

Special Investigation
MELBOURNE AREA
HILL END

**LAND CONSERVATION COUNCIL, VICTORIA
MELBOURNE, APRIL 1982**

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GOVERNMENT OF VICTORIA

LAND CONSERVATION COUNCIL

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REPORT

SPECIAL INVESTIGATION
MELBOURNE AREA
HILL END

This report is published to allow all who are interested the opportunity to comment by making written submissions to the Land Conservation Council.

All such submissions must reach the Secretary no later than Monday, 30 August, 1982.

These submissions will be considered by the Council before Proposed Recommendations are made on the use of public land in the area.

I. KUNARATNAM
Secretary
Land Conservation Council

SPECIAL INVESTIGATION - MELBOURNE AREA - HILL END

ERRATUM

- P. 24 2nd para. should read ".... 200,000 cubic metres of softwood pulpwood to be available annually by the year 2000".
- P. 46 Number of birds known to breed in natural habitat should be 114, not 108.

SPECIAL INVESTIGATION

MELBOURNE AREA -
HILL END

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CHAPTER 1 : INTRODUCTION

Foreword

The Land Conservation Council, Victoria, established by the *Land Conservation Act* 1970, carries out investigations and makes recommendations to the Minister for Conservation on the balanced use of public land throughout the State.

In February 1982, the Council was directed to investigate an area of public land east and west of Hill End, according to the following Order in Council:

'Whereas it is provided in Section 8 of the *Land Conservation Act* 1970, that where the Governor in Council is of the opinion that an investigation and recommendation of the Land Conservation Council in relation to any particular district or area of Victoria is necessary or expedient, the said Council may be required to make such investigation and recommendation within such time as is fixed by the Governor in Council.

And whereas the Government has directed the Forests Commission to increase the planting rate of softwoods in Gippsland by 700 hectares per annum, additional land is required by the Forests Commission for plantation establishment. Furthermore the Government has given an undertaking to Australian Paper Manufacturers Ltd. that where company forest land is required for coal extraction, power station and other purposes, suitable other land will be made available to the company.

Now therefore, His Excellency the Lieutenant-Governor as Deputy for the Governor of the State of Victoria by and with the advice of the Executive Council thereof, hereby requires the Land Conservation Council to carry out an investigation of public land within the area delineated on the plan hereunder and to make recommendations by 1 March, 1983 on the best use of the land, including the extent to which it might be used to fulfil the Government's

commitments to increased softwood establishment and to replacement of land acquired from Australian Paper Manufacturers Ltd.'

Land Conservation Act - Extract

Public land

Section 2.

(1) "Public land" means -

(a) land which is not within a city town or borough and is -

(i) unalienated land of the Crown including land permanently or temporarily reserved under section 4 of the *Crown Land (Reserves) Act* 1958 and State forest and parks within the meaning of the *National Parks Act* 1975;

(ii) vested in any public authority (other than a municipality or a sewerage authority within the meaning of the *Sewerage Districts Act* 1958); or

(iii) vested in the Melbourne and Metropolitan Board of Works; and

(b) any other land which the Governor in Council declares under sub-section (2) to be public land for the purposes of this Act

"Reserved forest" and "State forest" have the same meanings as in section 3 of the *Forests Act* 1958.

(2) The Governor in Council may on the recommendation of the Minister made after consultation with -

(a) any Minister of the Crown in whom any land is vested; or

- (b) the Minister responsible for a public authority in which any land is vested -

by proclamation published in the *Government Gazette* declare any such land to be public land for the purposes of this Act.

Functions of the Council

Section 5.

- (1) The Council shall -

- (a) carry out investigations and make recommendations to the Minister with respect to the use of public land in order to provide for the balanced use of land in Victoria;
- (b) make recommendations to the Governor in Council as to the constitution and definition of water supply catchment areas under the *Soil Conservation and Land Utilization Act 1958*; and
- (c) advise the Soil Conservation Authority concerning policy on the use of land (whether public land or any other land however vested) in any water supply catchment area.

- (2) In making any recommendation the Council shall have regard to the present and future needs of the people of Victoria in relation to -

- (a) the preservation of areas which are ecologically significant;
- (b) the conservation of areas of natural interest beauty or of historical interest;
- (c) the creation and preservation of areas of reserved forest;

- (d) the creation and preservation of areas for national parks;
 - (e) the creation and preservation of areas for leisure and recreation, and in particular of areas close to cities and towns for bushland recreation reserves;
 - (f) the creation and preservation of reserves for the conservation of fish and wildlife;
 - (g) the preservation of species of native plants; and
 - (h) land required by government departments and public authorities in order to carry out their functions.
- (3) Where the Council recommends the alienation of any land the recommendation shall include the Council's opinion as to the best method of alienating the land to ensure the most satisfactory use and management of land in the public interest.
- (4) Any person or body may make submissions to the Council as to how any public land can be better used to meet the needs of the people of Victoria and the Council shall consider any such submissions before making any recommendations under paragraph (a) of sub-section (1).

Investigations, Notices and Reports

Section 9.

- (1) The Council shall not make any recommendations under this Act in relation to any district or area without a prior investigation of the district or area.
- (2) Before commencing any investigation under paragraph (a) of sub-section (1) of section 5 the Council shall publish a notice in the *Government Gazette*, in a newspaper circulating throughout the State and in a newspaper circulating particularly in or in the vicinity of the area or district to be investigated stating that an investigation

of the district or area described in the notice is to be carried out for the purposes of this Act.

- (3) On completing an investigation of a district or area under paragraph (a) of sub-section (1) of section 5 the Council shall -
- (a) publish a report of the investigation;
 - (b) give notice in the *Government Gazette* of the publication of the report, the address where copies of the report may be obtained or inspected and stating that any submissions to the Council in relation to such report will be considered by the Council if they are made within 60 days of such notice; and
 - (c) publish notice in a newspaper circulating throughout the State and in a newspaper circulating particularly in or in the vicinity of the area or district investigated of the publication of the report, the address where copies of the report may be obtained or inspected and stating that submissions may be made to the Council and the date before which they should be made.
- (4) The Council shall consider any submissions in relation to such report made by any person or body within 60 days of notice being given under paragraph (b) of sub-section (3).

Notice to be given to public departments and authorities in certain area.

Section 10.

- (1) Not earlier than 60 days after notice being given under paragraph (b) of sub-section (3) of section 9, the Council shall send a copy of its proposed recommendation to -

- (a) the Council of any municipality in the municipal district of which any part of the area or district to which the recommendation relates is situated;
- (b) any other public authority or government department that in the opinion of the Council has an interest in the area of the proposed recommendation; and
- (c) any person or body who made a submission under section 9 -

and shall consider any submissions received within 60 days of the sending of such copy to the council, authority, department, person or body or in the case of a public authority or government department within such longer period as may be agreed upon between the Minister and the Minister administering that department or responsible for that authority.

- (2) Where any recommendation is made to the Minister under this Act it shall be accompanied by a copy of any submissions received from any person body department authority or council pursuant to the provisions of sub-section (4) of section 9 or sub-section (1) of this section.
- (3) Where the Council has made a recommendation to the Minister under paragraph (a) of sub-section (1) of section 5 the Minister may, after he has given not less than fourteen days notice of his intention so to do to the Minister administering a government department or responsible for a public authority recommend to the Governor in Council that notice of the recommendation or that part of the recommendation that affects the government department or public authority concerned and where notice of that recommendation or part is so given by the Governor in Council it shall be the duty of the government department or public authority to use all diligence and dispatch to give effect to such recommendations so far as it affects any land vested in or controlled by it.

Copy of every recommendation and of proposals to be tabled in Parliament.

Section 11.

A copy of every recommendation of the Council made under sub-section (1) of section 5 and of the proposals of the Council submitted to the Minister pursuant to section 7 shall be laid before both Houses of Parliament within fourteen days of the making thereof if Parliament is then sitting and if Parliament is not then sitting within fourteen days after the meeting of Parliament.

A copy of the *Land Conservation Act* 1970 can be obtained from the Government Printing Office, 7a Parliament Place, Melbourne, 3002.

Aims and methods

The major impetus for this study comes from the need to establish whether further public land should be made available for softwood plantations, but at the same time the other values and capabilities of all public land in the study area will be investigated.

The land examined in this special study is part of the Melbourne area and was first investigated by the Land Conservation Council in 1973. Final recommendations on the use of the public land were published in January 1977. With a few minor exceptions, these recommendations have been accepted by the government and have been or are being implemented.

This descriptive report uses information contained in the original 'Report on the Melbourne Study Area' published in 1973. Where necessary, information has been updated, and additional material that was previously unavailable has been incorporated.

The report contains information on which members of the community may base their submissions to Council, and on which land use decisions can eventually be made. Information for it has been

obtained from government departments, public authorities, and interested individuals, as well as from published reports.

The study area

The Hill End special investigation area comprises parts of the Shires of Narracan, Buln Buln, and Warragul and covers an area of approximately 69,000 ha, of which approximately 42,000 ha is public land. The public land occurs in two large parcels, separated by a strip of cleared private land within which the townships of Willow Grove and Hill End are situated. Strips of private land also occur along the western and southern boundaries of the investigation area. Major adjacent population centres are Moe to the south-east and Warragul to the south-west.

CHAPTER 2 : NATURAL FEATURES

Climate

Rainfall is the main form of precipitation in the area, although regular snowfalls do occur in the north-eastern section. Annual rainfall ranges from 950 mm at the lower elevations in the south of the study area to 1,400 mm at the higher elevations in the north. It is fairly evenly distributed throughout the year, with a tendency to spring maxima. The growing season can be affected by summer drought.

Low temperatures will affect growth from June to August in the south, but this period increases with increasing elevation, to last from May to September in the northern parts of the area.

Physiography and Geology

Dissected hilly terrain developed on Silurian to early Devonian sediments predominates. In the extreme west of the investigation area, extensive areas of undulating terrain have developed on flows of older basalt, while in the centre of the area similar terrain occurs on basalt residuals capping Palaeozoic sediments of the Tanjil--La Trobe divide. In the north-east the terrain rises rapidly over contact metamorphosed Palaeozoic sediments to the edge of the Baw Baw plateau, consisting of late Devonian granodiorite.

The many broad flat ridges on both the Palaeozoic sediments and older basalt flows are remnants of the dissected Nillumbik Surface, which slopes down gradually from about 500 m in the north to about 250 m in the south.

In the south-east, moderate dissection of Tertiary gravels and sands in the La Trobe Valley has produced an undulating terrain that merges into the flat alluvial deposits of the Moe swamp at an elevation of about 60 m.

Soils

The predominant soil type in the investigation area has been formed on Devonian sediments. Apart from the predominant soil, however, a wide variation in soils reflects the interaction that has occurred between the major soil-forming factors.

In the north-east of the area, brown gradational soils occur at higher elevations on the steep slopes to the Baw Baw Plateau. These are characterized by a high organic colloid content, are well structured, and have extremely good water-holding characteristics.

At a lower elevation, the long mountain slopes leading from the massif and the surrounding metamorphic-based rock comprise generally red or brown gradational soils, with a loam surface texture where the organic content closely influences the water-holding capacity and permeability of the upper horizons. The lower horizons of these soils are generally poorly structured, with high sand and low clay contents. They overlie decomposing granodiorite at variable depths.

The soils of the lower foothills (the predominant soil type) are derived from Siluro-Devonian-aged sediments comprising mudstones, shales, and fine sandstones. Such soils are generally yellow gradational, are weakly structured, and very acidic, with pH values at the surface around 4.5 rising slightly with depth to around 5.0. Textures gradually change with increasing depth, from surface loams to clay.

The basalt influence occurs in isolated areas as residual deposits and commonly as capping along the north--south ridge lines. These soils are usually deep red gradational, being well structured with a clay-loam surface texture and red clay subsoil. Such areas have generally been cleared for agricultural purposes.

The other main soil types in the study area are those associated with the areas of unconsolidated Tertiary gravels,

sands, and clays. Such soils are weakly structured throughout the profile and show an abrupt change from either a sand or sandy loam in the upper horizon to a predominantly clay subsoil. Their permeability is poor, and they would be subject to seasonal waterlogging.

Vegetation

The natural vegetation of an area is determined largely by the environmental factors of the site, and therefore is particularly important when considering possible uses of land.

Vegetation on public land within the investigation area has been classified into a number of structural forms, based on the height of the tallest stratum and on the percentage of projective foliage cover. These are shown on Map 2, together with their distribution. The classification presented here is a modified version of the scheme developed by Specht.

Sub-alpine woodland and open forest I

This vegetation type is confined to a few small areas on the edge of the Baw Baw plateau in the far north-east of the investigation area. It is dominated by snow gum, with an understorey of grasses and shrubs.

Open forest IV

While it predominates in the Tanjil--Tyers Forest between about 1,200 and 370 m elevation, open forest IV also occurs in gullies and on sheltered aspects in other parts of the study area. Above 950 m, the forests are dominated by alpine ash, while at lower altitudes mountain ash predominates. Shining gum occurs in the junction zone between the two ash species. The more sheltered gullies contain closed forest of myrtle beech with some blackwood and sassafras.

Open forest IV of mountain grey gum and messmate stringybark becomes increasingly common at the lower elevations, and may

also be encountered on northern and western aspects at elevations up to about 820 m. Below 370 m, open forest IV is restricted to some wetter gullies and sheltered aspects. The understorey of open forest IV areas is characterized by tall shrubs and ferns.

Open forest III

Over much of the remainder of the investigation area, open forest III predominates. On the more favourable sites, the chief eucalypts are messmate stringybark, mountain grey gum, and narrow-leaf peppermint, while various mixtures of silvertop, messmate stringybark, brown stringybark, and yertchuk are found on the less favourable sites. White stringybark also accompanies the latter vegetation type in parts of the western half of the investigation area. At lower elevations the main valleys support open forest III of narrow-leaf peppermint and manna gum.

The understorey varies with the microenvironment. In moist sheltered situations it may comprise tall dense shrubs similar to those in the mountain ash forests, while drier sites usually have a grassy understorey with scattered short shrubs.

Open forest II

Various mixtures of silvertop, messmate stringybark, brown stringybark, and yertchuk (plus white stringybark in the western half) comprise the open forest II found on ridge tops and dry aspects, especially at lower elevations. The understorey is grassy with low open shrubs.

Open forest I

Some of the driest ridges carry an open forest I of almost pure yertchuk. Here the trees are less than 15 m tall and have very poor form. Understoreys may be grassy with low open shrubs as in open forest II, or a thick heath as found in woodland areas.

Woodland

Heathy woodland is found on infertile soils in the southern half of the investigation area. Stunted yertchuk is the chief eucalypt, with broad-leaf peppermint sometimes also present. The dense heath includes various species of tea-tree, banksia, heath, and wattle.

Fauna

Three major faunal habitats occur on public land within the investigation area: wet open forest, dry open forest, and woodland. These approximate to open forest III and IV, open forest I and II, and woodland respectively, as described in the previous section and shown on Map 2. Small areas of sub-alpine habitat are found in snow gum woodland in the extreme north-east.

Wet Open Forest

Mammals

In this habitat, 21 species of native mammal have been recorded and several others are likely to occur. The most common and widespread small ground mammals are the bush rat, brown antechinus, and dusky antechinus. Also common are wombats and swamp wallabies, while long-nosed bandicoots are less so. The tiger quoll was last recorded in the investigation area in 1962, but it may still be present in this habitat.

Seven arboreal mammal species are known to occur here: the mountain brushtail possum, common ringtail possum, sugar glider, and yellow-bellied glider are common and widespread; the feathertail glider is likely to be common and widespread, and the greater glider is uncommon.

Leadbeater's possum has been recorded within 1 km of the investigation area and, as suitable habitat is available, it is likely to occur within the area. This possum is considered an endangered species, as its entire distribution is restricted to a number of scattered colonies in the Central Highlands. It occurs

mainly in wet open forest of mountain ash containing large dead trees, which it uses as nesting sites. The eastern pygmy-possum has also been recorded just to the north in wet open forest and is likely to occur in this habitat in the investigation area.

The eight species of bats recorded in wet open forest include the great pipistrelle, an uncommon species in Victoria. The most common are the chocolate bat and the little forest eptesicus. All eight species are forest-dwelling, and roost mainly in tree hollows.

Introduced species found in this habitat include the feral cat, feral dog, fox, sambar deer, and rabbit.

Birds

Of the 73 species of birds recorded in this habitat (see Appendix 2), the most common characteristic species are the yellow-tailed black-cockatoo, crimson rosella, superb lyrebird, eastern whipbird and pied currawong. The less common species are the wonga pigeon, gang-gang cockatoo, Australian king-parrot, fan-tailed cuckoo, brush cuckoo, sooty owl, White's thrush, rose robin, pink robin, olive whistler, rufous fantail, pilotbird, Lewin's honeyeater, and satin bowerbird. These birds occur largely in wet forest because it meets their basic needs: many, for example, forage in the moist leaf litter of such forests.

Among these birds, the most significant are the sooty owl and Lewin's honeyeater, which are restricted to this habitat. The sooty owl is regarded as particularly rare in Victoria (see Figure 1). It occurs down the eastern coast of Australia from near Cooktown to the Dandenong Ranges. In Victoria it occupies heavily timbered wet forests, especially in the gullies. It is a cryptic species and consequently very little is known of its habitats and biology. The investigation area appears to support a significant population of the species and has the greatest density of records known in Victoria.

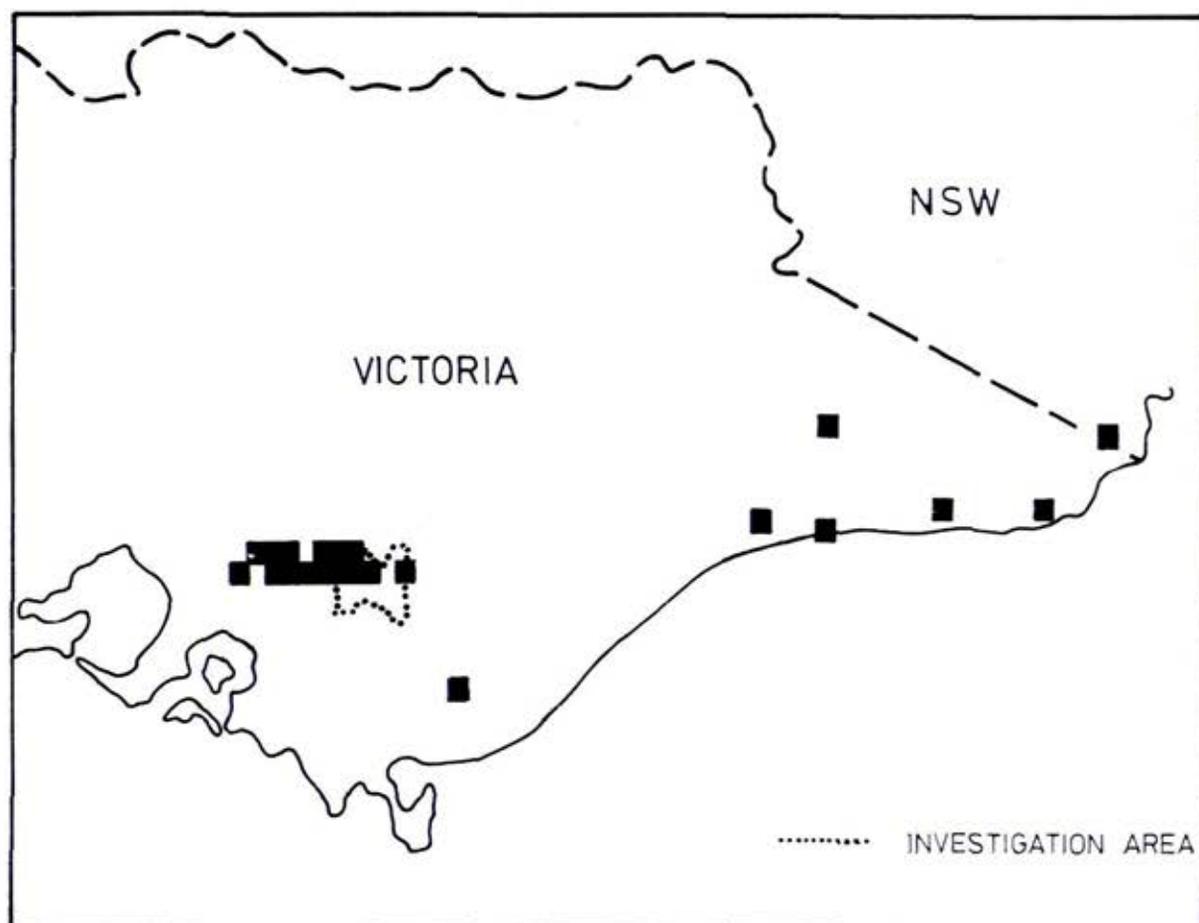


Figure 1. Distribution of the sooty owl (*Tyto tenebricosa*) in Victoria

Reptiles

Although wet open forest is generally regarded as less suitable for reptiles than other habitat types, due to lower temperatures and reduced light penetration to the forest floor, some species have become specialized and restricted to this habitat. McCoy's skink, for example, is dependent on a thick, moist litter layer, and may reach very high densities here. Coventry's skink is also restricted to this forest type, relying on the moist interior of large fallen logs for refuge. Spencer's skink, an arboreal species found on large stag trees, also occurs in large numbers.

Altogether, 14 species have been recorded in wet open forest in the investigation area, other common species being the southern water skink, black rock skink, and the highland form of the copperhead snake. The lowland form of the last-named is less common, as are the weasel skink, grass skink form B, metallic

skink, southern blue-tongue lizard, tree goanna, white-lipped snake, and tiger snake.

Amphibians

Ten species of amphibian have been recorded in this habitat, with the common eastern froglet, brown tree frog, and *Geocrinia victoriana* being the most common and widespread throughout the investigation area. Lesueur's tree frog requires rocky water-courses for breeding, while the southern toadlet utilizes temporary ponds. The westernmost populations of the leaf-green tree frog occur within the investigation area (see Figure 2), and could be of considerable scientific interest when the relationships of the various taxa in this species-group are investigated.

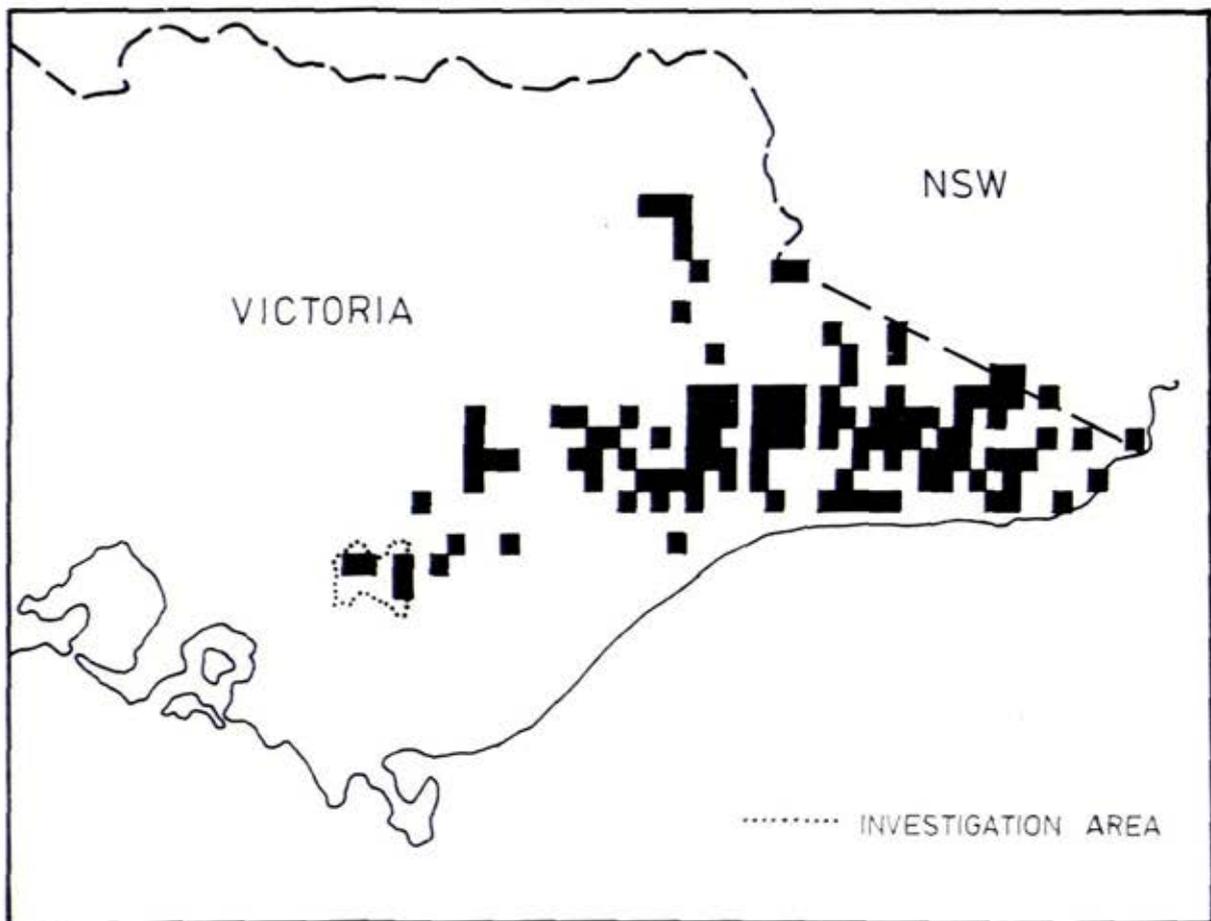


Figure 2. Distribution of the leaf-green tree frog (*Litoria phyllochroa*) in Victoria

Dry Open Forest

Mammals

Of 24 species of native mammal recorded here, common and widespread terrestrial species are the brown antechinus and the bush rat. The swamp rat, dusky antechinus, and long-nosed bandicoot are restricted to areas with a dense understorey. Wombats and swamp wallabies are common. Eastern grey kangaroos are uncommon but have been recorded in the foothills in this habitat. Echidnas are widespread but uncommon. Brush-tailed phascogales (tuans) have been recorded in various localities throughout the area, especially between the 1930s and 1960s. The most recent record was in 1969, but it is possible that tuans still occur in the area.

Five species of arboreal mammal have been recorded in dry open forest within the investigation area. The common ringtail possum and the sugar glider are common and widespread, while the common brushtail possum and feathertail and yellow-bellied gliders are less common.

Eight species of bat have been recorded, including the uncommon great pipistrelle.

Seven introduced mammal species are known to occur - the feral cat, feral dog, and fox are widespread, while the house mouse, sambar deer, rabbit, and pig are less common and more localized in their distribution.

Birds

This habitat occurs largely in the south of the investigation area, and 80 species of bird have been recorded there (see Appendix 2). The most common characteristic species are the brush bronzewing, yellow-tailed black-cockatoo, southern boobook, Australian owlet-nightjar, laughing kookaburra, rufous whistler, and yellow-faced honeyeater. The less common species are the painted button-quail, common bronzewing, Horsfield's bronze-cuckoo, shining bronze-cuckoo, pallid cuckoo, white-throated nightjar,

sacred kingfisher, black-faced cuckoo-shrike, scarlet robin, spotted quail-thrush, varied sitella, red-browed treecreeper, red wattlebird, brown-headed honeyeater, mistletoebird, and striated pardalote.

This forest generally contains a more open and less luxuriant understorey, with dry leaf litter on the ground, which makes it suitable for ground foragers such as the spotted quail-thrush and painted button-quail.

Reptiles

Among the 17 species recorded in this habitat, the most common are the widespread southern water skink and black rock skink, both of which require fallen logs for refuge and basking sites. White's skink and the garden skink are both common here, but do not occur in wet open forest.

The highland form of the copperhead snake reaches the southern limit of its distribution in dry open forest in the investigation area, and overlaps extensively with the less common lowland form of this snake (see Figure 3). As these forms have probably reached specific status, the investigation area is important for the study of their taxonomic relationships and ecological requirements. Both species of blue-tongue lizard also occur together here.

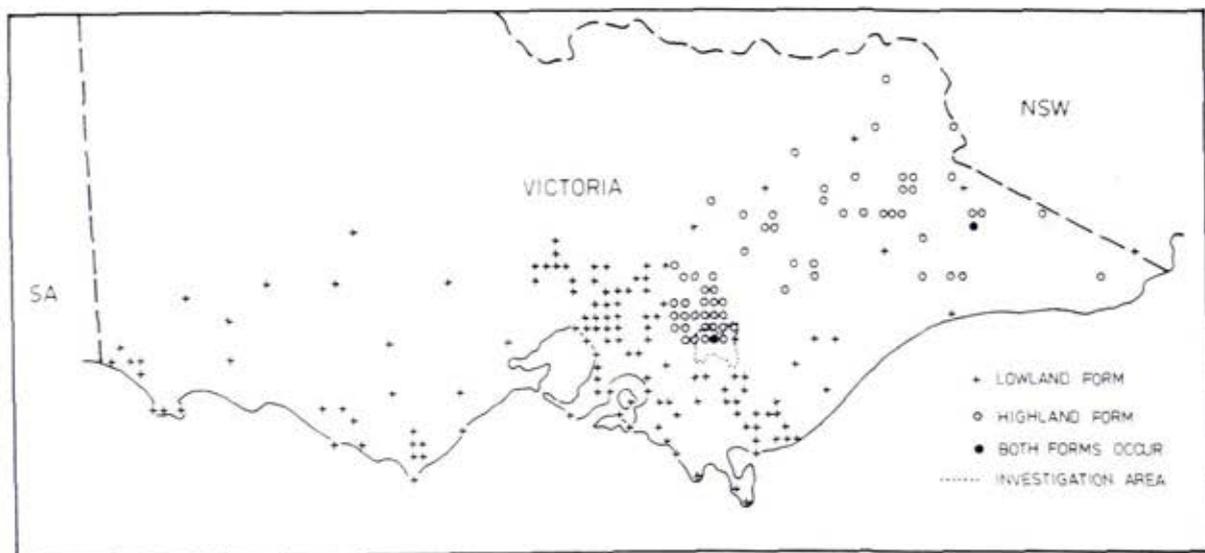


Figure 3. Distribution of the highland and lowland forms of the copperhead snake (*Austrelaps superba*) in Victoria

Appendix 3 gives a complete list of the species found in the dry open forest, which supports the most diverse reptile fauna of any habitat in the investigation area.

Amphibians

The wetter areas of this habitat support essentially the same amphibian species as are present in wet open forest, the most notable change being the increase in abundance of the eastern banjo frog.

Woodland

Mammals

Native mammals of 20 species have been recorded in woodland, in which the understorey may vary between the dense wet heaths found in valley flats and the sparser drier heaths occurring on exposed ridges. The different understoreys support different ground-dwelling mammals. In the dense wet heath understorey the bush rat, swamp rat, brown antechinus, and dusky antechinus are common, while the long-nosed bandicoot is recorded less frequently. Swamp wallabies and wombats are common in this type of understorey.

The broad-toothed rat has been recorded at one locality in the investigation area, in woodland with a dense wet heath understorey along Bull Beef Creek, north-east of Willow Grove. Within Victoria, the species has a restricted and patchy distribution. Until recent work expanded the known range, its survival was considered threatened. It is restricted to areas with a dense ground cover of grasses, sedges, and herbs, as it feeds mainly on the stems and leaves of grasses and sedges.

The drier understorey of some woodlands supports a very different range of ground-dwelling mammals, including the uncommon white-footed dunnart. Also present are the echidna, eastern grey kangaroo, and the brown antechinus.

Compared with the forested habitats, woodland supports fewer

species of arboreal mammal, with the sugar glider, common brushtail, and common ringtail possums being the only ones recorded. Six species of bats have been found. Five introduced mammal species (feral dog, feral cat, fox, rabbit, and house mouse) utilize this habitat.

Birds

Most bird species occurring in dry open forest also occur in woodland. An exception is the chestnut-rumped hylacola, which only occurs in dry heaths associated with some woodland in the area.

Reptiles

One of the 13 species of reptiles recorded in woodland in the investigation area, the three-lined skink, has only been found in this habitat. As shown in Appendix 3, the species dependent on forest - for example, Spencer' skink, southern water skink, and black rock skink - do not occur in woodland, while others, such as the delicate skink, grass skink, and mourning skink, increase in abundance.

The occurrence of the mourning skink is of particular interest, as this rare species has specialized habitat requirements and a markedly disjunct distribution (see Figure 4). The investigation area - within which it is restricted to wet, heathy swamps in small pockets in woodland and dry open forest - supports a sizeable population along Bull Beef Creek, as well as two smaller populations elsewhere.

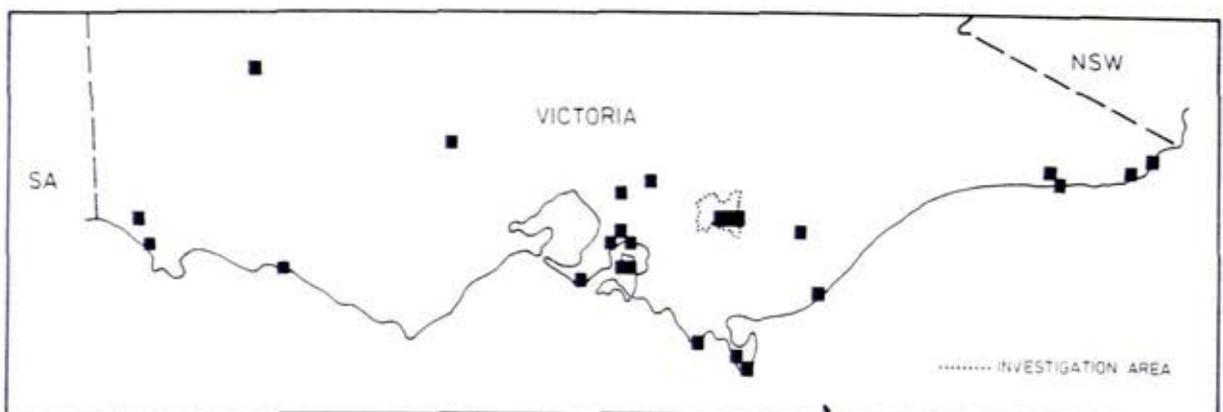


Figure 4. Distribution of the mourning skink (*Egernia coventryi*) in Victoria

Amphibians

Eight amphibian species occur in the woodland areas, two notable exceptions being Lesueur's tree frog and the leaf-green tree frog, both of which are restricted to forest vegetation along watercourses. All species present are shown in Appendix 3.

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CHAPTER 3 : SOFTWOODS

Softwood production has become a major decentralized industry in Victoria, and is increasing in importance. The major softwood species planted in Victoria is radiata pine (*Pinus radiata*), which occupies 98% of the total planted area. It is a hardy species well suited to growth in an even-aged plantation and its wood is readily acceptable for a variety of uses.

Radiata pine in Victoria

Planting of radiata pine in Victoria commenced late last century, to meet a requirement for softwood sawn timber and to supplement the wood supply from native hardwood forest. Subsequently softwood plantations expanded erratically until the 1960s, when there was a renewed appreciation that Australia should not rely on the continued availability of imports to make up the shortfall between future requirements and supply of wood from native forests. An expanded national planting programme since the mid 1960s has seen the area of Victoria's softwood plantations increase to 168,000 ha, of which 52% is in public ownership.

As part of this State's expansion programme, eight softwood plantation development zones were defined in which planting would be concentrated in order to create resources of sufficient size to attract permanent industries at suitable decentralized sites. They fall generally into the geographic regions that have climates and soil types suitable for radiata pine, as follows: Portland/Rennick, Otways, Ballarat, Central, Benalla/Mansfield, Ovens, Upper Murray, and La Trobe.

The Hill End investigation area is located in the La Trobe Development Zone, which covers south and central Gippsland. Both the Forests Commission and A.P.M. Forests Pty Ltd (a subsidiary of Australian Paper Manufacturers Limited) have plantations here. A.P.M. plantations currently total about 40,000 ha (net planted area) while Forests Commission plantations total approximately 12,700 ha net.

Demand and supply in the La Trobe Zone

Plantations in the La Trobe Zone are required in order to provide material for a pulp mill, saw and veneer mills, and preservative-treatment plants.

The Australian Paper Manufacturers Ltd pulp mill at Maryvale is Australia's largest producer of wood pulp, using eucalypt and pine pulpwood from both private and government forests. The company is currently undertaking a substantial expansion programme to increase the pulp-making capacity at its Maryvale mill. Softwood pulpwood from Forests Commission plantations within the La Trobe Softwood Plantation Zone is obtained under an agreement ratified by legislation in 1974, which provides for volumes increasing to 100,000 cubic metres per annum by the year 2000. In March 1981, the then government indicated that funds had been allocated to the Forests Commission for planting an additional 700 ha of softwoods annually in Gippsland, to enable 200,000 cubic metres of softwood pulp to be available annually by the year 2000.

Current saw- and veneer-log allocations from Forests Commission plantations exceed 40,000 m³ per annum. The Commission has indicated that there is a shortage of softwood timber in the region, especially with regard to materials suitable for sawlogs and veneer-logs. At present it is unable to fulfil requests from various companies in the region and Melbourne for softwood timber over and above present commitments. As the established plantations approach maturity, however, the volume of sawlog and veneer-log material becoming available can be expected to rise.

Demand for softwood timber in the La Trobe Zone is also partially determined by factors that affect the whole Victorian timber industry. Companies involved in the State's industry are seeking to expand or diversify their operations, in order to meet consumer demand for softwood products. In softwood sawmilling and subsequent processing, substantial economies of scale can be achieved as log supply increases. This leads to a generally more efficient industry.

In 1977, as part of its final recommendations for the Melbourne area, Council recommended that 1,300 ha of public land in the La Trobe Zone be planted to softwoods in the period to 1983 inclusive. This was based on a contribution of 160 ha net per annum to the softwood plantings target, which at that time was 600 ha net per annum for the zone. However, as a result of the direction to increase the planting rate for the zone to 1,300 ha net per annum, the area of land allocated for softwoods is now being reviewed. This review is necessary, although 845 ha of land, net, in the Melbourne area remain to be planted, because of the lead time involved in the preparation of land for plantation establishment.

Australian Paper Manufacturers Ltd

This company seeks, as its long-term goal, to have a net 40,000 ha of established softwood plantation at any one time, with additional areas in the process of re-establishment following clear-felling. It has extensive plantation holdings on land in the La Trobe Valley that could be required for coal-field developments over the next 50 years. Some of these fields have been reserved for future power generation projects of the State Electricity Commission, Victoria. Others could be used for non-S.E.C. projects, such as the production of oil from coal. Should these fields be brought into production, the plantation resource on the affected land will have to be harvested. Premature harvesting of existing plantations will disrupt supply schedules to processing plants as well as reducing the net softwood plantation estate.

In January 1981, the then government indicated that, where A.P.M. forest land is required for coal extraction, power station, and other purposes, suitable other land will be made available to the company.

It is estimated that A.P.M. Forests Pty Ltd could lose as much as a net 12,000 to 13,000 ha of plantation lands to coal-field and associated development over the next 50 years. Of this area, 1,200 to 1,300 ha is leased land or land that has been recommended by the Council to be leased in the South Gippsland 1

and Stradbroke areas. Land required for the S.E.C. Drifffield project is reasonably well defined. The established plantations that will be required to be harvested should this project and associated works proceed will probably not exceed 1,100 ha net over the next 10 to 15 years.

Currently, no firm proposals exist for the development of coal-field resources associated with private projects. Should, proposals be approved in the near future, however, it is unlikely that over the next 10 to 15 years these would involve the loss of more than about 900 ha of plantation owned or leased by A.P.M. Forests Pty Ltd. Thus the total net area of pine plantation that A.P.M. could lose because of coal-based development over the next 10 to 15 years is unlikely to exceed 2,000 ha.

Social and other benefits

Softwood plantations and associated industries contribute to the welfare of the community by providing employment in rural areas and provincial towns. At present A.P.M.'s Maryvale Pulp and Paper Mill and Morwell Woodmill directly employ about 1,750 persons. The proposed expansion of these mills will provide another 400 permanent jobs.

In addition to direct employment, softwood plantations also provide considerable indirect employment in services and support industries, and thus have considerable importance for the regional economy.

Softwood plantations in the Hill End area

In its final recommendations for the Melbourne area, the Council recommended that an area of 1,770 ha be allocated to softwood production, within which 1,300 ha net could be planted to softwoods. This was in addition to the 400 ha, net, of existing plantations in the area.

Of the 1,300 ha net recommended for planting with softwoods, 455 ha net has been planted so far in the Neerim East and

Shady Creek areas (Recommendations F14 and F15 in the final recommendations for the Melbourne area). No planting has commenced yet in the Mount Carmel area (Recommendation F16).

Site requirements for radiata pine

Commercial production of radiata pine has the following site requirements:

- * mean annual rainfall should exceed 700 mm
- * soils should be acid and well drained and have moderate fertility
- * more than 0.5 m of topsoil should overlie any soil layer that may impede root development or water percolation
- * the site should not be subject to heavy snowfalls

These conditions occur over most of the investigation area. Wide variations in growth rate will occur, however, because of differing site factors.

Productivity of a site is measured in terms of the average annual growth of wood volume per unit area. It is expressed in cubic metres per hectare, and is known as the Mean Annual Increment (M.A.I.).

The M.A.I. potential of a particular site can be estimated from the form and composition of the native vegetation, the soil, and the climate at the site.

Table 1 shows the suitability for growth of radiata pine indicated by each of the native vegetation categories that occur in the study area. The range of potential productivity given for each class is necessarily broad, since it is influenced significantly by the intensity of silvicultural treatment applied. These treatments include site preparation

such as ploughing and ripping, weed control, and fertilization. Significant gains are also expected from genetic improvement through tree-breeding.

It can be seen that the vegetation classes with greatest capability for softwood production are open forest IV and open forest III. Most of the open forest IV areas, however, also have hardwood and conservation values.

Table 1

SOFTWOOD PRODUCTIVITY

Category	Structural form and main species of natural vegetation (1)	Predominant soils	Potential Productivity (MAI m ³ /ha/an) (2)
A very high	Open forest IV: mountain ash, at elevations below 950 m (3)	Friable brownish gradational	28 - 25
	Open forest IV: mountain grey gum	Friable brownish gradational	28 - 25
	Open forest III: messmate stringybark	Friable reddish and yellowish gradational	28 - 22
B high	Open forest III: narrow-leaf peppermint	Friable reddish and yellowish gradational	25 - 18
C moderate to low	Open forest III or II: silvertop	Well-drained soils only	18 - 13
D unsuitable	Open forest I: yertchuk	Duplex and shallow stony soils	less than 8
	Open forest III or II: silvertop	Shallow stony or poorly drained soils	less than 8

(1) for full details of species refer to Map 2 - Vegetation.

(2) MAI (mean annual increment) = total volume production to a 10-cm small-end diameter under bark, divided by the number of years in rotation.

(3) areas above 950 m are generally unsuitable for commercial plantations of radiata pine, as heavy falls of snow can cause widespread damage by breaking and uprooting trees.

CHAPTER 4 : CONSERVATION

Nature conservation

Softwood plantations support fewer native animal species than native eucalypt forests. Those that do occur are usually less abundant there than in adjacent eucalypt forests, although the plantation may contain a few species at high densities at some stage in its development. Also, many of the native animals found in softwood plantations rely on adjacent eucalypt forest for some of their ecological requirements, such as nest sites and refuge areas. Others are excluded from plantations because of their total dependence on the indigenous forest (see Appendices 1-3). Especially affected are arboreal mammals, which feed in the foliage of native trees and shrubs and depend on tree hollows for nesting sites and shelter, hollow-nesting and nectar-feeding birds, and reptiles that rely on large logs for home sites.

The removal of native forest can have the following three major effects on the native fauna of an area.

In some species, such as the greater glider (*Schoinobates volans*), individuals whose territory is cleared will perish because of their inability to establish new territories in the adjoining native forest. As a result, population numbers of such species will decline in proportion to the area cleared.

Species that require a relatively large contiguous area to survive may be eliminated because the blocks of remnant native forest may be too small to support viable populations. Studies carried out in south-eastern Australia indicate that a minimum area of 1,000 ha is required to support a viable population of arboreal mammals such as the greater glider. Smaller areas would have to rely on migration from adjacent habitat in order to maintain population numbers and genetic variability.

Separation of blocks of native vegetation by areas of unfavourable habitat results in the fragmentation of the original

population into a number of smaller isolated groups. This isolation leads to a restriction of gene flow and inhibits recolonization movements. Moreover, animals occurring in low numbers in an isolated block are more susceptible to destruction by natural causes such as fire and predation. Where large continuous area of favourable habitat occur, sensitive species would usually survive somewhere, even during a major bushfire, and the surviving individuals and their offspring could ultimately recolonize the vacant habitats.

The impact that these effects have on populations of native fauna can be reduced by maintaining strips of native vegetation within the plantation complex. It would appear that these strips within softwood plantations are of major importance to some species, but as yet little information is available on their optimum size to conserve viable populations of indigenous fauna.

Current practice in softwood plantations is to retain native vegetation along streams and ridges and clear the intervening slopes. In regions where large areas of softwood plantations are established, conservation of many mammal species can apparently best be achieved by retaining adequate areas of protected and preferably inter-connected habitats. Provision of such corridors, however, demands the allocation of more land to softwoods in order to achieve the same net area planted to pines. The question then arises as to whether it is more beneficial, in terms of wildlife conservation, to concentrate the alteration of habitat in one large area or to distribute the impact over several smaller ones. The former alternative may allow for greater viability of the areas reserved for wildlife, while the second allows greater scope for conserving a range of environments. This argument assumes, however, that the distribution, status, and habitat requirements of every native species are adequately documented, so areas for softwood production could be allocated without endangering the survival of any species. Unfortunately this information is not available for many species.

It should be stressed that softwood plantations provide habitat that changes markedly as they develop, and consequently the animal species utilizing them change during different stages of their development. For example, some of the species found in young plantations, which have a dense understorey of native plant species, are not present in mature plantations.

Native mammals that may inhabit softwood plantations include the bush rat, brown antechinus, dusky antechinus, swamp wallaby, eastern grey kangaroo, wombat, and common brushtail possum, and occasionally the long-nosed bandicoot, echidna, and common ringtail possum (see Appendix 1). Many bats feed there, but require adjacent eucalypt forest for roosting. Swamp wallabies and wombats are abundant only in young plantations, where food supply and low cover are plentiful. The common brushtail possum, bush rat, and brown antechinus appear able to survive and reproduce in most plantations, particularly where native vegetation is retained along creeks.

Of all the bird species found within the boundaries of the investigation area, 45% have been recorded in softwood plantations elsewhere in Victoria (see Appendix 2), but only 14% are known to breed in plantations. Non-specialized and widespread species such as the eastern silvereye, red-browed firetail, grey shrike-thrush, grey fantail, brown thornbill, and eastern yellow robin have been recorded breeding in softwood plantations. Many other species only partially fulfil their basic ecological requirements in these areas; these include the welcome swallow, striated thornbill, black-faced cuckoo-shrike, yellow-tailed black-cockatoo, fan-tailed cuckoo, and laughing kookaburra. Others depend fully on eucalypt forest - the satin flycatcher, large-billed scrubwren, red-browed treecreeper, Lewin's honeyeater, yellow-tufted honeyeater, little lorikeet, and painted button-quail are examples. Requirements not provided by softwood plantations include nest hollows (which 23% of birds recorded in the forest or woodland habitats in the investigation area require) and some food sources (like fruit, seeds, or prey species that depend on eucalypt forest). For example, some nocturnal raptors, such as the sooty owl, prey on possums and gliders that require hollow trees in eucalypt forest for nesting.

Far less information is available on the reptiles and amphibians that may survive in softwood plantations. Most species feed on a wide range of invertebrates, but any change in the diversity and abundance of these prey items may lead to consequent changes in the reptile and amphibian fauna. Common, widespread and less specialized species such as the garden skink, weasel skink, White's skink, and brown tree frog probably have all their basic requirements satisfied in softwood plantations. Less common and more specialized species, or those that require hollows or logs, probably cannot survive in these areas; they include the black rock skink, Coventry's skink, Spencer's skink, southern water skink, Lesueur's tree frog, and leaf-green tree frog.

Landscape considerations

Softwood plantations have a strong visual impact on the local and regional landscape. This impact is accentuated when large plantations are established in a relatively small area close to softwood-processing plants.

They often have greater visual effect because of their position in the landscape. Some of the more elevated parts of the investigation area, such as Mount Tanjil, are visually prominent, and consequently conversion of these areas to softwood plantation would cause a considerable alteration to the present native forest landscape.

The uniformity of plantations contrasts with the variation in adjoining native forest. Maintenance of native vegetation to screen the plantation from view is important in reducing the visual impact, particularly in areas of outstanding scenic value.

Erosion hazard

The investigation area embraces two water supply catchments that are utilized for both industrial and domestic supplies, which have been proclaimed under the provisions of the *Soil Conservation and Land Utilization Act 1958*.

As a major change in land use in a catchment can affect water supply and water quality, these factors must be assessed when

consideration is being given to additional establishment of softwood plantations.

Major erosion hazards associated with the development of softwood plantations depend on a number of interacting factors. Such factors include topography, climate, geology, soils, and the intensity of the drainage pattern.

Actual hazards during and after softwood conversion operations relate to the clearing of extensive areas of native forest, the construction of roads and tracks, the development of steep land on vulnerable soil types, and soil disturbance during thinning or extraction operations.

A number of management techniques can be applied to reduce these hazards, provided the hazard has been recognized during the initial planning stages.

Some sites within the investigation area - where the soil type and slope combine to provide an inherently high erosion hazard - should not be considered for conversion.

Preliminary assessment of the investigation area indicates that some of the shallow yellow gradational soils on the steeper slopes to both the La Trobe and Tanjil Rivers have a high erosion risk when disturbed. Likewise, some of the lighter Tertiary sands offer a high hazard should large-scale clearing and earthworks be undertaken in areas that are excessively steep.

Acid rain

The release of sulfur and nitrogen oxides into the atmosphere during the burning of fossil fuels can result in a phenomenon known as acid rain. It is currently causing considerable concern in Europe and North America.

In the La Trobe Valley, some measurements have been made of the acidity of rainfall samples and the sulfur content of pine

foliage. Although data currently available are insufficient to allow definite conclusions to be drawn about the possibility of acid rain formation, the State Electricity Commission believes that there is no evidence of a problem. However, the Commission intends to commence a long-term monitoring program for acid rain. Since most of the Hill End investigation area is at a considerable elevation above the La Trobe Valley, any adverse effects would not be as serious as in the valley itself.

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CHAPTER 5 : CAPABILITIES

Nature conservation

Most of the public land in the study area has a moderate capability for nature conservation. The area includes representative samples of most forest types in this region, with considerable wet and dry open forest habitats and small areas of woodland.

Some of the public land has a high capacity, as some rare or restricted species occur there. Of particular importance are the heathy woodlands and forests of the Bull Beef and Sweetwater Creek catchments, where a wide range of animal species occur together as well as several rare and restricted species, including the board-toothed rat, white-footed dunnart, chestnut-rumped hylacola, and mourning skink.

Relatively large numbers of the rare sooty owl have been recorded in the gullies in the wet open forest, and Leadbeater's possum probably also occurs in this habitat in the north-east of the investigation area.

The leaf-green tree frog reaches the westernmost limit of its distribution at the La Trobe River. This river, in the south-eastern sector of the area, is also the type locality for four species of vascular plants.

Both forms of copperhead snake are widespread in the investigation area, which is the only area of extensive overlap of the two forms. As such, it is valuable for scientific investigation of the taxonomic and ecological relationships of these snakes.

Recreation

Public land in the investigation area has a moderate capability for recreation. It has no outstanding natural features, but will be subject to increasing pressure as the nearby population centres in the La Trobe Valley continue to grow.

Canoeing, fishing, and camping along the La Trobe and Tanjil Rivers are the main recreation activities at present. Limited pleasure driving and picnicking occur in the area, but are restricted by poor internal access.

The lake that will be created by construction of the Blue Rock Dam on the Tanjil River will provide opportunities for picnicking, walking, fishing, swimming, and use of small boats.

Timber production

Open forest III, which predominates in the investigation area, has a moderate capability for hardwood timber production. Capability is high in open forest IV, but low or very low in open forest I and II, sub-alpine, and woodland areas. The main commercial hardwood species here are mountain ash, messmate stringybark, and silvertop.

Capability for softwood production is discussed in Chapter 3.

Agriculture

Capability for agriculture on public land is generally low except in pockets adjacent to existing clearing. Much of the land is steeper than desirable for agriculture, and the growing season is limited in the winter months. To date, beekeepers have made little use of the area, but some parts probably have a moderate capability, with messmate stringybark, white stringybark, and yertchuk being regarded as useful species.

Minerals

At present, the investigation area supports very few mining or extractive industry activities. The Russell Creek and Tanjil goldfields occur roughly in the centre and constitute the main zone of mineral potential. There is also potential for the exploitation of Tertiary gravel and sand deposits in the south, but exploration would be required to prove deposits.

Water production

Two major rivers flow through the investigation area: the Tanjil and the La Trobe. The Tanjil River is one of the main northern tributaries of the La Trobe River, entering its middle reaches near Moe. The north-eastern part of the area is drained by the western branch of the Tyers River.

Average annual discharge records indicate that the investigation area is relatively efficient in the production of surface water per unit area of catchment, with the bulk of catchments occurring on public land. Salinity records are not available, but water quality is generally good.

At present the only storages that receive water from the investigation area are the Moondarra Reservoir on the Tyers River and the Yallourn storage on the La Trobe River. The Moondarra Reservoir serves urban and industrial requirements at Traralgon, Morwell, and Yallourn, while the Yallourn storage provides cooling water for S.E.C. power stations and also, after treatment, urban supplies. Minor diversions are made for local irrigation use.

The Tanjil River Water Supply Catchment was proclaimed in 1979 and stretches from the Baw Baw Plateau in the north to the Moe-Walhalla road crossing in the south. The State Rivers and Water Supply Commission is currently constructing Blue Rock Dam, located 4 km east of Willow Grove on the Tanjil River. The dam is programmed for completion in 1984, and its construction will result in the inundation of parts of the proposed Tanjil Education Area and the Tanjil-Tyers Forest, both of which the Land Conservation Council recommended in its final recommendations for the Melbourne area.

Water from the Blue Rock storage will primarily be supplied to the S.E.C. for cooling purposes and also to private industry. Small amounts will augment private irrigation in the La Trobe Valley and domestic supplies to the city of Moe.

Moe's domestic water currently comes from the Narracan Creek and a supplementary source of supply is required. It is intended that water will be diverted from the Tanjil River about 4 km north of Moe to provide for these supplementary needs. Any works related to this project would not affect any public land except river frontage.

The water resources of the upper La Trobe River in the investigation area have not been utilized as yet. However, investigations by the State Rivers and Water Supply Commission have identified three possible sites for storage construction along the upper La Trobe River - one near Willow Grove and two in forested public land further upstream. If future development in the La Trobe Valley proceeds as expected, one of these sites may be required by the year 2000.

APPENDICES

The following comments apply to Appendices 1-3:

1. Habitat classification follows Specht (1970).
2. 'Agricultural' habitat includes farms, dams and reservoirs, towns, and the Moe Settling Ponds.
3. 'Forest-dependent' includes only species that are restricted to wet open forest and dry open forest throughout their range (after Tyndale-Biscoe and Calaby, 1975).

Key:

- + Recorded, but abundance not assessed
- A Abundant
- C Common
- U Uncommon
- R Rare

Pine plantation habitats:

- Young 0-9 years
- Mid 10-29 years
- Mature older than 30 years

Additional key to Appendix 2:

- (I) Introduced species
- Does not occur in this habitat
- r Recorded
- rr Recorded regularly
- B Breeding record - nest with eggs or young

Appendix 1

HABITAT CORRELATION FOR MAMMALS, HILL END INVESTIGATION AREA

Species	Forest- dep- endent	Needs hollows	Habitat				Recorded in plantations †		
			Open forest		Wood- land	Agri- cult- ural	Young	Mid	Mature
			Wet	Dry					
Short-beaked echidna				+	+	+	U	R	U
Platypus				Aquatic					
Brown antechinus		X	A	A	C		A	A	C
Dusky antechinus			C	U	C		A	U	R
Tiger quoll			R	R					
Brush-tailed phascogale		X		+					
White-footed dunnart					U				
Long-nosed bandicoot			+	U	+		R	R	R
Mountain brushtail possum	X	X	C						
Common brushtail possum		X		+	+	+		U	C
Feathertail glider	X	X	+	+					
*Eastern pygmy-possum		X						R	
*Leadbeater's possum	X	X							
Yellow-bellied glider	X	X	C	U					
Sugar glider	X	X	C	C	+				
Common ringtail possum			C	C	+	C	R	U	U
Greater glider	X	X	U						
Eastern grey kangaroo				U	U	+	U	C	C
Swamp wallaby			C	C	C		A	R	C
Common wombat			C	C	C	C	A	U	
Gould's wattled bat		X	U	U	+	+	+	+	+
Chocolate wattled bat		X	A	C	+	+	C	C	C
King River eptesicus (bat)		X	C	C	+	+	+	+	+
Large forest eptesicus		X	C	C	+	+	+	+	+
Little forest eptesicus		X	A	A	+	+	+	+	+
*Common bent-wing bat									
Lesser long-eared bat		X	U	U	+	+	+	+	+
Gould's long-eared bat		X	U	U			C	C	C
Great pipistrelle (bat) X		X	U	U					
Broad-toothed rat					R		+		
Bush rat			A	A	C		A	A	A
Swamp rat				C		+	+	+	+
Totals	7	18	21	24	20	12	18	19	17

INTRODUCED SPECIES

House mouse				U	U	+	+	+	+
*Black rat						+	+	+	+
Feral dog			+	+	+	+	+	+	+
Fox			+	+	+	+	+	+	+
Feral cat			+	+	+	+	+	+	+
Sambar (deer)			+	+					
Pig				+					
European rabbit			U	U	U	A	+	+	+

*Probably present, but no confirmed records, although recorded in adjacent areas.

†Abundance after Suckling *et al.* (1976). (This refers to north-eastern Victoria, but the situation is likely to be similar in Gippsland.)

Appendix 2

HABITAT CORRELATION FOR BIRDS, HILL END INVESTIGATION AREA

Species	Forest- dep- endent	Needs hollows	Habitat				Recorded in Plantations †			Breed- ing record
			Open forest		Wood- land	Agri- culti- ural	Young	Mid	Mature	
			Wet	Dry						
Hoary-headed grebe			-	-	-	C				
Australasian grebe			-	-	-	U				
Australian pelican			-	-	-	+				
Darter			-	-	-	+				
Great cormorant			-	-	-	U				
Pied cormorant			-	-	-	+				
Little black cormorant			-	-	-	U				
Little pied cormorant			-	-	-	U				
Pacific heron			-	-	-	+				
White-faced heron						C				
Cattle egret			-	-	-	+				
Great egret			-	-	-	+				
Little egret			-	-	-	+				
Rufous night heron			-	-	-	+				
Sacred ibis			-	-	-	C				
Straw-necked ibis			-	-	-	C				
Royal spoonbill			-	-	-	+				
Yellow-billed spoonbill			-	-	-	U				
Black swan			-	-	-	C				
Australian shelduck			-	-	-	U				
Pacific black duck						C				
Mallard (I)			-	-	-	+				
Grey teal			-	-	-	C				
Chestnut teal			-	-	-	U				
Australasian shoveler			-	-	-	U				
Pink-eared duck			-	-	-	U				
Hardhead			-	-	-	U				
Maned duck						C				
Cotton pygmy-goose			-	-	-	R				
Blue-billed duck			-	-	-	R				
Musk duck			-	-	-	U				
Black-shouldered kite			-			+		r		
Whistling kite						U				
Brown goshawk	X		U	U			rr	rr	rr	B
Collared sparrowhawk	X		U							
Grey goshawk	X		+							
White-bellied sea-eagle			-			+				
Wedge-tailed eagle			U	U	U	U				
Little eagle	X			+		+	r		r	B
Marsh harrier			-			R	r	r		

Species	Forest- dep- endent	Needs hollows	Habitat				Recorded in Plantations †			Breed- ing record
			Open forest		Wood- land	Agri- cult- ural	Young	Mid	Mature	
			Wet	Dry						
Peregrine falcon		X		+		+				
Australian hobby				+		+				
Brown falcon		X				U	r			
Australian kestrel		X				C	r			
Painted button- quail	X			U	U					
Buff-banded rail			-	-	-	+				
Lewin's rail			-	-	-	+				
Dusky moorhen						U				
Purple swamphen			-	-	-	U				
Eurasian coot						U				
Masked lapwing			-	-		C				
Black-fronted plover			-	-	-	+				
Latham's snipe			-	-	-	+				
Silver gull			-	-	-	+				
Feral pigeon (I)			-	-		U				
Spotted turtle-dove (I)			-	-		U				
Peaceful dove					+					
Common bronzewing	X		U	U	U			r		
Brush bronzewing	X		C	C	U					
Wonga pigeon	X	U	U					rr		
Yellow-tailed black-cockatoo		X	C	C	U	C	r	r		
Gang-gang cockatoo		X	U	U		U	r	r		
Galah		X		+		+				
Sulphur-crested cockatoo		X				+	r	r		
Little lorikeet		X	+	+						
Australian king-parrot		X	U	U		+	r			
Swift parrot		X		+						
Crimson rosella		X	C	C	C	U	rr	rr	rr	
Eastern rosella		X	-			U	r	r		
Blue-winged parrot		X	R			+				
Pallid cuckoo				+		+	r	r		
Brush cuckoo			+							
Fan-tailed cuckoo			U	+		+	r	rr	rr	
Horsefield's bronze-cuckoo				+	+		r			
Shining bronze-cuckoo				+	+			r		
Powerful owl	X	X	+							
Southern boobook		X	C	C	U		r	r		
Sooty owl	X	X	U		-					
Tawny frogmouth			U	U			r	r		
Australian owlet- nightjar	X	X	C	C	C					
White-throated nightjar	X			U	U			r		

Species	Forest- depen- dent	Needs hollows	Habitat				Recorded in Plantations †			Breed- ing record
			Open forest		Wood- land	Agri- culti- ural	Young	Mid	Mature	
			Wet	Dry						
White-throated needletail					Aerial			r		
Azure kingfisher			U							
Laughing kookaburra		X	U	C	U	U		rr	rr	
Sacred kingfisher		X		U						
Dollarbird		X		+		+				
Superb lyrebird	X		C	C	-	-	rr	rr		
Singing bushlark			-	-	-	+				
Welcome swallow						C	r			
Tree martin		X				U				
Richard's pipit			-	-	-	+	rr			
Black-faced cuckoo-shrike			U	U		U	rr		r	
White-winged triller					+					
White's thrush	X		U	U	-	-	rr	rr	r	B
Rose robin	X		U	U	-	-			r	
Pink robin	X		R	R	-	-		rr	rr	B
Flame robin			U	U	+	U	r	rr	rr	B
Scarlet robin			R	U	U	U	r	rr	rr	B
Red-capped robin					+					
Eastern yellow robin			A	U	U	+	rr	rr	rr	B
Jacky winter				R	+	U				
Crested shrike-tit			U	U					r	
Olive whistler	X		U			-	rr			
Golden whistler			A	C	C	+	rr	rr	rr	B
Rufous whistler			R	C	C	+	rr	rr	rr	B
Grey shrike-thrush		X	C	A	C	+	rr	rr	rr	B
Black-faced monarch	X		R			-				
Satin flycatcher			U	U	+					
Restless flycatcher			-			+				
Rufous fantail	X		C	U			rr	r	r	
Grey fantail			A	A	C	+	rr	rr	rr	B
Willie wagtail			-	-	+	C	r	r		
Eastern whipbird			C	U			rr	r		
Spotted quail- thrush	X			U		-	r	r		B
Clamorous reed- warbler			-	-	-	+				
Little grassbird			-	-	-	+				
Golden-headed cisticola			-	-		+				
Rufous songlark			-	-		+				
Superb fairy-wren			C	A	C	+	rr	rr	rr	B
Southern emu-wren			-	-	+					
Pilotbird	X		U	R	-	-	rr			
Large-billed scrubwren	X		R		-	-				

Species	Forest- dep- endent	Needs hollows	Habitat				Recorded in Plantations †			Breed- ing record
			Open forest		Wood- land	Agri- cultural	Young	Mid	Mature	
			Wet	Dry						
White-browed scrubwren			A	C	U	+	rr	rr	rr	B
Chestnut-rumped hylacola			-	-	R					
Calamanthus			-	-		+	r			
Weebill					+					
White-throated gerygone				+						
Brown thornbill			A	A	C	+	rr	rr	rr	B
Buff-rumped thornbill			-		U	U	r	rr	rr	B
Yellow-rumped thornbill			-			U		r	r	
Yellow thornbill			-		+					
Striated thornbill			A	A	C	+	r	r	r	
Varied sittella			U	U	U			r	r	
White-throated treecreeper		X	A	A	C			rr	rr	B
Red-browed treecreeper	X	X	U	U		-				
Brown treecreeper		X	-	-	+					
Red wattlebird			U	U	+	+	r	rr	r	
Little wattlebird			-		+					
Regent honeyeater	X			+						
Bell miner			+		-					
Noisy miner			-			+				
Lewin's honeyeater	X		C	-	-	-				
Yellow-faced honeyeater			C	C	+		r	rr	r	
White-eared honeyeater			U	C	C		r	rr		
Yellow-tufted honeyeater			U							
White-plumed honeyeater			-			+				
Brown-headed honeyeater			U	U				r		
White-naped honeyeater			C	U				r		
Crescent honeyeater			U	U			r	r		
New Holland honeyeater				U	U		r	r		
Eastern spinebill			A	C	C	+	r		r	
Scarlet honeyeater						+				
White-fronted chat			-	-		+				
Mistletoebird				U	U		r	r	r	
Spotted pardalote		X	A	A	C	+		r		
Striated pardalote		X	U	U	U	+	r			
Silvereye			A	C	C	+	rr	rr	rr	B
Red-browed firetail			U	U	U	+	rr	rr	rr	B

Species	Forest- dep- endent	Needs hollows	Habitat				Recorded in Plantations †			Breed- ing record
			Open forest		Wood- land	Agri- cult- ural	Young	Mid	Mature	
			Wet	Dry						
Beautiful firetail			-	+						
Diamond firetail			-		+					
Olive-backed criole			R	U						
Satin bowerbird			R	R	-	R		r		
White-winged chough			-		+			rr	rr	B
Australian magpie- lark				R	R	C	r			
Masked woodswallow		X			+					
White-browed woodswallow		X			+					
Dusky woodswallow		X	U	U	U	U	r			
Grey butcherbird			R	U	U	+	rr	r	r	
Australian magpie			U	U	U	A	rr	rr	rr	
Pied currawong			C	C	U	U	rr	rr	rr	B
Grey currawong			U	U	U	R	r	rr	rr	B
Australian raven			U	U	U	+	r	r	rr	
Little raven			-	-		+		r		
Skylark (I)			-	-	-	+	r			
Blackbird (I)			R	R		+	r	r	r	B
Song thrush (I)			-			+				
European goldfinch (I)						+	rr	rr	r	B
European greenfinch(I)			-			+			r	
House sparrow (I)		X	-	-		+				
Tree sparrow (I)			-	-		+				
Common starling (I)		X				+	r	r		
Common mynah (I)		X	-	-		+				

Totals:

In habitats: 25 33 73 80 60 119 57 57 50 25

Number of species: 182

Number recorded in pine plantations: 81

Number known to breed:

in natural habitat 108

in pine plantations 25

† Records extracted from: Suckling *et al.* (1976); Davidons (1976); Friend (1978); and Disney and Stokes (1976).

Appendix 3

HABITAT CORRELATION FOR REPTILES AND AMPHIBIANS,
HILL END INVESTIGATION AREA

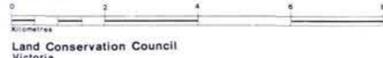
Species	Forest- dep- endent	Needs hollows or dead timber	Habitat				Possibly present in pines	
			Open forest		Wood- land	Agri- cult- ural		
			Wet	Dry				
Copperhead snake (highland form)			C	C	U	+	X	
Copperhead snake (lowland form)			+	+	+	+	X	
White-lipped snake			U	C	U	+	X	
Tiger snake			+	+	+	+	X	
McCoy's skink		X	A				X	
Mourning skink				R	U			
Black rock skink	X	X	C	C				
White's skink				C	C		X	
Delicate skink				+	U	+	X	
Garden skink				A	C	C	X	
Weasel skink			U	U	U	+	X	
Coventry's skink	X	X	C					
Three-lined skink					U			
Grass skink (form B)		X	+	+	U			
Metallic skink			U	+	+	+	X	
Spencer's skink	X	X	C	U				
Southern water skink (C.T.F.)	X	X	A	C				
Southern blue-tongue lizard			+	U	+	+	X	
Common blue-tongue lizard				+			X	
Tree goanna	X	X	U	U				
Reptile subtotal:	20	5	7	14	17	13	9	12
Brown tree frog			C	A	A	+	X	
Lesueur's tree frog	X		U	U				
Leaf-green tree frog	X		U	R				
Green and golden bell frog			+	+	+	+	X	
Verreaux's tree frog			+	+	+	+	X	
<i>Geocrinia victoriana</i>			A	A	C	+	X	
Eastern banjo frog			+	C	C	+	X	
Brown-striped frog			+	+	+	+	X	
Southern toadlet			U	C	C	+	X	
Common eastern froglet			C	C	C	C	X	
Amphibian subtotal:	10	2		10	10	8	8	8
Total:	30	7	7	24	27	21	17	20

† While no data are available on reptiles and amphibians in Victorian pine plantations, species that may be found there at some stage in development of the plantation have been tentatively predicted. Predictions are based on assessment of similarity between the habitat structure within pines and the natural habitats of these species, and on tolerance to other environmental changes (for example, partial clearing for agriculture).

PUBLIC LAND USE

Special Investigation:
Melbourne Area
Hill End

1:100 000

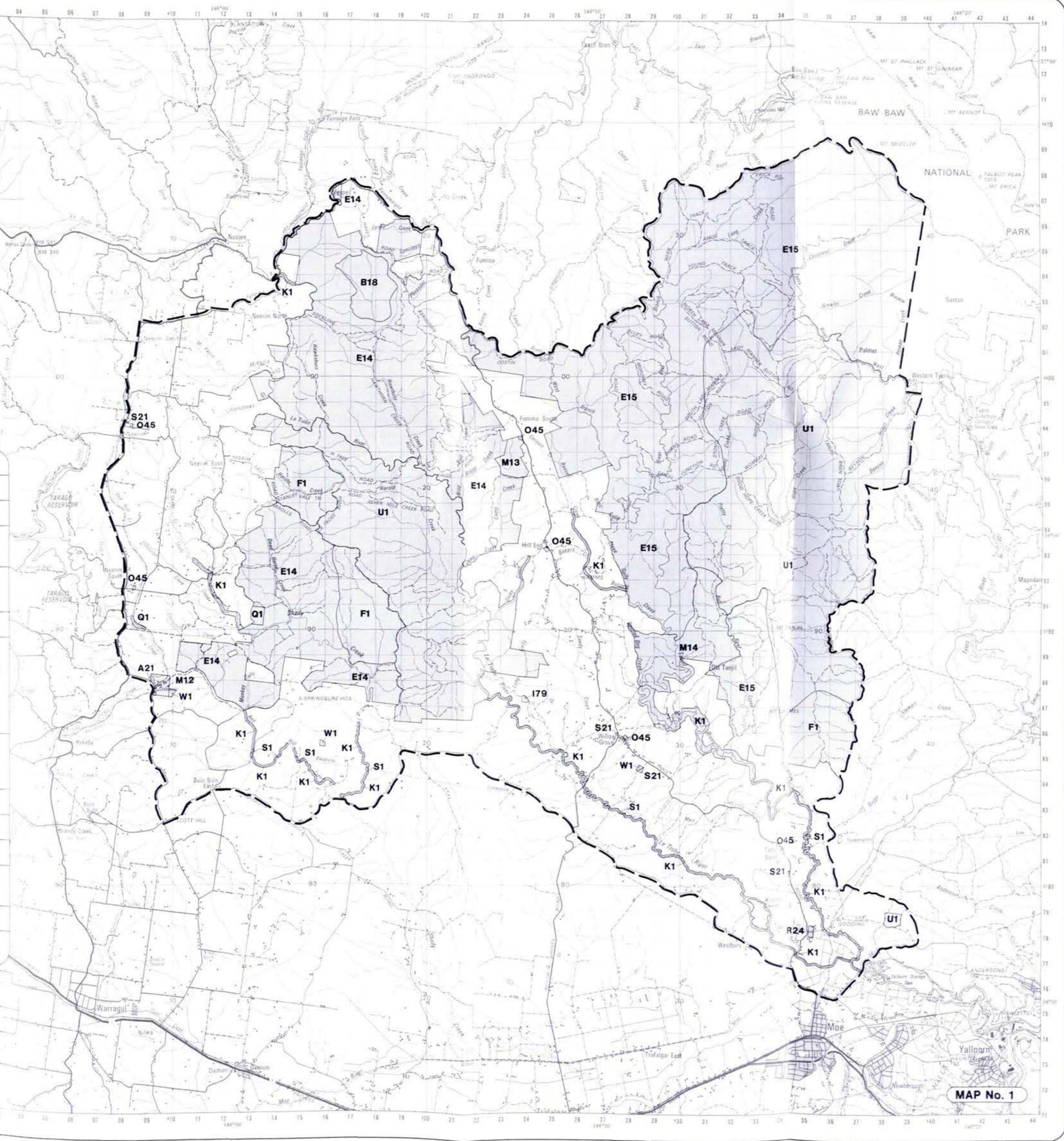


Land Conservation Council
Victoria

LEGEND

REGIONAL PARK	A21 Crossover
REFERENCE AREA	B18 Hawthorn Creek
HARDWOOD PRODUCTION	E14 Neerim East E15 Tanjil-Tyers
SOFTWOOD PRODUCTION	F1 Various (includes land allocated to softwood production but yet to be planted)
BUSHLAND RESERVE	I79 Willow Grove
PUBLIC LAND WATER FRONTAGE RESERVES	K1 Various <i>Note: Public land water frontage reserves cannot be accurately defined at this mapping scale. Refer to the appropriate parish plan to determine the boundaries of the reserve and whether the reserve is on one side, or both sides, of the stream.</i>
EDUCATION AREAS	M12 Crossover M13 Fumina South M14 Tanjil
RECREATION	O45 Existing Recreation Reserves
AGRICULTURE Alienation	Q1 Various
MINERALS AND STONE	R24 Westbury
UTILITIES AND SURVEY	S1 Existing Powerlines S21 Various Existing Utilities
UNCOMMITTED	U1 Various
OTHER RESERVES AND PUBLIC LAND	W1 Various

Note: The recommendations shown on this map refer to the final recommendations of the Land Conservation Council for the Melbourne Area published in 1977.



VEGETATION

Special Investigation:
Melbourne Area
Hill End

1:100 000

Land Conservation Council
Victoria

LEGEND

Map Symbol	Structural form	Major species of tallest stratum	Associated tree species	Form and common species of lower strata
1	Sub-alpine Woodland-Open forest I	Snow gum		Grass, low shrubs or heath; Tussock grass, Alpine pepper, Mueller's bush-pea, Sub-alpine beard-heath.
2	Open forest IV > 40 metres	Alpine ash	Shining gum	Ferns, sparse to dense shrubs, scattered small trees: Elderberry panax, Silver wattle, Snowy daisy-bush, Rough coprosma, Tasman flax-lily, Morder shield-fern, Hard water-fern.
		Mountain ash	Shining gum, Manna gum, Mountain grey gum, Messmate stringybark.	Tree ferns, dense layers of shrubs and small trees: Silver wattle, Hazel pomaderris, Mountain correa, Musk daisy-bush, Blanket-leaf, Forest wiregrass.
		(Closed forest in the wet gullies)	Myrtle beech, Blackwood, Sassafras.	Ferns and mosses.
	(Regrowth)	As for mature		
3	Open forest III 28-40 metres	Mountain grey gum	Messmate stringybark, Narrow-leaf peppermint, Manna gum.	Dense layers of small trees, shrubs and ferns: Silver wattle, Hazel pomaderris, Blanket-leaf, Forest wiregrass.
			Narrow-leaf peppermint, Mountain grey gum, Manna gum.	Generally dense tall shrubs; Narrow-leaf wattle, Varnish wattle, Cherry ballart, Hop goodenia, Prickly tea-tree, Handsome flat-pea, Common cassinia, Prickly moses, Austral bracken, Forest wiregrass.
			Messmate stringybark, Yetchuk, Brown stringybark, White stringybark.	
4	Open forest II 15-28 metres		Messmate stringybark, Yetchuk, Brown stringybark, White stringybark.	Generally low open shrubs; Narrow-leaf wattle, Prickly tea-tree, Burgan, Small grass-fern, Tussock grass, Forest wiregrass, Thatch saw-sedge.
5	Open forest I 15 metres		Yetchuk.	Generally low open shrubs or heath; Narrow-leaf wattle, Prickly tea-tree, Burgan, Furze hakea, Common ground-fern, Thatch saw-sedge.
6	Woodlands		Yetchuk.	Low heath; Thatch saw-sedge, Heath tea-tree, Prickly tea-tree, Silver banksia, Common heath, Furze hakea, Scented paperbark, Pouched coral-fern.
7	Softwood Plantation		Exotic conifers	
8	Cleared land		Pasture, cultivated, abandoned farmland, recreation grounds, public utilities.	

NOTE:
1. This map does not show the vegetation of all small blocks of public land and river frontages.
2. The areas shown on this map as softwood plantations include some areas allocated in the final recommendations of the Land Conservation Council for the Melbourne Area but not yet planted.

--- Investigation Area boundary
□ Public land

