesting Regulations and associated forest operator accreditation and licensing have been implemented. These regulations provide the legislative basis on which provisions in the Code of Forest Practices for Timber Production (NRE 1996a) are implemented. The Forests Act requires that proper and sufficient work be carried out for prevention and suppression of fire in State forest, national parks and protected public land.

***Forests (Wood Pulp Agreement) Act 1996***

This Act guarantees AMCOR Plantations Pty. Ltd. with a supply of pulpwood for its pulp and paper mill at Maryvale until 2030. Logs are drawn from State forest in a supply zone that falls within Central Gippsland, Dandenong and Central Forest Management Areas. The annual supply level is well within the forecast yields of residual logs resulting from sustainable sawlog harvesting in these areas.

### ***Heritage Act 1995***

This Act aims to provide for the protection and conservation of places and objects of cultural heritage significance and the registration of such places and objects. The Act establishes a Heritage Council and Victorian Heritage Register. The main function of the Heritage Council is to advise the Minister for Planning and Local Government on the state of Victoria's cultural heritage resources and to determine which heritage places and objects are added to the Victorian Heritage Register. Only items of special significance to the history and development of Victoria are added to the Register.

The Act also establishes the Heritage Inventory which is a listing of all known historical archaeological sites in Victoria regardless of their level of significance.

### ***Heritage Rivers Act 1992***

This Act establishes a number of Heritage Rivers and Natural Catchment Areas on public land, where significant nature conservation, recreation, scenic or cultural heritage values have been identified. The Act specifies activities which are not permitted in these areas and requires that a management plan be prepared for each area.

### ***Land Act 1958***

This Act governs the alienation and use of unreserved Crown land, other than State forest, including the issuing of licences and leases for occupational use.

### ***Land Conservation (Vehicle Control) Act 1972***

The Act controls the movement of private motor vehicles on public lands, to prevent soil erosion and other environmental damage.

### ***Land Titles Validation Act 1994***

The purpose of this Act is to validate, in accordance with the *Native Title Act 1993* of the Commonwealth, past acts that are invalidated because of the existence of native title. It also provides for compensation rights for the holders of native title which have been affected by past acts attributable to the State and to confirm certain existing rights.

### ***Mineral Resources Development Act 1990***

This Act aims to encourage an economically viable Victorian mining industry which makes the best use of mineral resources in a way compatible with the State's economic, social and environmental objectives. It provides for the granting of licences to explore and extract minerals. Three categories of public land have varying levels of exemption from mining activity.

### ***Planning and Environment Act 1987***

This Act establishes a framework for integrating policies and environmental considerations into planning decisions affecting private lands across the State. It establishes a system of planning schemes with local, regional and State sections into which appropriate controls for the use, development and protection of land can be incorporated through instruments such as planning permits and landowner agreements.

The objectives of the Act include provision for the protection of natural resources and the maintenance of ecological processes and genetic diversity, and to conserve places of scientific, aesthetic or special conservation value. It requires 'responsible authorities' to administer and enforce planning schemes, under which applications for planning permits may be referred to other relevant authorities to stipulate permit conditions or the grounds for permit refusal.

***National Parks Act 1975***

This Act provides for the declaration and protection of national, wilderness, State and other parks. Its objectives are to protect the natural and cultural values of the State's system of parks, and to provide the community with opportunities for enjoyment, recreation, education and research. It also provides administrative procedures for the licensing and control of activities in parks, the preparation of management plans and creates the statutory office of Director of National Parks.

***Reference Areas Act 1978***

This Act provides for the setting aside and management of 'Reference Areas' on public land. These are areas of special ecological and scientific interest or significance, which could serve as a baseline for comparative assessment of impacts of land uses elsewhere. Their use is largely confined to scientific study. A Reference Areas Advisory Committee advises the Minister on how the areas should be protected, controlled and managed. The aim is to ensure that ecological processes within them continue unhindered.

***Victorian Conservation Trust Act 1972***

This Act establishes the Trust for Nature (Victoria) to encourage and assist the preservation of areas of private land which are of significant conservation value, and to assist in flora and fauna conservation. It provides for the establishment of 'conservation covenants' on private land titles in order to protect important environmental values.

***Victorian Plantations Corporation Act 1993***

This Act confers operational and administrative powers on the Victorian Plantation Corporation, a statutory corporation established under the *State Owned Enterprises Act 1992*. The Corporation is responsible for the management and protection of State-owned plantation timber resources, both hardwood and softwood.

***Water Act 1989***

This Act (and amendments) establishes rights and obligations in relation to water resources, provides mechanisms for the allocation of water resources (including to the environment), governs the statutory powers and functions of water authorities outside the metropolitan area and provides for integrated management of water resources for environmental and consumer protection.

***Wildlife Act 1975***

This Act provides for the establishment and management of State wildlife and nature reserves, licences, research and management, wildlife management co-operative areas, prohibited areas and sanctuaries, declaration of noxious wildlife, offences, enforcement and legal proceedings.





## APPENDIX 2. MEMBERSHIP OF COMMITTEES

### JOINT COMMONWEALTH-VICTORIA STEERING COMMITTEE

#### Victoria

Richard Rawson (co-chair)	Department of Natural Resources and Environment (NRE)
Kevin Love	Department of Premier and Cabinet
Ian Miles	NRE
Gerard O'Neill	NRE

#### Commonwealth

Grahame Cook (co-chair)	Department of Prime Minister and Cabinet (PM&C)
Tony Press	Environment Australia (EA)
Peter Yuile	Department of Primary Industries and Energy (DPIE)
Phillip Fitch	PM&C

### JOINT COMMONWEALTH-VICTORIA TECHNICAL COMMITTEE

#### Victoria

Ian Miles (co-chair)	NRE
Rod Anderson	NRE, Parks, Flora and Fauna
Chris Ashe	NRE, Parks, Flora and Fauna
Alison Boak	NRE, North East Region
Daniel Catrice	NRE, Parks, Flora and Fauna
David Clarke	Aboriginal Affairs Victoria
Sue Houlden	NRE
Andrew Maclean	NRE, Forests Service
David Parkes	NRE, Parks, Flora and Fauna
Phil Roberts	NRE, Minerals and Petroleum
Michael Sutton	NRE, Forest Service
Brian Thompson	NRE, North East Region

#### Commonwealth

Paul Marsh (co-chair)	EA, Environment Forests Taskforce
Michael Stephens (co-chair)	DPIE, Forests Division
Geoff Dyne	EA, Environment Forests Taskforce
Phillip Fitch	PM&C, Forests Taskforce
Michelle Gabriel	DPIE, Social Assessment Unit
Peter Gooday	DPIE, ABARE
Yannis Miezitis	DPIE, Bureau of Resource Sciences (BRS) Minerals
Juliet Ramsey	EA, Environment Forests Taskforce
Pam Robinson	DPIE, Community Coordinator
Felix Schlager	EA, Environment Forests Taskforce
Ray Spencer	DPIE, BRS Forestry
Phil Tickle	DPIE, BRS National Forest Inventory
Steve Watts	PM&C, Forests Taskforce



## APPENDIX 3. DEFINITION OF SAWLOG GRADES

In Victoria all hardwood sawlogs other than River Red Gum and box-ironbark species must be graded in accordance with hardwood sawlog grading instructions and interpretations. The Hardwood Sawlog Grading Card (Jeremiah and Roob 1992) defines sawlogs by grades (A to D) as described below, and allows for some variation between grades by relative changes between diameter, number of defective quarters and size of pipe defect.

### DEFINITION OF SAWLOG:

A sawlog is defined as any length of a log of merchantable species which:

- is at least 2.7 m in length
- has a small end diameter (measured under bark) of 25 cm or greater
- does not have sweep or crook which exceeds one-fifth of the diameter along a 2.4 m straight edge
- is of grade D standard or better

### DEFINITION OF SAWLOG GRADE:

#### A Grade

Any sawlog with a minimum small end diameter under bark of 50 cm which has no defective quarters and maximum defects on exposed ends of:

- one-quarter diameter lengths of all gum vein or gum pockets
- light stain

In addition:

- maximum angle of sloping grain of 1:10 along the length of the sawlog

#### B Grade

Any sawlog with a minimum small end diameter under bark of 35 cm which has maximum allowable defects on exposed ends of:

- one quarter diameter length of loose gum veins/pockets and shakes
- one diameter length of tight gum vein more than 3 mm in width
- two diameters length of tight gum vein less than 3 mm in width
- light stain

In addition:

- 1:10 angle of sloping grain along the sawlog axis
- a maximum of one defective quarter along the length of the sawlog
- a maximum of 105 cm squared of pipe in an exposed end.

#### C Grade

Any sawlog with a minimum small end diameter under bark of 30 cm which has maximum allowable defects on exposed ends of:

- one diameter length of loose gum veins/pockets and shakes
- seven diameters length of tight gum vein more than 3 mm width
- unlimited lengths of tight gum veins less than 3 mm width
- dark stain

In addition:

- maximum sloping grain angle of 1:8 along the length of the sawlog
- maximum of two defective quarters
- maximum of 112 cm square of pipe in an exposed end

## **D Grade**

Any sawlog with a minimum small end diameter under bark of 25 cm which has maximum allowable defects on exposed ends of:

- two diameters length of loose gum veins/pockets or shakes
- 10 diameters length of tight gum vein more than 3 mm width
- unlimited length of tight gum vein less than 3 mm width
- dark stain

In addition:

- maximum sloping grain angle of 1:8 along the length of the sawlog
- maximum of three defective quarters
- maximum of 120 cm square of pipe on exposed ends

(NRE 1996e)

## APPENDIX 4. ECOLOGICALLY SUSTAINABLE FOREST MANAGEMENT

The Commonwealth and Victoria have considered the ESFM assessment and the comments made by the Expert Advisory Group and Professor Ferguson as summarised in chapter 17 of this report. The discussion below outlines the response of the Commonwealth and Victoria to the ESFM assessment as reported in the Central Highlands Directions Report (VicRFASC 1997c). It is important to note when reading this response that some of the improvements suggested by the Expert Advisory Group have already been addressed through commitments made in the East Gippsland and Central Highlands RFAs, while others are not considered sufficiently significant to justify an adjustment to the systems and processes already in place. Each of the issues (or suggested improvements) in the Statewide ESFM report are briefly described below with a page reference, together with a response from the Commonwealth and Victoria. The issues are grouped according to the five environmental management system components described in the Statewide ESFM report.

In addition, since the release of the Central Highlands Directions Report the following actions, as reported in the following discussion as planned actions, have been completed:

- review of Commonwealth legislation dealing with the environment (Commonwealth of Australia 1998);
- Parks Victoria has been established under the *Parks Victoria Act 1998* to provide management services to the State for parks, reserves and other Crown land;
- the East Gippsland Forest Management Plan Amendment (NRE 1997k) has been completed in accordance with the East Gippsland RFA;
- regional prescriptions for timber production have been completed;
- Biodiversity Strategy, previously referred to as the Flora and Fauna Guarantee strategy, has been published (NRE 1997l);
- the internal audit of the compliance with the Code of Forest Practices for Timber Production for 1997 has been published (NRE 1997c); and
- Guidelines for the Management of Cultural Heritage Values in Forests, Parks and Reserves in East Gippsland (NRE 1997j) have been published and it is intended to prepare Statewide guidelines by 1999.

### Commitment and Policy Framework

*Issue:* Review of the Victorian Forests Act. (p40)

*Response:* As a result of commitments given in the National Competition Policy Agreement and through the Victorian Legislative Review Committee, a review of the *Forests Act 1958* is scheduled to be completed by 1999.

*Issue:* Review of Commonwealth Acts dealing with the environment. (p40)

*Response:* The Commonwealth will formally initiate a review of Commonwealth environmental law by publishing a discussion paper canvassing possible reforms by the end of 1997.

*Issue:* The need to address the duplication of processes associated with the Commonwealth Endangered Species Protection Act and the Victorian Flora and Fauna Guarantee Act. (p40)

*Response:* This issue has been addressed through commitments agreed in the East Gippsland RFA.

*Issue:* The need to address the duplication in application of Commonwealth and State heritage legislation. (p40)

*Response:* Avoidance of duplication is being addressed through State-Commonwealth initiatives to standardise criteria and assessment processes. The review of Commonwealth environmental legislation may also address this issue in part.

## **Planning**

*Issue:* Flexibility with respect to the boundaries of the CAR Reserve System is necessary to accommodate long-term changes. (p42)

*Response:* This issue is addressed in commitments made in the East Gippsland RFA and will be implemented according to the guidelines in the amendment to the East Gippsland Forest Management Plan. It is envisaged that similar provisions will also apply in future RFAs.

*Issue:* The need for more thorough treatment of socio-economic factors in forest management plans. (p47)

*Response:* This requirement would only be considered in the event that significant social and economic implications are likely to arise from a forest management plan. However, this is unlikely given the current RFA processes. Major changes to land use and consequently, potentially significant socio-economic implications have usually been addressed in Land Conservation Council investigations and these have been accompanied by detailed socio-economic studies.

*Issue:* The need for formal risk assessment at the commencement of planning processes and at periodic reviews to guide new research. (p47)

*Response:* A systematic identification and assessment of risk and threatening processes is already undertaken at the commencement of forest planning processes. Those risks that are of particular significance are given greatest attention. For example, the potential risk to a range of forest-dependent species such as large forest owls and the Long-footed Potoroo in East Gippsland was identified early in the planning process and resulted in the development of detailed strategies to ameliorate the potential risk. The process of risk assessment will be addressed at the time of reviews to identify changes in factors affecting risk management.

*Issue:* The contribution of all forest areas to regional conservation goals needs to be recognised. (p48)

*Response:* This concept is a fundamental component of the National Forest Reserve Criteria and will be taken into account in the development and design of the CAR Reserve System in each region.

*Issue:* The need for performance indicators to monitor forest management plan implementation. (p48)

*Response:* Management plans already include a set of specific actions against which implementation can be assessed. There is also a requirement for an annual report on the implementation of the plans and these will establish timelines for priority actions attached to the approved service agreement.

*Issue:* The need to include specific targets for soil and water quality in plans. (p48)

*Response:* There is already a commitment in the East Gippsland RFA to develop indicators of sustainability, including appropriate protection of soil and water values that are relevant to particular regions.

*Issue:* More detailed strategies are required to identify and protect cultural heritage values. (p48)

*Response:* This issue is being addressed through the development of cultural heritage guidelines and improved arrangements in relation to consultation with Aboriginal communities. It is envisaged that guidelines and provisions similar to those prepared for the East Gippsland Region will be prepared for the remainder of the State.

*Issue:* Better links between the range of forest management planning processes within and across regional boundaries and the requirement that significant changes in forest management or condition should provide a trigger to review plans. (p48)

*Response:* There are already considerable linkages between relevant planning processes which ensure that activities operating across tenures and regions are properly coordinated and planned and the need for major improvement is not considered necessary at this time. Major changes in the planning area, such as wildfire or major changes in land use, have resulted in major reviews in the past and will continue to do so.

*Issue:* More research is required to strengthen the scientific basis of the Code of Forest Practices, especially soil protection, and monitoring to confirm the effectiveness of prescriptions as a basis for their improvement. Further work is required to develop regional prescriptions that build on the Code to take account of local factors such as soil types and climatic conditions. (p48)

*Response:* Further research to underpin the Code of Forest Practices (NRE 1996a) is underway including a program to develop ecologically sustainable development indicators for soil and develop and evaluate long term soil monitoring programs. A field guide is being developed to assist staff in dealing with soil erosion hazard and soil permeability and potential for overland flow in accordance with the Code. Further information on research is contained in the Compendium of Forest Research (VicRFASC 1998d) (see review and improvement section below). Work is also progressing such that regional prescriptions for all Forest Management Areas will be completed by the end of 1997.

*Issue:* Greater explanation of the procedure for estimating sustainable yield is required, as well as the need to make information on the methodology and data used available at an earlier stage. Sustainable yield and sawlog supply levels should be routinely reported and be publicly available. (p49)

*Response:* Victoria will continue to publish the methodology, including reviews and improvements of methods, and data sources used in estimating sustainable yield at the time of each review and to make this publicly available as soon as possible, recognising that the Minister is required to seek parliamentary approval of sustainable yield levels in each Forest Management Area following the Review. Victoria already provides public reporting of sustainable yield levels through the *Forests Act 1958* (Schedule 3), while sawlog supply levels for Victoria is provided in the Department's annual reports.

*Issue:* There is a need to set clear and strategic goals for the conservation of biodiversity (or other express purposes of reservation) in parks and reserves that are realistic in relation to available resources and against which the success of management can be judged. This would involve a procedure for monitoring implementation of plans. The contribution of parks to regional conservation should also be considered. (p50)

*Response:* Recent park plans contain specific implementation actions with respect to biodiversity conservation and other express purposes for reservation against which plan implementation can be monitored. The specified actions are prioritised and must be included in relevant service agreements which identify funding levels associated with their implementation. Each park plan is prepared with the parks regional context in mind, including its contribution to the regional conservation goals and the recreational and tourism opportunities. The Commonwealth and Victoria consider that the new plan approach meets the suggested requirements outlined in the ESFM report. There is a commitment to complete all plans across the State by the end of 1998 and this approach will be adopted in these plans. Park managers, including Parks Victoria, are developing a complementary framework for monitoring the condition of the parks and reserves estate. This framework should be achieved by 1999. The contribution of all land tenures, including parks, is considered in determining the CAR Reserve System for RFAs.

*Issue:* Wider use should be made of Reference Areas for long-term comparative studies on the impacts of human disturbance in other forested areas. (p50)

*Response:* The Commonwealth and Victoria support the use of reference areas as baseline research sites as long as that use is consistent with the objectives of reference areas.

*Issue:* The implementation of processes to protect environmental values on private land require improved coordination and the expertise of local government to implement the controls and to assess values or monitor compliance needs to be improved. (p53)

*Response:* Better coordination of actions on private land is a stated objective of the new Catchment Management Authorities through the implementation of strategic regional plans and the Native Vegetation Retention controls. The Commonwealth and Victoria agree that local government requires improved expertise in monitoring compliance with permit conditions and in assessing environmental values on private land. A pilot program is underway to identify accredited experts who can be utilised by local government to address these issues.

*Issue:* The implementation of consistent approaches to auditing of compliance with the Code of Forest Practices on both public and private land is needed, as is the development of further practical guides and other material describing good forest practice, especially to assist small forest growers. Greater consistency is required in the interpretation of the Native Vegetation Retention Controls for plantation development. (p54)

*Response:* Victoria is not currently intending to require audits of compliance with the Code of Forest Practices on private land. It should be recognised that forest activity is the only private land use currently subject to a Code of Practice. Both the Commonwealth and Victoria are involved in the development of practical information and guidance relating to plantation establishment on private land. These initiatives will continue and funding arrangements are in place to promote private forest industry development over the next few years. Both the Commonwealth and Victoria consider that the issue of consistency in the interpretation of Native Vegetation Retention Controls will be facilitated by the information being collected as part of the RFA process, such as standard vegetation mapping across the State. Vegetation information should assist in identifying important vegetation types that are in particular need of protection in a regional context. Auditing of compliance with the Code of Forest Practices on public land is dealt with under 'Implementation' below.

*Issue:* There is a need to strengthen the scientific basis of fire management plans through research in order to better balance protection of life and property with conservation of biodiversity, soil and water. (p58)

*Response:* The Victorian Code of Fire Practice for Public Land requires that the Department undertake, participate in, or support research programs aimed at improving: firefighter safety; understanding of fire behaviour; prediction of threat of wildfire to life, assets and values; the effects and effectiveness of preparedness actions; and, firefighting methods, including knowledge of their impact on environmental values. The East Gippsland RFA identifies further research on fire management as a high priority and in 1997/98 Victoria will spend more than \$300,000 on fire research which is directly related to strengthening the scientific underpinning of fire management. This research will include impacts on flora, invertebrates, bats, and birds as well as investigating prescribed burning prescriptions for heathlands. This will facilitate the continued improvement of the scientific basis of fire management and protection measures.

*Issue:* While Action Statements under the Flora and Fauna Guarantee Act have been completed for numerous species, they have not been completed for communities and threatening processes. The Flora and Fauna Guarantee Strategy has yet to be completed. The effectiveness of Action Statements and Recovery Plans needs to be better assessed, based on monitoring and research. (p59)

*Response:* Victoria is committed to the completion of Action Statements for threatened communities and threatening processes, but it must be recognised that this work needs to be prioritised with other Action Statements required under the Flora and Fauna Guarantee Act. Action Statements are currently in preparation for several communities and threatening processes. Victoria is also committed to the



completion of the Flora and Fauna Guarantee Strategy and this is scheduled to occur by the end of 1997. Action Statements already include provisions for monitoring and research and a standardised method of monitoring their implementation is in place. An example of the process for developing and implementing Action Statements, including provision for monitoring, is provided by past and continuing work on Leadbeater's Possum. Victoria has committed in the East Gippsland RFA to a Quality Assurance Program (QAP). This will identify feedback loops between the components of the forest management system.

*Issue:* There is a need for a systematic approach to the ongoing identification of Aboriginal cultural values, collaboration with Aboriginal communities to facilitate and increase their participation in natural resource management, improved liaison between Aboriginal Affairs Victoria (AAV) and the Department of Natural Resources and Environment in implementing the Aboriginal and Archaeological Relics Act, and improved consultation with local Aboriginal communities in the preparation of Wood Utilisation Plans (WUPs) and the proposed siting of forest operations. (p60)

*Response:* The assessment work completed as part of the RFA process has provided good information on sites of Aboriginal cultural significance and this information has been included in an existing database maintained by AAV. Victoria has committed in the East Gippsland RFA to manage Aboriginal cultural heritage in accordance with a set of guidelines agreed between the governments and the Aboriginal communities and this should facilitate better communication and participation in natural resource management. The guidelines include a strategy for targeted survey of archaeological sites and a procedure for checking existing site data bases for archaeological values as part of forest planning. Forest Management Plans and Park Management Plans also commit the Department to better communication with local Aboriginal communities and this is already occurring in East Gippsland, particularly in relation to the development of WUPs and other forest operations. Regular meetings of the local communities, Departmental staff and AAV staff have been established.

*Issue:* Local government planning processes for assessing mining applications is slow and often more adversarial than the Environmental Effects Statement (EES) process, which tends to be more objective and rigorous, providing better opportunities for consideration of scientific evidence and differing views on the relative merits of a proposal. (p63)

*Response:* While the governments do not necessarily agree with this view, it is noted that major proposals in Victoria usually require an EES before they can proceed. The East Gippsland RFA also requires that an EES must be completed prior to any mining activity in the CAR Reserve System. It is envisaged that similar provisions will also apply in future RFAs.

*Issue:* The overall effectiveness of pest management is limited by the lack of strategic plans for pest plant and animal control that cover all tenures. Operational planning should provide for ongoing training and updating of field staff and access to support materials. (p64)

*Response:* Strategic programs for pest plant and animal control covering all land tenures currently exist. For example, strategic rabbit control plans for the release of rabbit calici-virus (RCD) and follow-up control works using other methods; Statewide Good Neighbour Programs which coordinate pest plant and animal control on private property and adjoining public land; pest plant and animal control programs within parks are developed in a regional context and in accordance with parks procedures. In relation to staff training, the Department has a comprehensive and individually based training program for its staff, especially in key areas such as fire protection and suppression, forest and park operations pest, plants and animal control and flora and fauna management. These programs will continue.

## **Implementation**

*Issue:* The Expert Group was unclear about whether the policy and regulatory functions associated with the management of parks and reserves can be separated between the parks program in the Department and the new Parks Victoria entity. (p67)

*Response:* The Victorian Government has established Parks Victoria as a service agency for the provision of park management services in Victoria. New legislation which clearly establishes the separate roles and functions of that organisation and the Department is in preparation. Fire management responsibilities will also be clearly defined in the new legislation.

*Issue:* Particular attention is needed to identify costs on a regional basis and to separate the costs of commercial and non-commercial activities. A focus on research into ESFM requires an ongoing commitment to funding. (p68)

*Response:* Departmental budgets are already prepared on a regional basis taking into account regional priorities and needs. Further separation into commercial and non commercial activities or projects is achieved through allocation of funds to the head office business units. The Department commits significant funding to support ongoing research into land management. As part of this the Forests Service has developed a three year rolling program of research (with a budget of \$1.5 million for 1997/98) focussed on ESFM in order to provide stability for projects extending beyond one year.

*Issue:* Better supervision of forest operations where protection of archaeological or heritage values is important. (p71)

*Response:* The Commonwealth and Victoria do not consider there is sufficient evidence to warrant this conclusion. Provisions currently exist to audit compliance with the Code of Forest Practices in relation to the protection of cultural values, and audits have not shown any significant problems. Cultural heritage experts within the Department are also involved in the development of WUPs and the establishment of appropriate buffers to protect identified values. The development of Guidelines for the protection of Cultural Heritage values should also assist in overcoming communication issues associated with cultural site protection and help avoid damage to sensitive sites.

*Issue:* Improvement is needed in the forthcoming review of fire protection plans to ensure that specialist peer review is generally undertaken. (p71)

*Response:* The Code of Practice for Fire Management on Public Land specifies that when preparing each fire protection plan “the Department must involve its specialists in flora, fauna, parks, forestry, land and water protection and fire management.”

*Issue:* The lack of auditing processes for other Departmental operations is a weakness which should be addressed. In particular, there is a need to audit the extent of compliance of strategic and operational plans. (p72)

*Response:* The Commonwealth and Victoria consider that the key activities on public land are already subject to audit processes. An audit of the Code of Fire Practices on Public Land (CNR 1995d) is to be introduced. The implementation of strategic and operational plans such as the forest and park plans is already subject to regular review and reporting.

*Issue:* Up-to-date copies of key documents, for example, management prescriptions should be readily available to staff and other relevant parties. There is a need for a computerised database system to record forest operations in particular, to enable maintenance and updating of important datasets. (p72)

*Response:* A range of documents, including reports and management plans are readily available to staff and others on the Department’s site on the internet. Additional documentation is located at offices. Much of the information collected as part of the RFA process and the Statewide Forest Resources Inventory (SFRI) is stored in GIS format and can be readily used in future planning and management. The establishment of GIS systems in regional centres which will enable forest records to be stored digitally and be spatially referenced is occurring progressively as resources and data collection permit. The RFA and Forest Management Planning processes provide significant opportunities for this program to be accelerated.

*Issue:* Staff training, especially in key areas such as fire planning and suppression activities and in the area of cultural heritage protection is important. Long-term training strategies for individual staff and the retention and transmittal of corporate knowledge through ongoing documentation of procedures are very important as available resources decline. (p73)

*Response:* Both the Commonwealth and Victoria agree that these are important issues and resources are being committed to them to ensure that valuable information and expertise is retained or can be purchased from the private sector. Minimum standards for staff competencies have been established in key areas such as fire management and there is a focus on the preparation of important documents containing critical procedures, such as regional prescriptions. See additional comments in the Planning section above regarding staff training.

*Issue:* There is a need to promote good forestry practice on private land. (p74)

*Response:* This issue is already addressed in the Planning section above.

### **Information, Monitoring and Evaluation**

*Issue:* Data collection, storage and updating of forest information needs to be improved in specific areas. (p78)

*Response:* These issues are being addressed through the RFA and SFRI processes in particular and further information will be derived from the development and monitoring of sustainability indicators. The issue of socio-economic information has been addressed above. A database of visitor statistics is currently available for parks and priority reserves and it is intended to extend this program and its scope as time and resources permit. Systematic surveys of pest plants and animals are undertaken in priority areas across the State and these provide input to the development of regional control programs. Updating of datasets concerned with Aboriginal and National Estate values will occur as new information becomes available. The Commonwealth and Victoria are both committed to maintaining databases for which they have responsibility. The SFRI and IFPS programs are being progressively implemented across the State and are scheduled for completion by the year 2000. As indicated above, GIS capacity in regional centres is being introduced progressively as resources permit. The Governments have also agreed to the development of a Data Agreement which is intended to address storage and updating of datasets and to maintain them in the corporate NRE library.

*Issue:* Monitoring of implementation of park plans should commence as soon as possible and should be publicly available, along with actions to address any identified deficiencies. The monitoring of implementation of WUPs is hampered by the lack of an adequate coupe recording and tracking system. (p79)

*Response:* Implementation of park plans is undertaken through the development of Regional Action Plans which are prepared annually by Parks Victoria and are maintained in Regional offices. These are reviewed annually to ensure that implementation is proceeding in accordance with the specified outcomes. Coupe recording and tracking systems currently vary across the State. The Department is currently pursuing the development of a tool for delineating coupes on a GIS and ensuring consistency across the State, with the intention to introduce it progressively across Victoria from 1998.

*Issue:* There is a need to develop sustainability indicators in order to assess whether stated forest management objectives are being met. A detailed inventory of the Reference Area system is required, including an assessment of its representativeness, extent of replication, and the degree to which it provides reliable examples of forests unaffected by humans. (p80)

*Response:* Both the Commonwealth and Victoria are committed to the development and implementation of sustainability indicators for the forested regions of Victoria. This commitment was made in the East Gippsland RFA. Research into key aspects of the forest management system,

including the efficacy of buffers on streams is currently underway. An inventory of the Reference Area system was undertaken by the Land Conservation Council as part of its Statewide Review of Public Land Use (LCC 1988) which was completed in 1988. That report is publicly available and covers the issues raised by the Expert Group.

*Issue:* There are no formal processes for auditing of compliance with some Departmental policies and plans. Periodic audits are necessary for these. Consideration should be given to increasing the transparency of audits by making the results publicly available, along with measures to address deficiencies, and by increasing the independence of the audit teams. Log grade audits should be published and consideration should be given to independent log grading procedures. Code audits should cover both public and private land. (p82)

*Response:* The issue of further audits of Departmental processes is dealt with earlier, as has the issue of Code audits on private land. Victoria has committed to publish future reports of internal audits of compliance with the Code of Forest Practices for Timber Production (NRE 1996a) as part of the East Gippsland RFA. Audit teams are drawn from people who are actively involved in the day to day implementation of the Code and are stationed outside of the Region being audited. The Department currently has in place several procedures to ensure the independence and accuracy of log grading, including spot checks of logs in the forest and at sawmills. Other mechanisms are also being considered.

## **Review and Improvement**

*Issue:* A process for reviewing the forest management components has not been formally developed. A process with appropriate reporting mechanisms, such as the “State of the Forests Report” is required to ensure continuous review and improvement of the management system. Key elements of the system should be subject to more frequent peer review. (p83)

*Response:* The Commonwealth and Victoria consider that review and improvement mechanisms do exist in some areas of the management system, for example, the Code of Forest Practices for Timber Production which has just been independently reviewed and adjustments made in the light of new information. In addition, the ESFM assessment conducted in Victoria for the RFA process used an environmental management system approach against which to report. Victoria considers that this framework is a useful model for subsequent reporting when used in conjunction with sustainability indicators consistent with the Montreal criteria.

*Issue:* In relation to research, there is a need for a stronger commitment to the timely completion, appropriate peer review and publication. External peer review of research should be routinely sought and funding should be based on assessment of environmental threats. Formal processes are required to ensure that the most recent relevant research is used to assist in management decisions. A well-defined long term research program is needed. The Expert Group outlined the most critical areas for research and development. (p85)

*Response:* The basis of this issue is related to comments made by some groups in the community that the Department is not publishing some of its research because it has implications for current management. In fact, most of the documents of concern to community groups have not been published because they were in draft form and had not been reviewed by appropriate experts, both within and outside the Department. External peer review of research in the Department is regularly undertaken in order to ensure that research methodology and interpretation of results is appropriate and scientifically based. It would be very difficult for the Department to ignore published research when making management decisions, especially if the Department had conducted the research. The Forests Service within the Department develops a three-year rolling plan of research matched by appropriate funding in order to provide certainty for projects beyond the current financial year. The research program is developed with input from a range of experts and is geared toward the improvement of forest management, consistent with ESFM goals. The Commonwealth and Victorian Governments are committed to research in key areas as part of the East Gippsland RFA and the next

three-year rolling research plan will reflect those commitments. The areas of research are also consistent with those outlined by the Expert Group. The details of the research plan is publicly available and is accessible on the Department's internet site.



## **APPENDIX 5. SUMMARY OF GEOLOGICAL AND MINERALISING EVENTS**

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**Table 5a: Tabberabbera and Melbourne Zones - Summary of geological and mineralising events during the Palaeozoic**

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**Table 5b: Omeo Zone - Summary of geological and mineralising events during the Palaeozoic**

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**Table 5c: Summary of geological and mineralising events during the Mesozoic and Cainozoic over the Melbourne, Tabberabbera and Omeo Zones and the Murray Basin**

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