Land Conservation Council Victoria

South Gippsland Study Area, District 1.

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$2.00

REPORT

on the

SOUTH GIPPSLAND STUDY AREA

(district 1)

Land Conservation Council, Victoria
Melbourne: December 1972

10688/72—PL

CONTENTS

FOREWORD

The Land Conservation Act, 1970 established the Land Conservation Council whose function is to "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".

This report sets out to describe and assess the natural resources of the public land in the Shire of Rosedale and provides a factual basis on which members of the community may base their submissions to the Council. It ensures that all those persons and bodies who have an interest in the future use of public land in this area can obtain and study the basic information, which the Council will itself study, and so make informed and constructive suggestions to the Council for its considerations.

In making this report available the Government hopes that all interested parties will be able to participate in an informed fashion in the process of considering how public lands should be used. It is hoped that in making submissions, members of the community will use as a basis the information provided by this study. The Council will make its recommendations only after due consideration of these submissions.

Demands for land for various purposes are many and varied, some of which are compatible and some conflicting or competitive. It is therefore important that decisions made are based on factual evidence, not on subjective criteria.

Submissions are now invited and should reach the Secretary of the Land Conservation Council within 60 days of the publication of this report, as notified in the Victorian Government Gazette.

S.G.McL. DIMMICK,
Chairman

Land Conservation Council,
464 St.Kilda Road,
MELBOURNE. 3004.

LAND CONSERVATION ACT 1970

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 14 of the *Land Act* 1958 and State forest;

(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 the 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 recommendation under paragraph (a) of sub-section (1).

Investigations, Notices and Reports

Section 9.

(1) The Council shall not make any recommendation under this Act in relation to any district or area without a prior investigation of the district or area.

(2) Before commencing any investigations 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 purpose 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 cases.

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 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 recommendation 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.

ACKNOWLEDGEMENTS

Government departments, organizations, and individuals assisted in the compilation of this report by supplying information and photographs, checking drafts, and contributing discussion and advice.

The Victorian Forests Commission provided a great deal of assistance by undertaking a survey of the vegetation, which served as the basis of the vegetation map, and providing information for the chapter on timber production.

The soils map was prepared from a "soils - land unit" survey of the study area undertaken by the Soil Conservation Authority, and their unpublished report of "A Study of the Land in the Lake Reeve Area" provided much information for the coastal area.

The Mines Department prepared a detailed report on the geology and physiography of the study area as well as a geological map. The Department of Crown Lands and Survey provided assistance with drawing maps and providing maps showing public land.

The State Electricity Commission supplied the bulk of the material for the chapter on mining. The Department of Agriculture and the State Rivers and Water Supply Commission respectively contributed information for the chapters on agriculture and water resources.

The following government bodies also assisted with the compilation of the report - The National Herbarium, National Museum, Fisheries and Wildlife Department, Central Planning Authority, National Parks Service, and the Applied Geomechanics Division of CSIRO.

The assistance given by the following persons and organizations is gratefully acknowledged: Mr. and Mrs. O. Thompson, Mr. I. T. Maddern, Mr. W. Cane (President of the Gippsland Apiarists Association), Australian Paper Manufacturers Pty Ltd, the Mammal Survey Group, and field naturalists of the area.

The Council is indebted to the following persons and organizations for providing photographs: Mr. and Mrs. O. Thompson, Mr. F. W. Noble, Mr. B.M. Nicholson, Mr. H. Guyatt, Mr. B.R. Thompson, Traralgon Historical Society, and Australian Paper Manufacturers Pty Ltd.

PART I INTRODUCTION

AIMS AND METHODS

This report sets out to present all available information relevant to making decisions on public land in the study area, which involves consideration of both ecological and economic data. It does not contain land use recommendations, but rather provides a factual basis on which land use recommendations can be formulated.

Ecologic aims

The report describes land - attributes namely climate, geology, physiography, soils, fauna, flora, and water - and defines interrelations so that the capability of land for various uses can be assessed and any natural features of particular interest highlighted.

Economic aims

As far as possible, it assesses present level of use and likely future demand for various land uses, and considers the possible effect of such demand on public land.

Collection of information

Information collected from government departments, public authorities, private organizations, and individuals has been supplemented by three short-term projects commissioned in fields where information was lacking.

Presentation of information

The text is divided into four parts Part I is introductory and, as well as outlining the aims and methods, discusses the principles of conservation and presents a brief history of the Rosedale Shire.

Part II describes the nature of the land within the study area, covering climate, geology, physiography, soils, vegetation, fauna, and water resources.

Part III deals with the main forms of land use likely to make demands on public land. These include conservation, recreation, agriculture, timber production, and mining.

In part IV the public land is divided into six blocks based on similarities of soils, climate, and vegetation. The potential of areas of public land within each block for various uses is assessed.

The several maps presented include locality, rainfall, geology, physiography, mineral resources, soils, vegetation, and present land use.

CONSERVATION PRINCIPLES

Conservation is concerned with Man's relation to his environment. It is often said to be the wise, rational, or balanced use of resources. Because wisdom and balance are not absolute terms, the principles set out here attempt to explain this concept.

Conservation can be considered as an endeavour to resolve conflicts between the individual and society about the present and future use of resources, and between competing uses of the same resource. The conservationist recognizes that a community needs land for recreational, scientific, and aesthetic purposes as well as for the production of food, timber, and minerals, or for urban and industrial use.

The Use of Resources

Two broad classes of natural resource may be distinguished.

Non-renewable resources

The quantity of these resources does not increase significantly with time, and use consumes them. The expansion of Victoria's economy last century was based on the exploitation of gold - a non-renewable resource. The oil and gas fields of Bass Strait provide another example.

Conservation of a non-renewable resource requires the best techniques for exploration, recovery, and processing, and the efficient use of the end product.

Renewable resources

Quantity of a renewable resource such as timber or wheat may increase or decrease with time. Animal and plant communities and landscape fall within this class.

The balance of resource use is likely to change with time and the definition of resources will change as technology changes.

Relations Between Resource Uses

Many uses of a resource are compatible. They may be supplementary and add to each other, or complementary in that one use benefits from the other, but they may also be competitive when an increase in one leads to a decrease in the other.

For example, the relation between timber production and picnics within a forest may be complementary in the sense that picnickers gain access along tracks and use open spaces created during timber-harvesting operations. It may become competitive if logging makes the forest an unsuitable picnic area, and at other times picnickers may present a considerable fire risk.

In general, decisions on land use will involve selecting major land uses for a particular area, and determining other uses compatible with these and the intensity of use above which they become incompatible.

The Principles of Land Use

In the past, our society has grown (and the economic welfare of the people improved) through mining, farming, timber production, and industrial development. These industries have been given prime importance and the use of natural resources has often been decided in relation to short-term advantage when conflict arose. The deleterious effects of this type of development have been recognized and there is now a popular demand for attention to the total needs of the community.

The concept of balance requires equal consideration of all uses, as well as the needs of this and future generations. These needs should be clearly stated as aims.

Conclusion

Outstanding natural features should be preserved.

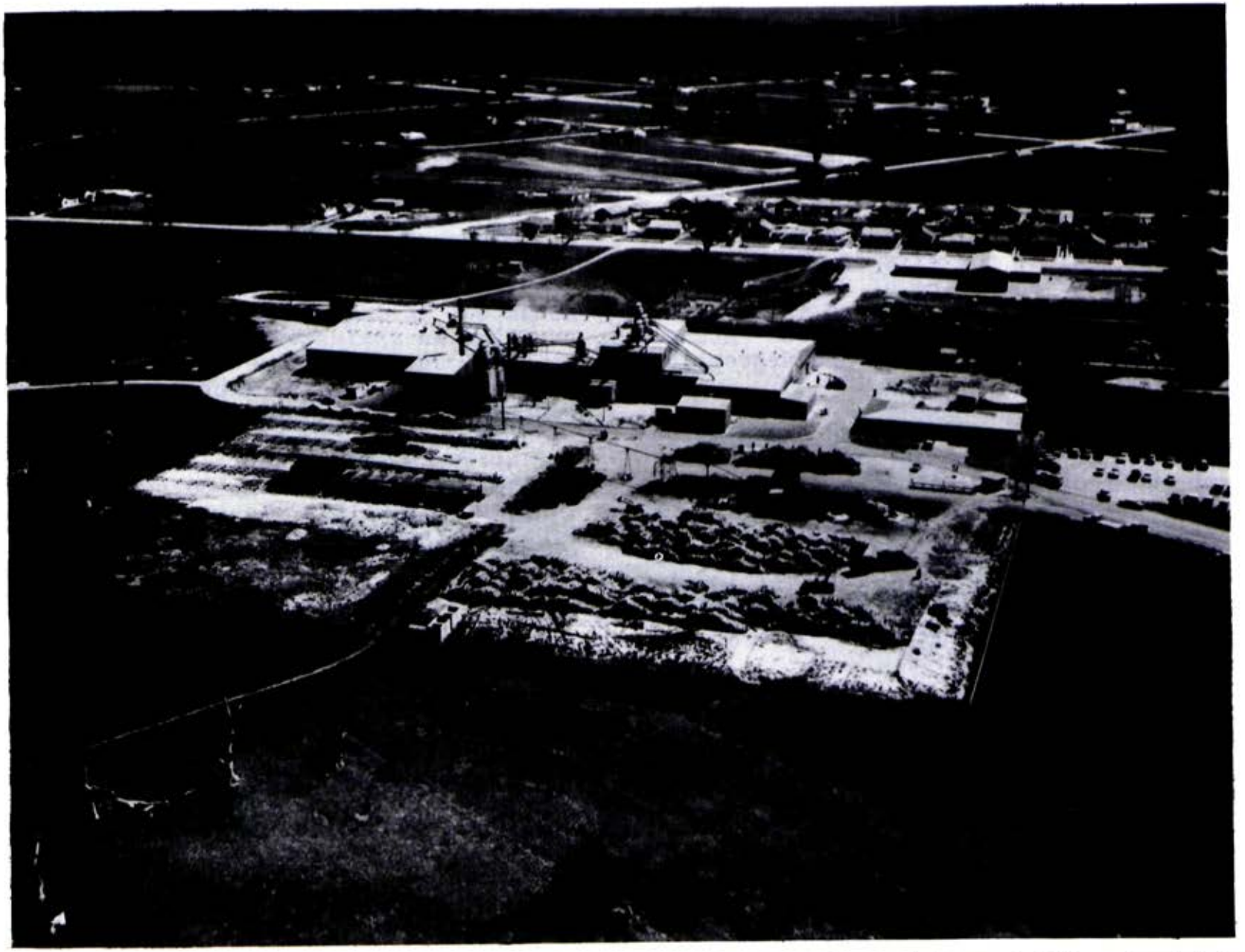
The intangible values of recreation, aesthetics, and preservation must not be ignored. In addition to actively providing land for these purposes, we must also consider the impact of other land uses upon them.

Where several land uses are compatible, land should be available for all such uses. It may be necessary to define major aims and to assess levels above which secondary uses are unacceptable.

Where land has been committed to a particular use it should be managed so that its capability for that use is not impaired. Uncommitted land should be maintained in a condition that will allow the widest possible choice of future uses.

Policy measures should stimulate the best use of partly developed lands and discourage significant changes in natural areas.

Review and reassessment of land become necessary as society and technology change.



Particle board factory at Rosedale which is supplied with wood from A.P.M. plantations

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THE STUDY AREA

The study area - approximately 160 km (100 miles) to the east of Melbourne - encompasses the Shire of Rosedale, an area of 2,510 sq km (960 sq miles). The boundary extends across various natural geologic, physiographic, and vegetative regions.

The Shire is bounded in the north by the Thomson River, the Latrobe River (west of its confluence with the Thomson), and the southern shores of Lakes Wellington, Victoria, and King. Monkey Creek forms part of the southern boundary. This flows from west to east into Merriman's Creek, which then forms the boundary to the coast at Seaspray (see map facing this page).

Gentle relief predominates in the study area. However, small areas of mountainous country occur in the south-west and north-west.

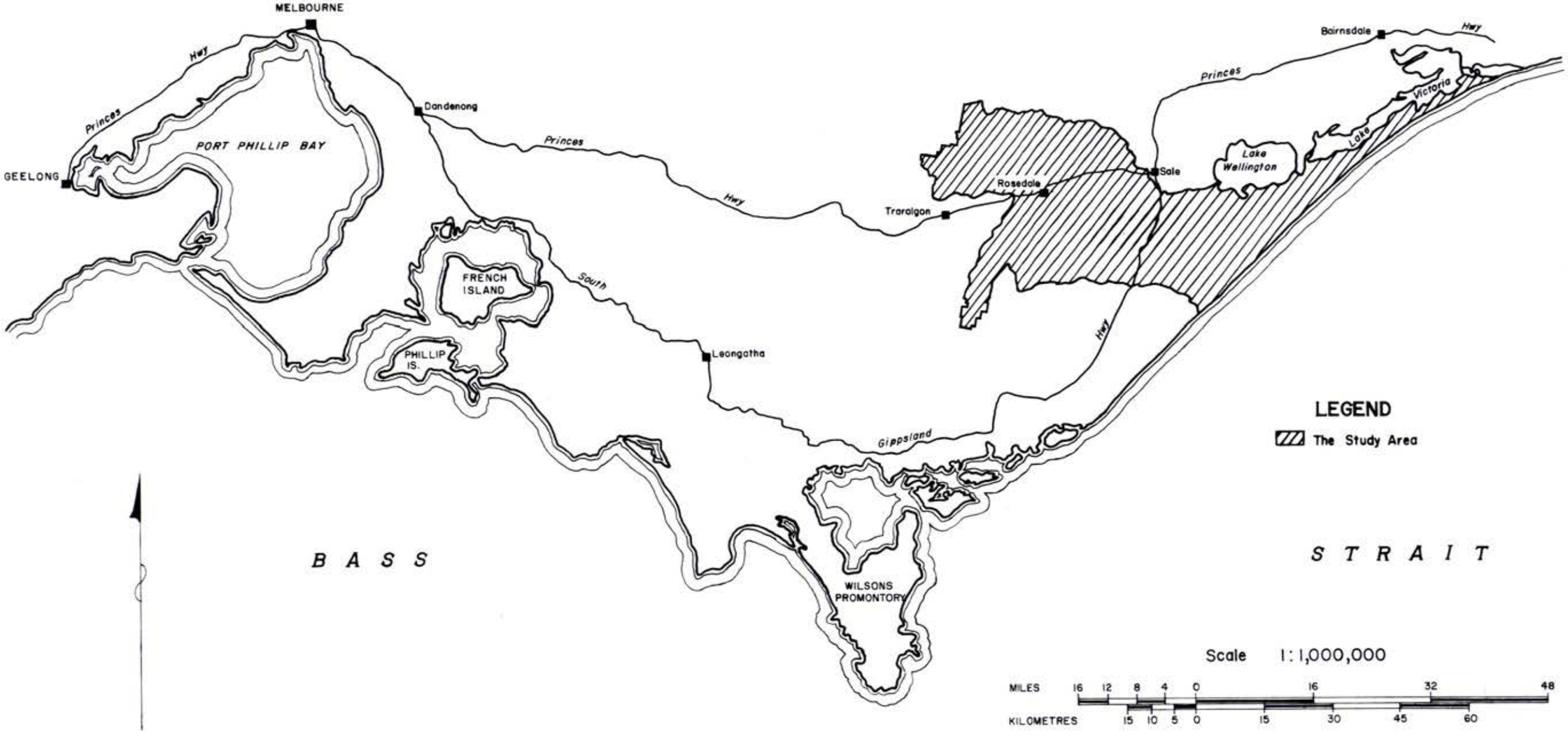
A variety of environments and several forms of land use occur in the region. Grazing is widespread and cropping of softwoods is important, while most of the land in irrigated areas supports dairy production. The Gippsland Lakes region is rapidly becoming an important recreational area.

The cities of Traralgon and Sale are located just outside the Shire, the largest town within the study area being Rosedale. The population of the Shire has been growing at about 1% per annum in the past decade, and totalled 4,989 in 1971.

The area is well served by roads, with the Princes and South Gippsland Highways passing approximately through the centre. Forests Commission and Shire roads and tracks provide access to most public land.

LOCALITY PLAN

LAND CONSERVATION COUNCIL
VICTORIA
SOUTH GIPPSLAND AREA
DISTRICT 1



HISTORY

The explorer surgeon, George Bass, followed the Gippsland coastline from east to west as far as Western Port Bay in 1798. Although, after his trip, sealers and whalers used this coast for temporary bases for their activities, nobody penetrated inland until more than 30 years later.

About 1835, some squatters reached the borders of Gippsland from the north-east, the Monaro Plateau area of New South Wales. It is probable that they penetrated some distance into Gippsland. But not until the explorations Scottish-born Angus McMillan and Polish scientist Paul Strzelecki, in 1840, were any runs taken up in the area.

McMillan (according to excerpts from his diary that Richard Mackay recorded) decided to explore the region after he had heard Aborigines in the Maneroo district, where he was based, talking about the fine country that existed near the coast south-west from Maneroo. He made three main exploratory trips to the region, in 1839, 1840 and 1841.

On his second journey in 1840, he discovered and named Lake Victoria, which he noted, "was alive with swans, ducks and pelicans". Following this trip, he sent a report to his employer in Sydney, Mr. Lachlan Macallister, describing "Caledonia Australia", as he had named the area, as having rich land and good climate. (Strzelecki later named the region Gippsland after Sire George Gipps, then Governor of New South Wales.)

On that same journey, McMillan and his party penetrated into the Rosedale Shire discovering the Thomson River, the Latrobe River, and Snake Ridge. The following year, he once again passed through the Shire *en route* to the coast, where he discovered Port Albert.

McMillan, incidentally, mentions numerous encounters with Aboriginal tribes during his trips. He records only one attack by a hostile tribe.

The squatters

After McMillan's explorations, the rush to Gippsland began. 1841 saw the first major cattle stations spring up in the region. That year, James and M. Mac-Farlane occupied Heyfield (which they later subdivided into Heyfield and Glen-maggie). P. Imlay took up Fulham, and Mrs. Helen Pearson occupied Kilmany with

Early Goodwin home at Toongabbie, 1884

her son, William Pearson.

John Reeve took up Snake Ridge Station, which included the present site of Rosedale, in 1842. This run covered more than 60,000 acres and was one of the largest in Gippsland. That same year, George and Walter Curlewis occupied the nearby station of Holey Plains, which still exists today, although much reduced in area.

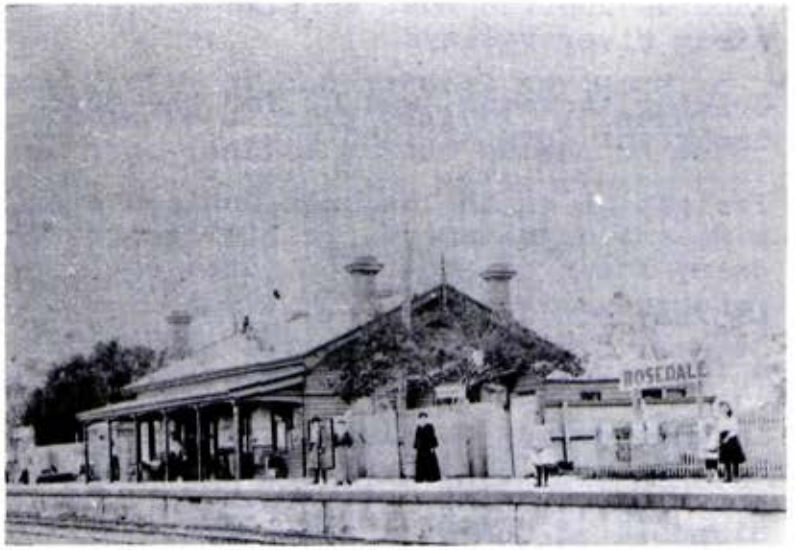
In 1843, Edward William Bayliss took up the Merton station (now known as Willung) of 15,360 acres on Merriman's Creek. The following year, Lieutenant David Parry-Okeden came to the Rosedale station, Edward Hobson arrived at Traralgon, Albert Brodribb and William Bennett at Hazelwood, and James Rintoull at Loy Yang. Hazelwood was named after Mrs. Hazel Bennett (nee Brodribb) and Marvale, after he daughter, Miss Mary Bennett, the first two white women to live in the Hazelwood-Maryvale area. By the end of that year all of the open country of Gippsland was occupied.

The era of the squatters lasted exactly 30 years - from the discovery of Port Albert in 1841 until 1871, when the Government decided to divide the land held by squatters into small farms to be thrown open for selection.

Transport and communications

Bush tracks formed the first lines of communications and bullock drays and horses were the principal means of transport. The first track ran between Sale and Port Albert. Soon afterwards, tracks were established along the coast in the south of Gippsland and in the north along a route approximating that of the Princes Highway. The latter was called Tyre's track, after C.J. Tyers, first Commissioner of Lands for Gippsland, who surveyed and improved this track in 1847. Tyers also named the Morwell River - after the Morwell Rocks, in the Tamar River, near Plymouth, England.

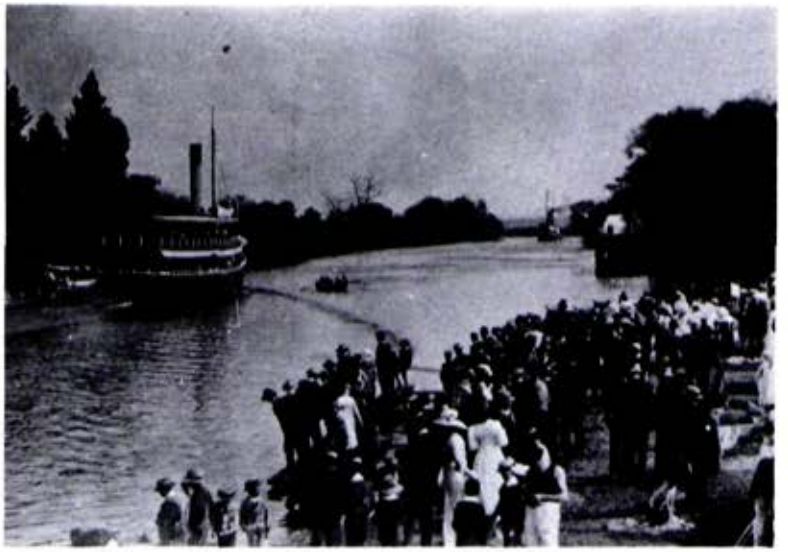
Rosedale found itself in a strategic position, at a point where the Port Albert-Rosedale track met the



Rosedale railway station, 1908

Melbourne-Sale track, and consequently it became one of the most important centres in Gippsland - quite a contrast to its status relative to other centres today.

In 1861/62, the completion of a bridge over the Latrobe River at Rosedale made the township an important transit centre for the stream of gold-miners travelling to the goldfields in the mountains to the north. This influx of people resulted initially in a coach service being established between Port Albert and Rosedale in 1862. Improvement of Tyre's track followed, and a direct coach service between Sale and Melbourne was created in 1865.



Boats on the Latrobe River at Sale

In April, 1859, a schooner was taken through the treacherous entrance to the Gippsland Lakes. Coaches and ships thus became the most accepted forms of public transport until trains replaced them.

The first section of the Sale-Melbourne railway line was built from Sale to Morwell in 1877. The other sections were completed during the following 2 years.

The arrival of the railway system adversely affected Rosedale. Trains did not need so many stopping places, so Rosedale was by-passed in favour of bigger centres, like Sale.

Problems of early transport in Gippsland mud.

Local Government

The first form of municipal government at Rosedale was the Rosedale Roads Board established in 1869. Within 2 years the Shire of Rosedale was proclaimed. Initially, it covered about 2,590 sq km (1,000 sq miles) but, due to alterations in boundaries, its present area is 2,510 sq km (969 sq miles).

Land Use

Agriculture

Squatters grazed either cattle or sheep. However, sheep were not a success. Cropping became the established form of land use on the most fertile soils - along river valleys.

Grazing, however, was by far the most important form of land use.

Irrigation in the Nambrok-Denison area, a recent development, initially provided dairy farms of about 100 acres each for returned servicemen from the 1939-45 war. These farms have taken the place of a few large estates.

In another new development, the Latrobe Valley Water and Sewerage Board has established a farm at Dutson for the disposal of domestic and industrial wastes.

Clearing trees with a hand winch by early farmers

Forestry

Very little of the natural hardwood in the area is of high quality, although some high-quality stands remain on part of the South Gippsland hills within the Shire. Most of this country, however, was cleared for farming following the building of the railway between Melbourne and Sale. Much of the cleared farmland was later abandoned and is now being converted back to forest.

Softwood plantations have been established in the Shire, mainly on freehold land and almost entirely by private enterprise. A.P.M. Forests Pty. Ltd. began planting in 1950, and since then expansion has been rapid.

Secondary industry

Industrialization of the Latrobe Valley began with the building of brown coal electricity-generating stations at Yallourn by the State Electricity Commission in 1921.

Australian Paper Manufacturers Ltd. (A.P.M.) established a pulpmill at Maryvale in 1939, which is supplied in part by the extensive plantations within the Shire.

In 1963, a particle-board factory, producing "Pyneboard" and owned jointly by A.P.M. and Colonial Sugar Refining Co. Ltd., began operating at Rosedale. More recently, following the discovery of oil and natural gas in Bass Strait B.H.P. and Esso have constructed the Gippsland Gas Processing and Crude Oil Stabilization Plant at Longford.

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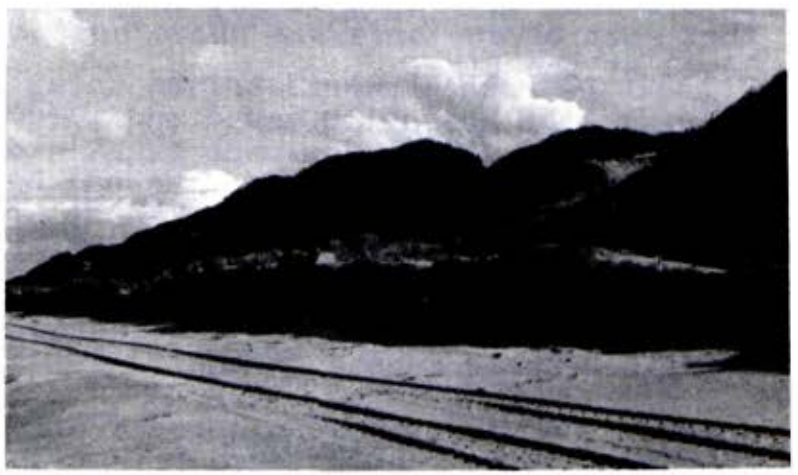
PART II NATURE OF THE LAND

GEOLOGY AND PHYSIOGRAPHY

Physiography

Much of the area consists of flat-lying Cenozoic sediments in the form of a coastal plain, which slopes gently eastwards from an elevation of 90m (300 ft) near the highlands to low-level swamps and dunes near the coast.

Near its northern boundary, the study area includes a small region of Palaeozoic sediments, which form the foothills of the eastern highlands of Victoria. The southern boundary encompasses part of the South Gippsland highlands formed by uplifted sediments of Mesozoic age. These are deeply dissected, as are the highlands to the north.



Calcareous dunes fringing the Ninety Mile beach

The coastal flood plain can be subdivided into an ancient alluvial flood plain and fans, high-level river and coastal terraces and sand sheets, stream flats, and low-level terraces. The dunes, raised beaches, and swamps along the coast are incorporated in a separate physiographic unit.

Geology

Palaeozoic

The sediments forming the eastern highlands consist of Palaeozoic argillites and greywackes originally deposited in a complex sedimentary basin, referred to as the Tasman Geosyncline, during the Ordovician, Silurian, and Devonian Periods. These sediments now form much of the land mass of south-eastern Australia.

Marine sedimentation ceased as a result of Middle to Upper Devonian tectonic

activity, which involved uplift, folding, and faulting and was accompanied by intrusion of granite. The intense and consistent north-south fold belts developed at that time are a characteristic structural feature of most of the Tasman Geosyncline system.

A period of terrestrial sedimentation followed, and quartzose sediments of Upper Devonian and Lower Carboniferous age were deposited in graben basins. Volcanic activity resulted in extrusion of rhyolitic lavas.

Upper Carboniferous and Permian glaciation removed much of the younger sediments and exposed granite masses.

Mesozoic

The landscape at the beginning of the Mesozoic was probably of low relief and, until the Jurassic, sedimentation consisted of localized deposits of quartzose sediments of Triassic age.

A marked change in the tectonic and sedimentary regime of the region occurred in the Jurassic, when a down-faulted rift or graben formed in the south of the Australian continent. This graben was only 80 km (50 miles) wide, but extended at least from South Australia to East Gippsland.

During the Jurassic and Lower Cretaceous Periods, down-faulting continued and a great thickness of felspathic sandstones, siltstones, and shales with minor coal seams were deposited within the graben. These sediments are referred to as the Strzelecki Group in the Gippsland Basin and the Otway or Merino Group in the Otway Basin.

Renewed tectonic activity at the close of the Lower Cretaceous resulted in the formation of a series of marine sedimentary basins across the rifted zone. These basins, referred to as the Otway, Bass, and Gippsland, eventually became open to marine influences. The marine incursions probably stemmed from the west, since the thickest sequence of marine sediments (of Upper Cretaceous age) occur within the Otway Basin.

Only a limited development of sediments of this age occurred in the on-shore part of the Gippsland Basin, indicating that most of the area was above sea level at the time.

Tertiary and Recent

The first sediments deposited in the on-shore part of the Gippsland Basin were coarse sands and gravels of terrestrial origin. They are referred to as the Childers Formation and are considered to be Paleocene or Eocene in age.

The suite of basic volcanic rocks often found overlying the Childers Formation is called the Thorpdale Volcanics. However, more than five separate flows have been recorded and basalts have been

found interbedded with brown coals of the Latrobe Valley Formation.

During the Eocene, block faulting and uplift was renewed and the sediments of the Strzelecki Group were elevated in blocks to form the South Gippsland highlands. However, tectonic activity was gradual and the basin deepened and was fitted with carbonaceous sediments interbedded with sands and clays.

A non-marine environment prevailed in the Gippsland Basin and relatively stable tectonic and climatic conditions resulted in the deposition of a thick sequence of brown coals, clean sands, and carbonaceous clays. This formation, with the Narracan Group (called the Latrobe Valley coal measures), can exceed 600m (2,000 ft) in thickness and can contain more than 240m (800 ft) of relatively pure brown coal.

A major marine transgression occurred during the Lower Oligocene because of more rapid down-warping of the basin, and the sea that spread across it resulted in deposition of a thick sequence of calcareous sediments within the basin. These are referred to as the Gippsland Formation and can be more than 914m (3,000 ft) thick. However, westward extension of these seas was probably limited by the Baragwanath Anticline and a monocline running north-south across the basin near Rosedale.

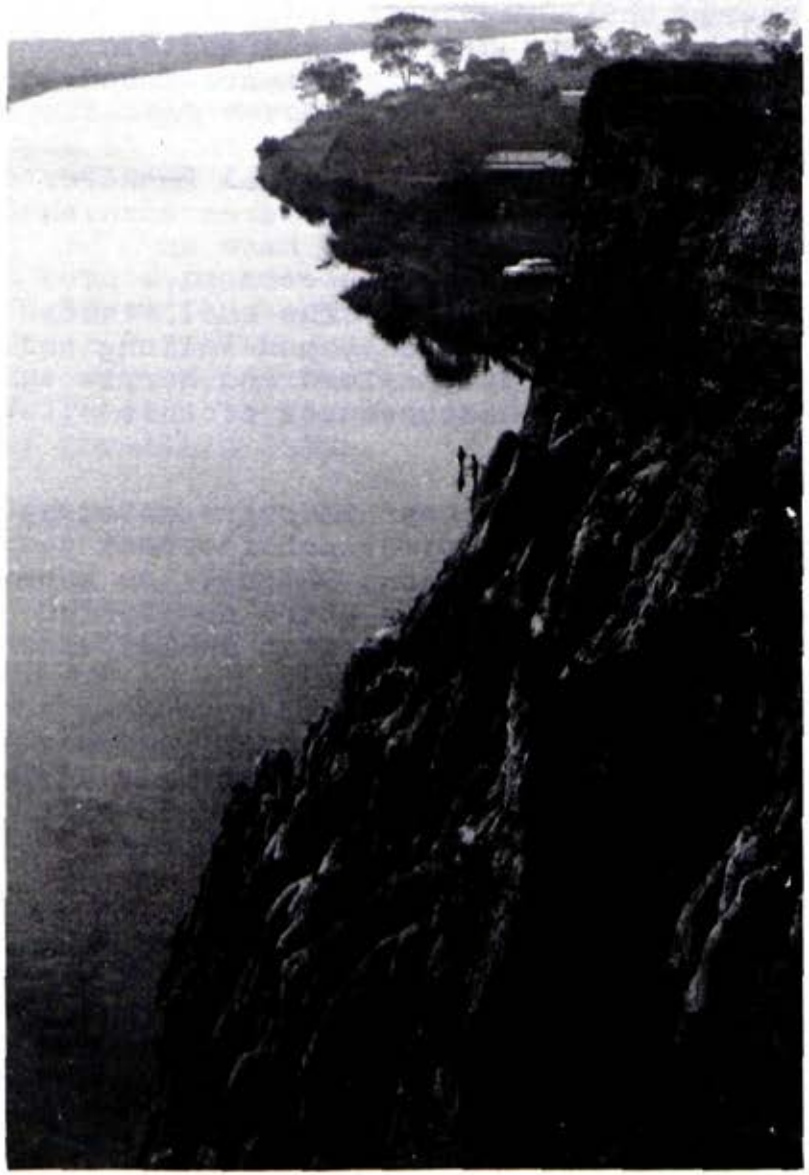
However the marine sediments once partly covered the Baragwanath Anticline; these have been exposed around its eastern limits and remnants of marl are found at Holey Hill.

The uplift and folding of coal measures and limestones along structures such as the Baragwanath Anticline have an important bearing on the economics of mining these deposits. The coal fields at Loy Yang, Gellendale, and Willung and the limestones at Longford and Merriman's Creek are occurrences of this type.

The final marine phase is represented by the late Miocene to early Pliocene Jemmys Point formation, which is a regressive sedimentary phase consisting of glauconitic and limonitic shelly sands.

A last regressive depositional phase occurred towards the close of the Tertiary. Marginal marine lacustrine deposits, referred to as the Boisdale Beds, were deposited across the marine sequence. They range in age from Pliocene or perhaps late Miocene to Pleistocene, and consist of more than 300m (1,000 ft) of sediments, including 120m (400 ft) of clays overlying carbonaceous silts that become calcareous and appear to grade into the Gippsland Limestone.

A thin flood-plain deposit of sands, gravels, and clays formed across the basin area as uplift increased the



Haunted Hills gravels exposed in a cliff at Eagle Point

production of detritus from the surrounding highlands during the late Pliocene and early Pleistocene Periods. These sediments have been called the Haunted Hills gravels.

Continued elevation of the highlands and the basin area resulted in the erosion of the flood plain by rivers of the region. Minor tectonic events and sea-level changes have resulted in the present complex system of drowned river valleys, river and marine terraces, and the beach barrier dunes, resulting in turn in the formation of the Gippsland Lakes.

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CLIMATE

The survey area has a warm climate, with a uniform rainfall and a long temperate summer.

Rainfall

Average annual rainfall

Average annual rainfall is highest on the elevated country in the south-west of the Shire, where it exceeds 50 in. It is lowest (as low as 20 in.) in the south-east on the coast. Much of the study area is in the rain shadow created by the Eastern and South Gippsland highlands.

Seasonal rainfall probability

The potential of an area for pasture growth, considering rainfall alone, can be determined from rainfall probabilities. Seasonal rainfall probability can be defined as the percentage chance of receiving a specified amount of rain in a particular season.

The following data outline the probability of receiving 4 in. in each season in the study area (see Table 1).

For the summer months - December, January, and February - the lowest percentage occurs in the south-eastern part of the survey area, where the chance of receiving 4 in. is a little below 70%. It is slightly less than 90% in the north-east and greater than 90% in the south-west.

During autumn - March, April, and May - the probability of 4 in. is greater than 75% for the whole area except the south-east, where it is slightly less than 70%.

For the winter months - June, July, and August - the chance of the area receiving 4 in. exceeds 75%. However the south-west, with 100%, is an exception.

For the spring - September, October, and November - the probability exceeds 80% over the whole area, and is generally greater than 90%.

Temperature

Temperatures in all but the elevated areas are relatively mild. July is the coldest month and February the warmest,

PHYSIOGRAPHY AND RAINFALL

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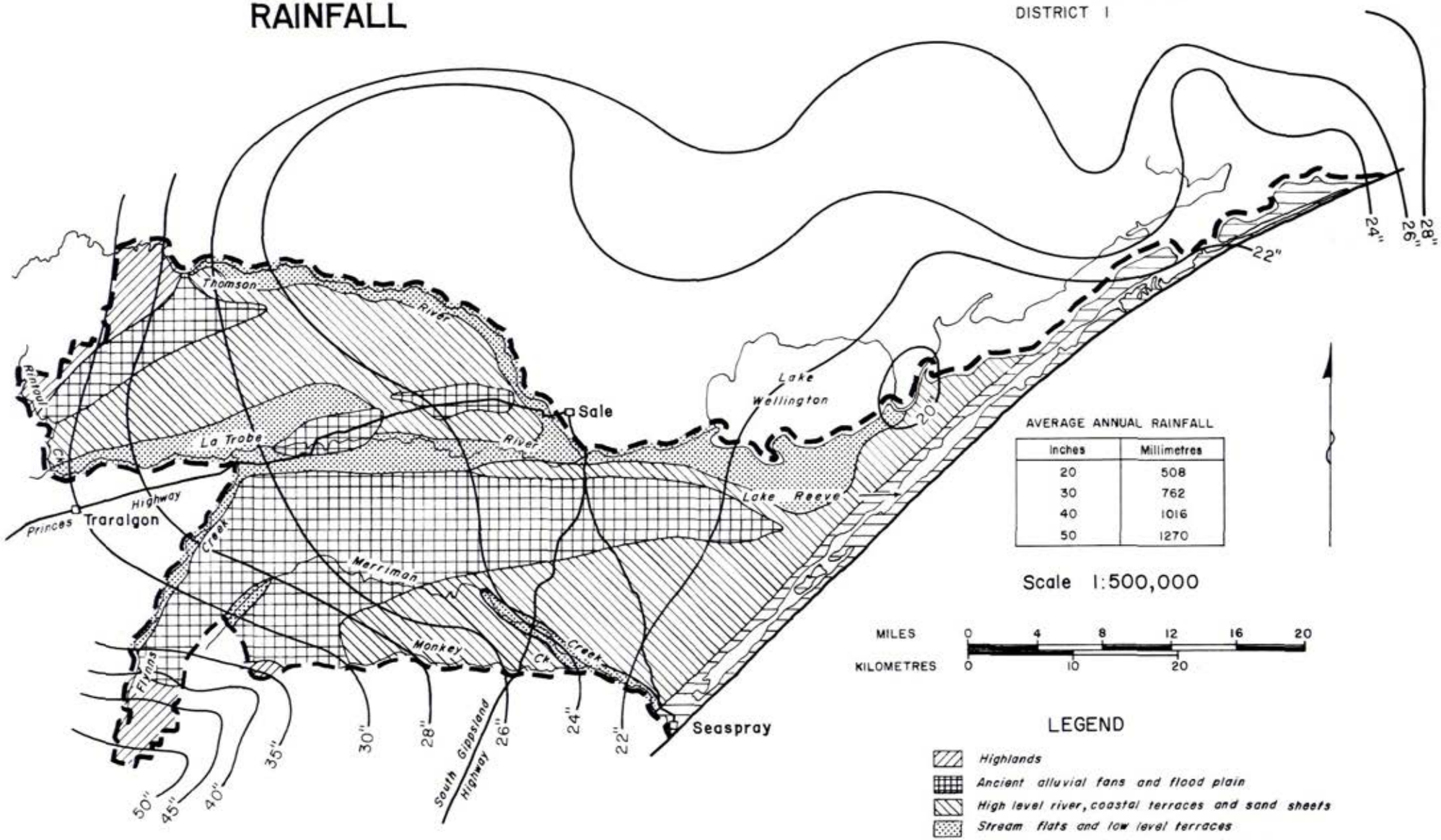

AVERAGE ANNUAL RAINFALL

Inches	Millimetres
20	508
30	762
40	1016
50	1270

Scale 1:500,000

MILES 0 4 8 12 16 20
KILOMETRES 0 10 20

LEGEND

- Highlands
- Ancient alluvial fans and flood plain
- High level river, coastal terraces and sand sheets
- Stream flats and low level terraces
- Coastal dunes, raised beaches and swamps
- 30" ~ Annual isohyets

Table 1

SEASONAL RAINFALL PROBABILITY

Rainfall (in.)	Percentage probability						
	Lakes Entrance	Paynesville	Sale	Dutson	Rosedale	Currajong	Traralgon
December-February							
2	97	98	99	98	98	100	98
4	88	84	73	68	73	93	82
6	57	48	38	31	32	78	52
8	29	25	15	13	13	53	17
10	15	14	8	4	4	30	9
12	7	6	5	1	1	14	3
March-May							
2	98	99	99	97	100	100	100
4	91	82	77	69	83	99	84
6	63	55	39	39	48	88	59
8	31	31	21	17	20	70	36
10	18	17	88	3	5	47	13
12	11	6	3		3	28	2
June-August							
2	99	96	99	99	100	100	100
4	81	79	74	77	89	100	96
6	53	40	32	27	41	99	80
8	24	15	10	9	16	89	39
10	9	7	4	3	5	70	9
12	3	4	1		2	49	3
September-November							
2	99	100	100	99	100	100	100
4	83	89	93	90	94	99	98
6	68	48	65	43	69	93	87
8	40	25	32	15	39	79	56
10	16	8	8	2	11	55	25
12	3	2	1		2	34	4

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as shown in Table 2. Over most of the survey area, frosts are infrequent: the frost-free period for Sale lasts from the end of September to the beginning of May. However, more frequent and severe frosts occur further inland, especially in the elevated country. Between May and July the coastal area receives more than 40% more hours of sunshine than Melbourne.

Growing Season

Effective rainfall

Effective rainfall is the amount necessary to initiate and maintain plant growth. The growing season is defined as the number of consecutive months during which the chance of receiving the effective amount equals or exceeds 50%. Effective rainfall provides a useful guide to the growth potential of crops and pastures, but probably has less significance for deep-rooted native perennials, which can tap underground moisture reserves.

In terms of effective rainfall, even the driest part of the Shire has a long growing season, extending from March to December (see Table 3).

Temperature

Low temperatures adversely affect plant growth, which is retarded in a month with an average temperature of less than 10°C (50°F), and virtually stops when the monthly average falls below 5.5°C (42°F). During winter, average temperatures in most of the study area are probably below 10°C. However, at Lakes Entrance average temperature falls below 10°C only during July (see Table 2). In elevated areas, monthly averages would probably be below 10°C for longer periods. Furthermore, they would be expected to fall below 5.5°C during July.

Soil properties

In addition to rainfall and evaporation, the amount of water available to plants depends upon drainage and the capacity of the soil to store moisture. Little information regarding this storage capacity exists for soils in the area, but in general it would be expected to be low.

Drought Frequency

Effective rainfall can form the basis for calculating drought frequency, in terms of periods during which less than the effective amount of rain falls. At Rosedale, the conditions from January onwards will be "droughty" for 2 months (in January and February) in 29% of years, while droughts continuing for 3, 4, and 5 months will occur with frequencies of 18, 6, and 1% respectively (see Table 5).

The Shire is not a particularly drought-prone area. For example, compared with

Table 2

AVERAGE MAXIMUM, MINIMUM, AND MEAN MONTHLY TEMPERATURES (^{o}C)

	Lakes Entrance			Sale			Yallourn		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
January	23.1	14.1	19.1	25.3	12.4	18.9	25.4	12.1	18.7
February	23.6	15.1	19.3	25.8	13.1	19.4	25.2	12.6	18.9
March	21.7	13.6	17.8	23.9	11.8	17.9	23.5	9.5	16.5
April	19.9	10.9	15.4	20.2	8.9	14.6	18.8	9.0	13.9
May	15.8	8.7	12.3	17.0	6.2	11.6	15.9	6.6	11.3
June	13.8	6.6	10.1	14.1	4.2	9.1	12.9	4.7	8.8
July	13.8	5.6	9.5	13.8	3.7	8.7	12.7	3.8	8.3
August	14.4	6.1	10.2	15.4	4.4	9.9	14.1	4.7	9.4
September	15.2	7.4	12.1	17.7	6.2	11.9	16.7	5.8	11.3
October	18.5	9.2	13.9	20.0	7.7	13.8	19.1	7.6	13.3
November	19.7	10.2	15.1	21.9	9.7	15.8	21.2	9.5	15.4
December	20.4	11.9	16.2	24.2	11.6	17.9	24.1	11.3	17.7

Table 3

PERCENTAGE FREQUENCY OF RAINFALL EQUAL TO OR GREATER THAN THE EFFECTIVE AMOUNT

	Lakes Entrance	Paynesville	Sale	Dutson	Rosedale	Currajong	Traralgon
January	63	57	41	45	42	68	39
February	55	49	45	44	45	65	50
March	74	68	62	56	62	77	62
April	83	72	65	62	69	90	77
May	84	80	70	70	79	94	90
June	91	87	90	92	93	99	97
July	96	87	91	90	93	100	98
August	88	89	93	90	96	99	96
September	98	89	93	91	96	100	98
October	90	86	87	85	91	96	93
November	70	63	68	55	68	87	95
December	70	65	55	54	55	77	55

Table 4

PROBABILITY OF DROUGHT DURATION (based on effective rainfall) AT ROSEDALE

	Percentage probability that drought beginning in a given month will last for			
	2 months	3 months	4 months	5 months
January	29	18	8	1
February	25	11	1	
March	15	1		
April	4			
May				
June	1			
July				
August				
September				
October	1			
November	14	7		
December	18	5	4	3

Rosedale's 29% chance of suffering a drought lasting 2 months, Casterton (which has an average annual rainfall of 26.46 in.) has a 67% chance.

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WATER RESOURCES

This chapter outlines water resources in the study area and how they are used.

Surface Water

Rainfall and run-off

Most of the Shire receives between 22 and 30 in. average annual rainfall except for a relatively small area of the elevated country in the south-west, Which has more than 50 in. Because of the generally low rainfall in relation to evapotranspiration, and the existence of permeable sandy soils, surface run-off is generally only 1-5 in., but reaches 20 in. in the high-rainfall area near the headwaters of Merriman's Creek.

Major streams

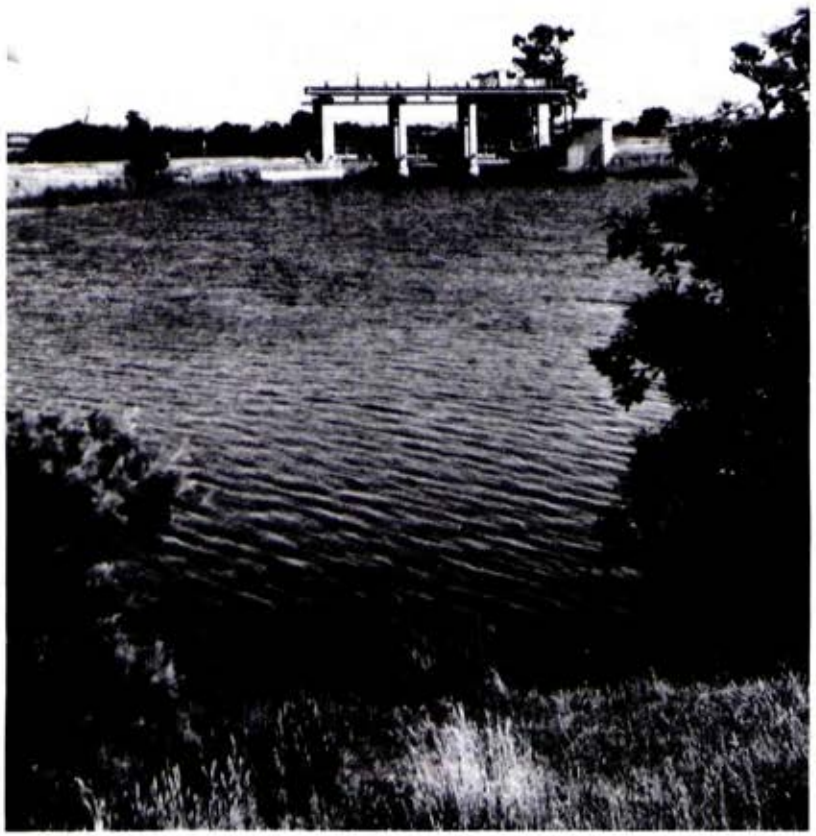
The major streams in the study area - the Latrobe and Thomson Rivers - both have their sources outside the Shire. The only other stream of significance is Merriman's Creek. Table 5 sets out the statistics for these streams. (101.94 cubic metres per hour = 1 cusec, and 1,233.48 cubic metres = 1 acre-foot.)

Table 5

STREAM STATISTICS

Stream	Gauging point	Years recorded	Mean annual discharge (acre-feet)	Peak flood flow (cusecs)
Latrobe River	Rosedale	55	763,800	124,000
Thomson River	Cowwarr	50	325,300	25,000
Merriman's Creek	Gormandale	4	13,500	1,305

The Thomson and Latrobe Rivers flood on the average approximately twice a year, although there have been years with no floods and others with up to seven.



Cowwarr Weir on the Thomson River

The Latrobe River is considered to be in flood when the flow at Rosedale is 4,000 cusecs or more, and the Thomson River when it flows at 2,000 cusecs or more at Cowwarr Weir. Flood flow for Merriman's Creek is not defined.

In all cases at minimum or average flood flows, the rivers flood only river flats used for grazing and do not cause any real damage. Flows of 20,000 cusecs or more in the Latrobe River at Rosedale and 15,000 cusecs in the Thomson River at Cowwarr Weir are necessary before any property damage occurs, and this would mainly involve roads. Such floods occur about once in every 5 years.

The Gippsland Lakes

Lake levels are relatively high during winter and low in summer, depending on the relations between evaporation, rainfall, and discharge from rivers. Flooding of rivers may significantly raise the levels, but floodwaters escape rapidly through the artificial outlet constructed at Lakes Entrance. In 1889, prior to its construction, floodwaters broke through the sand dunes, opening a natural outlet.

Before construction of the artificial opening, the Lakes were less saline than they are today. Their salinity is largely determined by the amount of salt water that flows from the sea through the entrance, and salinity follows a gradient from fresh water at the river

mouths to sea water at the entrance. This gradient is steeper in winter than in summer because of high discharge from rivers and low evaporation. It may well be, however, that any further increase in the use of water from the Thomson or Latrobe Rivers would have the effects of increasing the salinity level in the Lakes.

Ever-increasing numbers of commercial fishermen and pleasure-boat owners are discharging increasing amounts of sewage and other wastes into the Lakes.

Lake Coleman and Lake Wellington show some indication of increased weed growth as a result of nitrate- and phosphate-rich waters draining from agricultural lands in the Lake Wellington catchment area. Probably this will ultimately occur in other parts of the Lakes, also.

Groundwater

The Gippsland Basin forms one of the major groundwater provinces of Victoria. Artesian water, containing less than 5,000 parts per million total dissolved solids, occurs within the intra-coal sand beds of the Latrobe Valley formation at a depth of about 700 metres (2,000 ft). This resource is largely untapped because of its depth.

The sandy horizons of the Boisdale Beds form another major aquifer system at a depth of about 120 metres (400 ft). Like the Latrobe Valley formation, this aquifer is also artesian and contains water of similar quality. Its storage capacity has been estimated at 170 million litres (14 million acre-feet).

Water also occurs at a depth of about 10 metres (33 ft) and is of good quality except on the southern edge of the Nambrok-Denison irrigation project. Here it contains up to 4,000 parts per million total dissolved solids. A rise in the water table following irrigation caused an increase in soil salinities in parts of the Nambrok-Denison area. However, this has been rectified by drainage works.

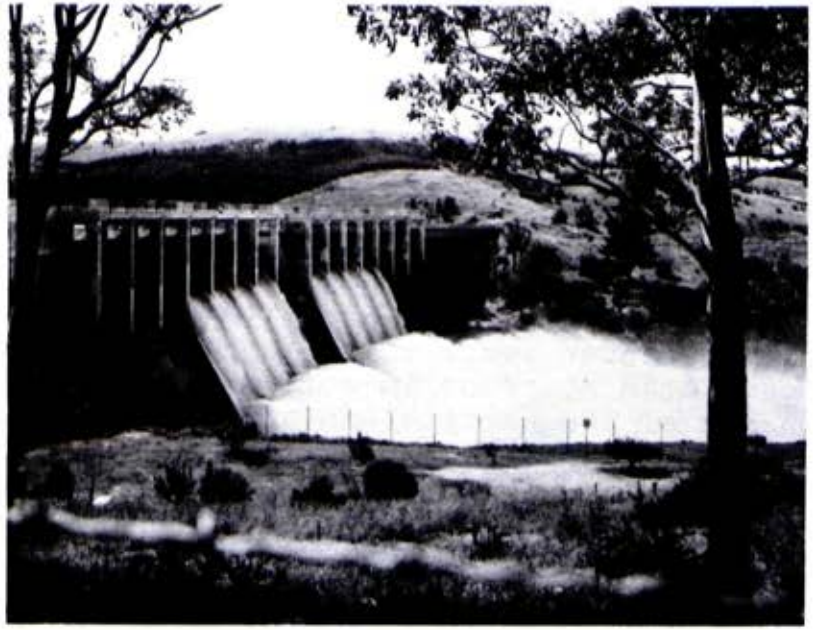
Groundwater occurs near the surface around the Gippsland Lakes, at a level approximating the levels of the Lakes and consequently lower in the summer than the winter. As would be expected, salinity is higher in summer.

Use of Water Resources

Water may be used either directly or indirectly. Water used directly may be consumed, as is the case with domestic and industrial usage and irrigation. However, indirect usage for such things as outdoor recreation, navigation, and wildlife habitat does not involve consumption.

Direct usage

The township of Seaspray draws its domestic supply from a low pondage weir



Lake Glenmaggie - the major source of irrigation water for the area

on Merriman's Creek. Because of the flatness of the terrain, no other storage sites occur within the study area.

A storage dam exists on the Latrobe River at Yallourn. The State Electricity Commission uses water from this dam for power generation, returning some of the cooling water to the river. This use at present requires 78,000 acre-feet per annum, of which approximately 35,000 acre-feet are returned to the river. This raises water temperatures in the Latrobe River by up to 10°C.

The river system is also regulated by the Moondarra Reservoir on the Tyres River, from which the Latrobe Valley Water Supply Board uses 53,000 acre-feet per annum to supply a domestic and industrial demand in the Latrobe Valley.

When available, water is diverted from the Thomson River to portion of the Central Gippsland Irrigation Area. However, since there is no storage, this purpose consumes less than 10% of the average annual flow and Lake Glenmaggie on the Macalister River provides the major source of irrigation water for area.

In addition to diversion for irrigation, a considerable number of land-owners pump directly from streams, irrigating at least 2,439 ha (6,000 ac) of land in this way.

In the north-west of the Nambrok-Denison area, many installations pump groundwater from the 10-metre aquifer, but no figures for actual usage and availability of this groundwater are available.

The city of Sale draws its daily supply of 6.5 million litres (1.5 million gallons) from the 120-metre (400 ft) aquifer, and a number of farmers use water from it for irrigation.

Indirect usage

This is discussed in more detail in other chapters. However, the Thomson

and Latrobe Rivers provide fishing. The Gippsland Lakes are used for navigation, water sports, and fishing, and form a valuable wildlife habitat.

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SOILS

Interactions between the climate, parent materials, topography, and organisms determine chemical and physical properties of virgin soils. The length of time for which these factors have been acting on the soil is also important.

In some environments one or two factors are obviously dominant. However, soils usually result from quite complex interactions between the features of the environment.

Classification

Almost all classifications of the soil are intrinsic. That is, soils are recognized by features that distinguish one soil from another rather than by features preselected according to their relevance to a particular form of land use. At the same time experience has established that many characteristics used to differentiate soils are relevant to a wide range of uses. This is a fortunate circumstance where the suitability of land for alternative uses is being considered.

The classification is based on the principal profile form laid down by K. H. Northcote in 1960. This divides soils into three classes on the basis of the texture pattern in the profile: uniform, gradational, and duplex. Gradational soils become more clayey with depth without any sharp change, while in duplex soils the texture changes suddenly to clay. Additional features such as colour, consistence, structure, and the presence and nature of impeding horizons are considered.

Table 6

SOIL GROUPINGS

Principal profile form	Descriptive name
Uniform	Calcareous sands Leached sands Black organic clay loams Grey silty loams and clays Shallow stoney soils
Gradational	Red gradational soils Brown gradational soils
Duplex	Duplex soils

Method of Survey

The survey on which much of this chapter is based made no attempt to map boundaries of individual soil groupings. Instead, field reconnaissance and detailed stereoscopic interpretation of aerial photographs allowed definition of repetitive topographic patterns that contain characteristic soil assemblages. These patterns were called land units and for the purposes of this report have been grouped on the basis of predominant soils within them to produce a generalized soils map for the study area.

Land Use

In order to determine the suitability of soils for various uses, chemical and physical properties have to be considered, together with climate and topography. Some chemical data exist for the leached sands, calcareous sands, grey silty loams and clays, and duplex soils. In other cases chemical properties have been inferred from those of similar soils outside the study area. Some physical data are available for all soils, but again some of this information is inferred.

Leached sands

These soils, which are developed on Tertiary and Quaternary sediments, are widespread on public land. Rainfall varies from more than 30 in. to less than 20 in. annually; topography varies

Leached sand with cemented gravel at a shallow depth

from flat to moderately dissected, but slopes are seldom steep.

The soils consist of siliceous sand with a dark-brown accumulation of organic matter at the surface over a grey-white bleached horizon. Profiles are friable and structureless throughout, although in many cases an impeding horizon of cemented sand or gravel occurs at depth.

Chemical analyses indicate acidity and severe deficiencies of phosphorus, potassium, and nitrogen. These elements, as well as copper and molybdenum, usually have to be applied before satisfactory pastures can be developed and maintained. Increased growth rate of pine occurs with the addition of phosphorus but not with other elements.

Although heavy applications of fertilizers may be necessary to rectify chemical deficiencies, this is a possibility. However, physical properties of these soils that may hinder plant growth may be impossible to alter. Such physical properties are low moisture-storage capacity and the presence of an impeding horizon.

Leached sands have a low moisture-storage capacity. At field capacity, the soil contains about 13% water (expressed in terms of oven-dry weight of the soil) and at wilting point 3%. This disadvantage is offset by the small amount of rain necessary to raise the moisture content above wilting point and

Gully erosion of leached sands on the Holey Plains

the even rainfall, which continually supplies soils with moisture.

Often the profile contains a cemented layer that may impede the downward movement of water or hinder root penetration, to a degree depending on its depth from the surface, hardness, and thickness. Topographic position also affects drainage. Even if an impeding layer is present, a soil on a slope or ridge top

will be well drained, whereas one in a swale may be subject to waterlogging.

Some leached sands have the water table close to the surface because they are developed on low ground adjacent to a free water surface. There is generally a soft layer of coffee rock at the level of the water table.

Erosion by water occurs on slopes denuded of vegetation and, although not widespread, has created some deep gullies. Wind erosion seems to be a problem only during droughts, when soil moisture is insufficient for germination of plants.

Calcareous sands

The calcareous sands vary from bright yellowish brown quartz sand containing shell fragments, at high-tide level, to weakly differentiated sands extending to the inland base of the foredunes above the Ninety Mile Beach.

These soils are extremely alkaline and support a very specific vegetation. Marram grass has been planted extensively where the native vegetation has been destroyed, in a bid to prevent wind erosion; this, however, remains a serious problem.

Black organic clay loams

Black organic clay loams generally have a well-developed structure but are often saline. They are confined to estuarine deposits, low lake-side beaches, and lake floors. Their salinity generally makes them unsuitable for any form of development.

Grey silty loams and clays

The texture of these soils varies, but profiles are almost always uniform. They have moderately developed structure and are almost invariably confined to recent alluvium. Probably these are the most fertile soils in the study area and consequently are used solely for agriculture, generally irrigated dairying.

Shallow stony soils

Stone fragments abound in a shallow profile, with poorly developed structure. These soils are confined to steep slopes or narrow ridge tops of Palaeozoic sediments. Stonyness and steepness preclude any possibility of development.

Red gradational soils

Often called krasnozems, these gradually change texture from clay loam to heavy clay with depth, but the moderately to well-structured profile is friable throughout. They are likely to be acid, with a low content of available potassium and very low available phosphorus. Krasnozems are confined to basalt where the annual rainfall exceeds 30 in.

Their well-developed structure and friability make these soils suitable for

development for agriculture or pine-growing as well as hardwood production.

Brown gradational soils

These may be friable, with a well-developed structure, or hard, with a poorly developed structure. The former generally occur in very moist situations. Texture changes from clay loam to clay with depth. The soils are confined to generally steep country on Mesozoic sediments with high rainfall. Thus, although pastures and pines can be successfully established, slope and climate limit these uses. Profiles are almost certainly acid and deficient in phosphorus and potassium. In general, these soils will support very high-quality hardwood forests.

Duplex soil developed on recent alluvium

Land slips occur on steep slopes where the native vegetation has been removed, particularly following heavy falls of rain.

Duplex soils

The light-textured topsoil abruptly overlies a clay subsoil of variable colour and structure. Often, a shallow bleached horizon lies above the clay. These acid topsoils and alkaline subsoils have poor reserves of phosphorus, and reserves of potassium are probably low in the A horizon. Characteristically, the subsoils contain high levels of sodium and magnesium. These soils occur on Tertiary and Quaternary as well as Palaeozoic sediments where the average annual rainfall is generally less than 30 in.

Duplex soils are obviously more fertile than leached sands and this is reflected by the extent to which they have been developed for agriculture, particularly north of the Latrobe River.

In general, hardwood forests on duplex soils are of moderate to poor quality. Drainage often presents a problem in establishment of pine plantations.

The clay of the B horizon of duplex soils is often highly dispersable and this can result in tunnel and gully erosion, although these do not appear to be serious problems in the study area.

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VEGETATION

Vegetation within the study area is diverse. For example, 23 different species of eucalypts have been recorded on public land within the Shire. This chapter confines itself to describing vegetation that occurs on public land, although it gives some indication of that on privately owned land. Appendix I includes a list of the botanical names of species referred to here by their common names.

Considering the vegetation very broadly, it is possible to recognize the wet mountain type, drier stringybark, peppermint, gum, and box-ironbark types, as well as scrub, salt-marsh, and swamp vegetation.

Basis of Classification

Structure

The tallest stratum has been assessed in terms of four height classes and percentage projective foliage cover (Table 7). On this basis, six structural units have been recognized: namely open forest I to IV, woodland, and grassland. In cases where these variables are not constant over areas large enough to be conveniently mapped at a scale of 1:100,000, complexes are recognized.

Floristics

Floristic units have been defined according to the most abundant species in the tallest stratum. Table 7, facing page 42, lists them and gives an indication of commonly associated species for each unit, but these vary from one area to another.

Vegetation Units and their Relation to the Environment

Vegetation, if it is allowed to grow without interference by Man, can be related to the interaction of climate, soils, and topography. However, Man has modified all the vegetation in the study area to some extent and, consequently, has obscured these interrelations in some cases.

Wet mountain type

This includes mountain ash open forest IV and most of messmate open forest III. Wet mountain forests are confined to the South Gippsland hills in the south-west of the study area, where the average annual rainfall exceeds 40 in.

In general, slopes are steep and soils gradational, friable, and brown or sometimes red.

Invariably, the understorey is dense and tall; species such as blackwood, musk daisy-bush, silver wattle, blanket leaf, and tree ferns are common.

Stringybark type

Yellow stringybark and silvertop (open forest II) forests are virtually

Mountain ash open forest II with tree ferns in the understorey

White stringybark open forest II

Shining peppermint and saw banksia woodland

confined to the Palaeozoic sediments in the north-east of the study area under an average annual rainfall of about 30 in. Slopes are steep and soils are shallow and stoney or duplex. The understorey is typical of mixed-species foothill forests, consisting of grass, various shrubs (including dogwood, blackwood, and heaths), various legumes, and bracken.

White stringybark (open forest II) forests occur on low, flat ridge tops on Tertiary or Quaternary sediments where there are duplex soils. Average annual rainfall is between 25 and 30 in. The understorey is generally open and grassy with scattered shrubs, such as heaths, wattles, and sparse bracken.

Yertchuk (open forest II and woodland) forests are widespread on leached sands that commonly have a cemented horizon in the profile. Rainfall varies between 25 and 30 in. per year. Saw banksia and bracken are the conspicuous components of the lower strata, with the height and density of bracken apparently depending on fire history. Shrubs, such as heaths and wattles, are common, but bracken often obscures them. Depth in the profile to the cemented layer appears to be important in determining structure of the tallest stratum, woodland occurring where the cemented layer lies closer to the surface, and forests where it lies deeper.

Mealy stringybark (open forest I) occurs sparsely, and only in poorly drained situations. Rainfall is between 26 and 28 in. per year. Plants tolerant of poor drainage, such as rushes and sedges, are common in the understorey.

Peppermint type

Narrow-leaf peppermint (open forest II) occurs in two distinctly different environments. In the extreme north of

the shire on duplex soils developed on Palaeozoic sediments, under an annual rainfall of about 30 in., it has the same understorey as yellow stringybark and silvertop open forest II. In isolated patches on Tertiary and Quaternary sediments where the soils are leached sands with coloured B horizons, under an annual rainfall of 24-28 in., it has the same understorey as yertchuk open forest II and woodland.

Shining peppermint (woodland I) is widespread on leached sands developed on Tertiary and Quaternary deposits, but occurs in two somewhat different environments. In isolated areas, almost invariably with a cemented layer in the soil near the surface, under an annual rainfall of 24-30 in. it has an understorey similar to yertchuk woodland II, with saw banksias sometimes taller than the eucalypts.

Along the coast, where the leached sands often do not have a hard cemented layer near the surface, under annual rainfall less than 22 in., bracken is generally absent.

Gum type

Mountain grey gum (open forest II) occurs intermixed with other species in the mountainous parts of the Shire, both in the south-west and north-west. However, it occurs as the most abundant species in one area of the foothills of the eastern highlands in the study area. Here the parent materials and soils vary. Rainfall is about 30 in. per year and the understorey is much the same as that of yellow stringybark and silvertop open forest II.

Mahogany gum (open forest II) is confined to a small area on the north-east of Sperm Whale Head, where it is at the southern extremity of its range. Soils are leached sands without an impeding horizon. Annual rainfall is about 22 in. Dense bracken obscures many small shrubs in the understorey.

Mahongany gum open forest II

On public land, forest red gum (woodland) occurs in small areas not large enough to be mapped. It grows near the Gippsland Lakes, where it is generally confined to leached sands with the water table near the surface or duplex soils. Less than 22 in. of rain falls annually, and the understorey varies depending on drainage. In drier situations bracken and coast banksia are prominent, together with numerous small shrubs, whereas in wetter situations rushes and sedges are common. Much of the land now cleared for agriculture was originally a forest red gum woodland.

Manna gum (woodland) occurs intermixed with other species in inland areas and as pure stands around the Gippsland Lakes. Invariably the soils are leached sands, generally without an impeding horizon and often with a coloured B horizon. Rainfall varies from 26 in. to below 22 in. per year. Saw banksia and bracken are common in the understorey, as well as many species of small shrubs.

Box-ironbark type

Red box and red ironbark (open forest II) forests are confined to dry situations on the Palaeozoic sediments in the north-east of the study area. Probably less than 30 in. of rain falls per year. Slopes may be steep and the soils shallow and stony or duplex. In the rather sparse and grassy understorey, scattered shrubs such as varnish wattle, dogwood, and wedge-leaf bush-pea occur.

Coastal scrub, salt-marsh, and saline swamps

Salt-marsh vegetation occurs on soils on low ground that are periodically inundated by salt water. The vegetation varies according to salinity and depth of inundation but, in general, rushes and sedges merge into salt-tolerant plants, such as glassworts, as soils become more saline.

Red ironbark open forest II with golden wattle in the understorey

Saltmarsh on the edge of Lake Reeve

Swamp paperbark wet scrub is found on the upper margins of areas that are inundated with salt water. Dry scrub of coast tea-tree grows on the calcareous sands of the foredunes, while further inland more open scrub or woodland of coast banksia occurs.

Freshwater swamps

Freshwater swamps often carry scattered eucalypts, such as swamp gum and mealy stringybark, with swamp paperbark and prickly tea-tree on the fringes. These merge into rushes and sedges and then open water.

Plantations

The height and density of plantations vary depending upon time of planting, site quality, and thinning regime. Radiata pine is by far the most widely planted species, although some maritime pine is grown.

Scrub complex

Scrub of variable height and density exists on some of the abandoned farmland in the South Gippsland highlands. Blackwood, dogwood, musk daisy-bush, bracken, and blackberries are common.

Grassland

No natural grassland occurs on public land. Grassland exists only in areas where the natural vegetation has been removed.

The Understorey

On leached sands developed on Tertiary and Quaternary sediments, in general the most conspicuous components of the understorey are dense bracken and saw banksia. Numerous heaths, legumes, and other low shrubs occur.

However, bracken does not grow densely on some areas where duplex soils are developed on these sediments, nor on leached sands under shining peppermint around the Gippsland Lakes. The reasons for this remain obscure, but may be

complex and possibly related to fire history and water availability in the soil.

Sticky boronia and golden grevillea, although common on leached sands in the study area, are widespread but localized in occurrence in Victoria. Ribbed thryptomene is confined to the Gippsland Lakes area in Victoria.

The forests growing on the foothills of the eastern highlands within the Shire carry an understorey composed of grasses, various shrubs (including dogwood, blackwood, and heaths), various legumes, and bracken. Shrubs grow densely under the stringybark forests, whereas they are scattered under box-ironbark forests.

A dense tall understorey exists under the forests on the portion of the South Gippsland highlands within the study area. Species such as blackwood, musk daisy-bush, blanket leaf, and tree ferns form strata above dense wire grass, bracken, and other ferns.

Relation of Vegetation to Land Use

Because vegetation is often an expression of the interaction of climate, soils, and topography, it can be used to indicate site potential. This can be demonstrated by comparing white stringybark open forest II with shining peppermint I, which may occur adjacent to each other. The well-drained duplex soils of the former would be far more suited for pine-growing than the leached cemented sands of the latter.

Part III of this report, which considers specific forms of land use, discusses direct usage of vegetation for timber production, and chapter 10 deals with the significance of vegetation with respect to various wildlife habitats.

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Table 7

VEGETATION UNITS

Structural forms	Height of tallest stratum	Percentage projective foliage cover of tallest stratum	Major species of tallest stratum	Commonly associated species of tallest stratum	Lower strata
Open forest IV	>40m (130 ft.)	>30	Mountain ash		Generally dense and tall: blackwood, musk daisy-bush, blanket leaf, silver wattle, wire grass; tree ferns in gullies
Open forest III	28–40m (40–130 ft.)	>30	Messmate	Blue gum, mountain grey gum	
Open forest II	15–28m (50–90 ft.)	>30	Yellow Stringy-bark	Yertchuk, white stringybark, narrow-leaf peppermint, blue gum	Moderately dense: dogwood, wattles and other legumes, heaths, tussock grass, and bracken
			Silvertop	Yertchuk, yellow stringybark, white stringybark, blue gum	
			White stringy-bark	Yertchuk, but but, narrow-leaf peppermint	Open and grassy: predominantly tussock grass with low scattered shrubs
			Yertchuk	But but, narrow-leaf peppermint	Dense bracken obscuring many low shrubs, including heaths and various legumes; saw banksia conspicuous and common; understorey without saw banksia or dense bracken on Palaeozoic sediments
			Narrow-leaf peppermint	Manna gum	
			Mountain grey gum	Messmate, narrow-leaf peppermint, blue gum	Moderately dense: dogwood, wattles and other legumes, heaths, tussock grass, and bracken
			Red Box	Yellow stringybark, narrow-leaf peppermint, red ironbark, blue gum	Generally open: scattered shrubs including wattles and dogwood; tussock grass
			Red ironbark	Yertchuk, mountain grey gum, blue gum, yellow stringybark	
Open forest I	5–15m (16–50 ft.)	>30	Mealy stringy-bark	Yertchuk	Rushes, sedges, and scattered low shrubs
Woodland	5–15m (16–50 ft.)	<30	Shining peppermint	Yertchuk, saw banksia, but but	Dense bracken obscuring many low shrubs, including heaths and various legumes; saw banksia sometimes taller than the eucalypts; bracken generally absent along the coast
			Yertchuk	Shining peppermint, saw banksia	
			Manna gum	Narrow-leaf peppermint, but but, saw banksia	
Grassland	<1m	>30	Native and exotic species		

Complex	General description
Coastal scrub salt-marsh and saline swamps	Dry scrub of coast tea-tree, banksia, dry scrub, and woodland. Swamp paperbark, wet scrub. Rushes and salt-marsh
Freshwater swamps	Occasional swamp gum, manna gum, mealy stringybark. Swamp paperbark, wet scrub, and rushes.
Scrub	Blackwood, dogwood, musk daisy-bush, bracken, blackberries, grasses and other shrubs.
Plantation	Predominantly radiata pine; some maritime pine.

FAUNA

In order to plan for conservation of animals, we need an understanding of their habitat requirements and behaviour.

Habitat and Behaviour

With the exception of some of the animals that live on or in water, plants provide both food and shelter. Because various animals have different requirements, each vegetation type contains a different community of animals. In addition, within each vegetation type, various animals may occupy different habitats because they have specific requirements for food and shelter. A classification of habitats that incorporates a simplification of the vegetation classification in Table 7 appears in Appendix II.

Understanding animal behaviour involves consideration of breeding habits, territorial requirements, and movement from one area to another.

Breeding habits

Provided habitat is suitable, breeding habits are often related to climatic conditions such as rainfall, temperature, and day length. Thus local climate variations can cause variations in breeding habits.

Territories and movement

Many animals require an area of a particular size in which they can establish themselves and which will provide for their needs. This territory, as it is called, is a definite area defended against competing intruders.

Animals move from one area to another in order to find the environment they require. These movements may be regular migrations, nomadic wanderings, or simply dispersion from overpopulated areas.

Significant Species

This section discusses only the species of birds and mammals that have significance in the study area because of thier rarity or scientific interest. Appendix II lists all the birds and mammals recorded from the study area, together with their habitats and status.

Bubulcus ibis: The cattle egret, in recent decades, has spread from Eurasia

and Africa to America, New Zealand, and Australia. It has been recorded breeding as far south as northern New South Wales and is regularly observed in Victoria. Apparently it particularly favours the Latrobe Valley and Gippsland Lakes area, where flocks of almost 40 birds have been recorded. As habitat, the species prefers meadows and swamps, where it feeds near cattle and other large grazing mammals.

Royal spoonbill

Himantopus himantopus: The white-headed stilt lives in all temperate and tropical regions of the world, inhabiting the waters of tidal estuaries and shallow lakes and swamps. Breeding colonies of this species are frequently reported from the area.

Pezoporus wallicus: The ground parrot, a terrestrial species, has a very discontinuous and scattered distribution along the coasts of southern, western, and south-eastern Australia, including Tasmania. Its habitat of coastal and adjacent montane heathland, 1-2 ft high, has largely been destroyed. Consequently, the species has suffered greatly and is now extremely rare in all mainland areas.

Stipiturus malachurus: The southern emu-wren lives in the damp, scrubby heathland of coastal and adjacent mountain areas in south-western and south-eastern Australia, including Tasmania. It is a shy, sedentary species and, as few areas of its habitat remain undisturbed in Victoria, it has become rather rare.

Emblema bella: The beautiful firetail lives in the coastal and adjacent areas from Newcastle to Kangaroo Island and Tasmania. Its habitat includes thick belts of coastal scrub and tea-tree and thickly wooded gullies. This shy species appears to have decreased considerably in recent years and is now considered rare. However, it has a stronghold in the south of the study area.

Family Anatidae: The many swamps and lakes of the study area lie on one of the major flight lines used by ducks. Eleven species of this family have been recorded, including eight popular game species. The following are of particular note:

Anas castanea: Chestnut teal prefer coastal lagoons, salt-water estuaries, and brackish tea-tree swamps. Tasmania, especially, and the south-eastern coastal districts of the mainland provide this species' strongholds. Being favoured as a game bird it may require special conservation measures if it is to survive. It has a restricted range and is more sedentary than the grey teal, from which it differs ecologically. Chestnut teal breed regularly in the region.

Oxyura australis: The blue-billed duck is seldom observed. It breeds in deep fresh-water swamps with a dense cover of either cumbungi or tea-tree. Significant numbers regularly breed in the region. Its habitat requirements differ

Chestnut teal

Pelicans and black swans on the Gippsland Lakes

New Holland mouse

from those of the common game species and special measures will have to be taken for its conservation.

Pseudomys novaehollandii: The New Holland mouse has only been recorded as a living animal since 1967. Prior to that it was known from only five modern specimens. Four living colonies of these animals have now been located: at Kuring-gai Chase (1967) and Port Stephens (1968) in New South Wales, and at Tyabb (1970) and Loch Sport (1972) in Victoria. At the last of these localities, in the study area, the colony was discovered by a team from Monash University carrying out survey work for the Land Conservation Council. The species habitat is apparently restricted to coastal heath woodland.

Reptiles

Reptiles rely on environmental factors to maintain their body temperature as, unlike birds and mammals, they have no internal control. Because of this, reptiles select conditions that enable them to maintain relatively constant body temperatures. When environmental conditions become either too hot or too cold, they seek out a suitable micro-environment, such as under a rock or log, and remain inactive until conditions become favourable once more. Oviparous species also need a warm, dry site for laying eggs.

Appendix II lists the species known to occur in the study area. Their rarity or otherwise is difficult to determine, as they are not well known. But their conservation usually depends entirely on the level of general environmental conservation. No species are known to be of particular significance in the study area.

Amphibians

Frogs and toads are the only amphibians in the study area. They belong to the Order Anura and have a complex life cycle, typically involving an aquatic larva (usually herbivorous) and a terrestrial carnivorous adult. Anurans are strongly influenced by the amount, effectiveness, reliability, and seasonal distribution of rain, as they require fresh water or sustained high humidity

Tiger snake at Dowds Morass

for the development of embryo and larva. They are intolerant of salt water, and the draining of swamps can cause extensive loss of habitat.

No full list of the species in the study area has been compiled, but none is known to be significant.

Fish

The greatest threat to fish lies in pollution of water, which is occurring in the Gippsland Lakes. Changes in water temperatures sand salinity can also affect them. Chapter 7 discusses the extent of these changes, but the nature of their effects is not yet known.

No full list of species for the study area has been compiled. However, the following species are known to be of significance in the area.

Percalates colonorum: The estuarine perch is an excellent sporting fish commonly taken in estuarine water. It is thought to breed only in brackish water.

Percalates novemaculeatus: The fresh-water perch is very closely related to the previous species, but differs in that it can live and breed in fresh water. It provides excellent sport too, and is normally taken in the higher reaches of rivers flowing into lakes.

Acanthopagrus butcheri: The black bream is undoubtedly the premier estuary fish in Victoria, and the Gippsland Lakes comprise the most important amateau bream fishery in Victoria. Three-quarters of the State's professional catch of bream also comes from here.

Salmo trutta (brown trout), *Salmo gairdneri* (rainbow trout), and *Anguilla australis* (fresh-water eel) are also found in the lower reaches of the rivers flowing into the Lakes.

Cyprinus carpio: The European carp poses a threat to other fish and water-fowl, as it increases the turbidity of water. Among other effects, this destroys aquatic vegetation. The species is confined to relatively fresh water either slow-flowing or still, and thus is commonly found in Lake Wellington.

PART III LAND USE

NATURAL AREAS

In Australia, in less than 150 years of extensive settlement, we have established a viable and prosperous nation, but in the process we have greatly changed the whole environment. It is now difficult to find any large tract of country in its virgin state.

Fortunately the worst excesses of land exploitation, such as uncontrolled logging, overgrazing, wildfires, and frequent burning, are now over. Nevertheless, a rapidly growing demand has developed here, as elsewhere, for land still carrying natural vegetation and wildlife to be set aside in special reserves in which all further development is kept to a minimum.

The Need for Natural Areas

Such natural areas are required for many reasons and the list below is not exhaustive:

Recreational

Many forms of outdoor recreation, including those related to enjoying and understanding natural environments and those requiring solitude, need natural reserves. These give people an opportunity to renew contact with the natural world where their ancestors once struggled for existence.

Tourism in one of the world's major industries, and natural areas that give a country its individual character are an important factor in attracting tourists. Visitors may put heavy pressure on an area and if it is to remain "natural" we must restrict access.

Aesthetic

The preservation of the beauty and regional diversity of the natural landscape should supplement our proper concern for the preservation and display of Man's own finest creations - art, music, buildings, and writing. Thus we must preserve characteristic Australian scenery and wildlife within an economic system that necessarily encourages the import and spread of exotic plants and animals, often in monocultures.

Scientific

We need to preserve undisturbed samples of natural ecosystems, which provide basic data of value in understanding and improving the man-made systems used for

productive purposes. For example, solutions to problems of soil erosion or salting may be found through a comparison of the natural situation with the artificial farmland developed by Man. We must also preserve species and varieties (a "gene-pool") that one day may have profound value to Man, either directly or through his domesticated plants and animals. We must conserve a bank of parental material for improving our agricultural and forest species and for medicinal purposes. Some Queensland rainforest trees are sources of useful drugs. Penicillium was a nuisance mould on bread until its antibiotic effects were discovered.

Educational

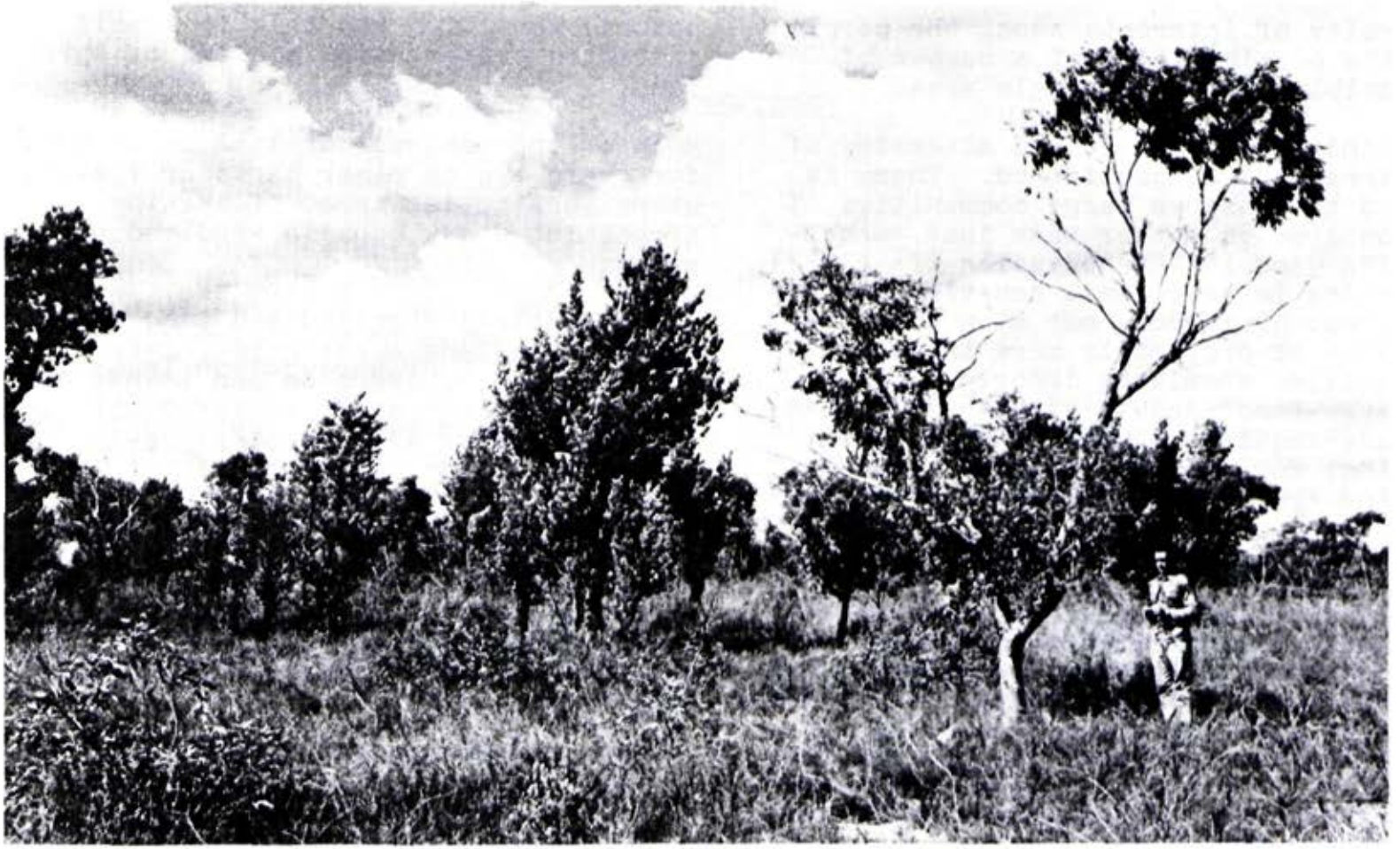
We need outdoor laboratories and an abundant and renewable supply of species and individuals for education in biology. A large natural area give opportunities *not only for enjoying* natural scenery, but for every variety of study, from simple natural history observation to the most sophisticated non-destructive experiments.

Viability of Natural Areas

The viability of a natural area is influenced by many factors. In general viable populations of plant species could be maintained on a smaller area than that needed by populations of large mammals. The area must be large enough to absorb the impact of any proposed uses. Natural areas set aside primarily to provide opportunities for solitude and primitive surroundings must be very large. In Canada it has been suggested that such an area should require 2 full days to cross on foot. This would usually require an area of about 50,000 hectares. But 50 hectares or less may be sufficient to preserve a particular small plant species.

Truly natural areas will require a buffer zone to reduce the impact of Man's activities in the surrounding countryside. The buffer zone could be affected by weed invasion, vermin, or fertilizer and pesticide applications. As well as hazards caused by Man's use of surrounding land, or the area itself, there are natural hazards such as fire, flood, and disease. The larger the area, the more likely it is to survive these. Protection may also be achieved by setting aside several separate examples of a particular type of land. Communities that exist in more variable climatic zones will usually require larger areas, or more examples set aside, to ensure survival.

"Natural" areas should be "managed". Although seemingly a contradiction in terms, this is often necessary as nature is dynamic. Management may take the form of controlling fire, culling animal populations, silviculture, strictly controlling the number and activities of visitors, fencing to exclude introduced animals, or eradicating introduced



Open woodland of shining peppermint and saw banksia

species. The degree of management possible or necessary depends upon objective interpretation of the environment, the techniques available, and the cost of implementing them. Carefuly management may enable small areas to remain viable.

Choosing Areas

In addition to the considerations of viability outlined above, many other factors influence the selection of natural areas. These include the great

diversity of interests among the people and the possibilities of a number of compatible uses of a single area.

The biological content and diversity of the area must be considered. There is a need to conserve large communities of common species rather than just concentrating upon the preservation of varieties in very small non-viable reserves. This does not mean that the remnants of previously more important communities should be ignored. The migratory and nomadic existence of some animals requires corridors of habitat linking, for example, breeding and feeding grounds.

It is desirable to select an area with natural boundaries, such as a watershed. These are usually the easiest to manage and maintain. Scenic or landscape values should also be assessed. In practice, it is likely that a balanced system will include a few fairly large areas (more than 20,000 hectares) in which the major communities are represented, supplemented by a greater number of smaller, more intensively managed areas.

The Study Area

Virtually all areas suitable for agriculture have been cleared of native vegetation. Only about 15% of the land in the shire remains in a relatively natural condition and this in itself justifies preservation of some of this land.

Much of the natural bushland is unique, for there are no other parts of Victoria where substantial areas of shining peppermint - saw banksia woodland now exist.

The geological deposits and land forms of the Gippsland Lakes were formed by rivers, wind, changes in sea level, and wave action, and are associated with bodies of water with greatly varying salinity. These are interwoven in a complex way and provide a wide range of environments, each with its own characteristic plant and animal community. One example of particular interest is the rare New Holland mouse, which occurs in about 4,450 hectares (11,000 acres) of shining peppermint heath woodland near Loch Sport.

Chapter 12 discusses the importance of the Gippsland Lakes for recreation.

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RECREATION

Recreation involves activity that is undertaken without compulsion for the pleasure of the individual. Obviously it takes a multitude of forms, and individual preferences vary.

This chapter concerns recreation on public land, which can involve such activities as skiing, hiking, picnicking, or simply sightseeing. Some of these may require large tracts of land, but uses such as timber production, cattle-grazing, or mining can occur together with recreational activities, provided certain restrictions are imposed.

Factors Affecting Demand

The increasing demand for land for recreation can be attributed to a number of factors, some of which are listed below.

Population

The size of the population as well as its density in particular areas will determine the demand for land for recreation. Victoria's population has doubled in the past 35 years and now totals about 3,500,000. An overwhelming proportion is concentrated in the metropolitan area.

Income

In general, the bulk of the population has more money to spend after paying essential expenses. Many spend some of this money on recreational activities.

Leisure time

As working conditions improve, individual periods of leisure such as weekends, annual holidays, and retirement years are lengthening.

Transport and communications

Improvements in transport increase the population's mobility, making areas more accessible and increasing the effective length of individual periods of leisure. More efficient communications disseminate information and ideas more freely and increase people's knowledge about places of interest and things to do.

Location of cities and towns

The geographic locations of cities and towns in relation to available natural

features of recreational interest, such as beaches and snow fields, influence the type of activities pursued.

Life style

Life style cannot really be considered in isolation from the factors outlined above. However, additional factors such as education, age, and fashion can influence the degree of participation in outdoor recreation.

Evidence indicating the increasing demand for outdoor recreation in recent years can be obtained from the few Victorian figures available. These indicate that, while the population has been increasing at 2% per year (doubling every 35 years), the number of people using developed areas of national parks and other outdoor recreation areas, the numbers of car and motor-boat registrations, and similar indices are all increasing at 10%-15% every year (doubling in less than 7 years). More than 725,000 people visited Victorian national parks in 1971/72, compared with about 350,000 in 1966/67.

Although it may be clear that the demand for outdoor recreation is increasing, the nature of this increase is difficult to predict. It has been suggested that by the end of this century the Australian population will total 22 million; a 3- or 4-day working week will be common; *per capita* income will have trebled in real terms; the 3 million cars will have increased to 10 million and they will be used nearly twice as often as today.

Activities that are popular now may not be so in the future, and completely new types are certain to emerge. All that can be done is to plan for an increased demand for outdoor recreation and keep the plan as flexible as possible to cope with changes in its nature.

Choosing land for outdoor recreation

As was previously mentioned, outdoor recreation is often compatible with other forms of land use. However, sometimes areas must be set aside specifically for recreation.

The area and nature of the land chosen will depend upon the type of recreation to be pursued. At one extreme, small areas that retain little of the natural environment are used for such activities as tennis, golf, and picnicking. Major usage occurs after work and at weekends, and they are invariably located close to the population that uses them.

At the other extreme, areas of thousands of acres are used for such activities as hiking, sight-seeing, camping, fishing, and nature study, mainly during vacations. Development is usually limited to a small part of the area, the rest being undisturbed. These areas are located where outstanding natural features occur, often far from the population using them.

Obviously a complete range exists between these extremes. American statistics indicate that the greatest increase in demand will be for the intermediate areas that are outside large urban centres but within about 2 hours' driving time of them.

Area of land required

In many respects, an area's carrying capacity for outdoor recreation can be assessed in physical terms in the same way as a farmer determines the optimum stocking rate for his farm. A particular site can accommodate a certain number of cars and people, and above this level damage to the vegetation and soil will occur, leading to deterioration of the land.

Moreover, a psychological element must also be considered; overcrowding detracts from people's enjoyment of the area, although the land may not suffer physical damage.

The analogy with the determination of stocking rates on a farm over-simplifies the case to some extent, because attractive and accessible parts of a recreational area tend to be heavily used while large parts are little used. An added complication is that people use these areas intensively for brief periods and not at all for longer periods. This results from the interaction of available leisure and weather conditions with the distance of the recreational area from the population.

The Study Area

The study area is relatively close to Melbourne. Lakes Entrance lies slightly less than 320 kilometres (200 miles) from central Melbourne, and other places in the study area are closer. Several large urban centres are located within 2 hours' drive of nearly all areas within the shire. Table 8 lists these, together with their population figures.

Table 8

URBAN POPULATIONS

Urban Centre	1966	1971
Sale	8,708	10,404
Bairnsdale	7,960	8,540
Yallourn-Moe	16,555	15,529
Morwell	16,635	16,827
Traralgon	14,079	14,624

Comparing the population figures for 1971 with those for 1966, Sale has increased by 19.48%, Bairnsdale by 7.40%, Traralgon

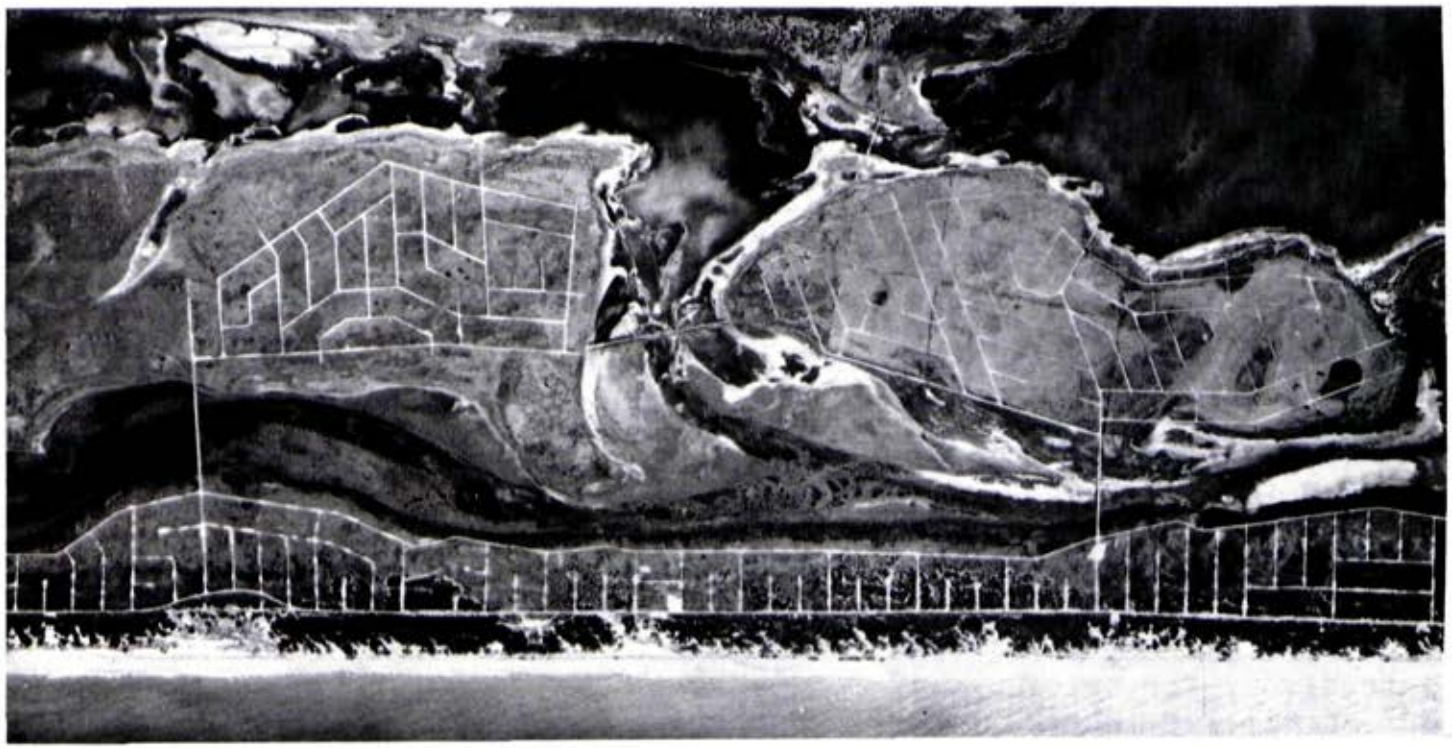
by 3.9%, and Morewell by 1.15%, while the Yallourn-Moe complex has decreased by 6.23%.

As far as recreation is concerned, it is best to discuss the Gippsland Lakes separately from other parts of the study area.

The Gippsland Lakes

The Lakes form a very popular tourist destination, not only for people living in Gippsland (particularly the Latrobe Valley), but also for those living in Melbourne and other parts of Victoria. It has been estimated that the population of the Gippsland Lakes may reach 25,000 during the summer holiday period.

Land developers have recognized the potential of the Lakes for tourism, and extensive subdivision between Golden Beach and Seaspray has resulted in near destruction of dune and lake-side environments. Although a bitumen road runs



Vertical aerial photograph, showing subdivision along the coast on the foredunes and onto the bed of Lake Reeve.

through the area, with a network of access roads, only three houses have been built by the 9,000 block-owners. This is not surprising, as this particular part of the Lakes holds little attraction for holiday-makers other than those interested in sea fishing. In marked contrast, Loch Sport, where there is also extensive subdivision, has a permanent water supply, sheltered sandy beaches on the edge of Lake Victoria, a jetty, and an artificial marina, as well as access to the ninety-mile beach.

In January 1968, a visitor survey was carried out at the four major towns around the Gippsland Lakes. The surveyors interviewed 60 people at Lakes Entrance and 30 each at the centres of Loch Sport, Paynesville, and Metung.

These data must be treated with some caution because:

* Samples were small

* Access to Loch Sport has improved greatly, and consequently this centre has become more important relative to the other centres than it was in 1968.

Some of the results from the survey are presented below.

Place of permanent residence

Most people interviewed at Loch Sport, Paynesville, and Metung lived in Melbourne, compared with only 48% of those interviewed at Lakes Entrance.

Table 9

PLACE OF PERMANENT RESIDENCE

	Melbourne	Gippsland and Latrobe Valley	Interstate	Other
Loch Sport	86.6	13.4	0	0
Paynesville	79.9	16.7	0	3.4
Metung	85.2	7.4	3.7	3.7
Lakes Entrance	48.0	24.6	14.7	11.4

Loch Sport store, post office, and motel

Lakes Entrance recorded the highest percentages of visitors from interstate and parts of Victoria other than Melbourne and Gippsland. Its location on the Princes Highway, compared with that of the other towns off the Highway, provides a possible reason. The Princes Highway serves the dual function of a national highway linking Melbourne and Sydney and a major State one directly linking Melbourne and the Latrobe Valley to Lakes Entrance. This makes Lakes Entrance more accessible to both intra- and interstate tourists.

The pattern has probably altered somewhat since 1968 with the improvement of the road to Loch Sport, as figures supplied by the National Parks Service indicate. In 1970/71, about 11,700 visited the Lakes National Park, whereas in 1971/72 the figure rose to 21,900.

Accommodation

It was found that more than 50% of those interviewed camped, slightly less than 30% stayed in houses or holiday flats, and only about 7% stayed at hotels, motels, or guest-houses. However, the pattern may well have altered, for since 1968 several motels have been constructed in Sale and Bairnsdale. The number of permanent residences at Loch Sport has increased dramatically - from 18 in 1961, to 130 in 1966, to 273 in 1971.

Table 10

ACCOMMODATION

Locality	Percentage staying with:		
	Family	Friends	Self
Loch Sport	86.8	3.3	3.3
Paynesville	83.3	16.7	
Metung	80.0	16.7	3.3
Lakes Entrance	86.8	11.5	1.7

The Gippsland Lakes is overwhelmingly a family holiday centre. At all centres, more than 80% of persons interviewed were accompanied by their family.

Length of stay

Holiday-makers may be described as those people who remain in resort centres for a week or longer, as distinct from tourists who stay only a few days. Of those interviewed, 86.3% stayed for a week or longer.

Recreational activities

With the exception of Metung, "environment" was the most important factor attracting tourists and holiday-makers to the Gippsland Lakes: 40% of persons at Loch Sport and 31.1% of persons at Lakes Entrance gave this as one of their reasons for coming to Gippsland Lakes.

Swimming

This is important to all centres. At Loch Sport and Lakes Entrance more than 60% interviewed went swimming, but only 22% swam at Metung. This difference can partly be explained by the presence of surf and lakeside beaches at Lakes Entrance and Loch Sport, whereas only lakeside beaches exist at Metung. At Lakes Entrance, although more people went swimming, smaller numbers went boating and water-skiing, while activities other than these involved little or no contact with the water.

Surf fishing on the 90-mile beach

Water-skiing

This activity appeared to be most popular at Loch Sport, with a figure of 46.7%, and least popular at Lakes Entrance, with a figure of 9.8%. The reason may lie in the fact that tourists and holiday-makers at Lakes Entrance were more transitory and carried a minimum of luggage and equipment.

Fishing

At Paynesville 63.3% of people interviewed went fishing, followed by Metung, Lakes Entrance, and Loch Sport with 55.5%, 49.2%, and 43.3% respectively.

The artificial marina at Loch Sport

Boating

Metung showed the highest percentage of persons participating in this activity (77%), followed by Loch Sport (40%), and then Paynesville (36.6%). Only 19.6% of persons at Lakes Entrance claimed participation.

Scenic drives

The highest figure - 26.6% - was registered at Lakes Entrance, but most of these people went to areas outside the study area, particularly the Buchan Caves.

Swimming and fishing are almost universal forms of recreation; holiday-makers at Paynesville, Metung, and Loch Sport were more active in water sports, such as boating and water-skiing. Lakes Entrance had the greatest diversity.

Hazards

Wind erosion

The activities of tourists and holiday-makers destroy some of the vegetation on the foredunes, resulting in wind erosion. This appears to apply particularly to amateur fishermen, who often drive vehicles across dunes, clear tea-tree around camps, and start fires. In addition, dune vegetation is being destroyed in some places by beach buggies.

Pollution

Sewage and other waste is being discharged into the Lakes in increasing quantities.

Fire

Vegetation in and around Loch Sport is generally dense and, if weather conditions are adverse during summer, fire could easily wipe out the township.

Other Parts of the Study Area

No visitor surveys exist for areas other than the Gippsland Lakes, but it is obvious that recreational usage at the

moment is low. There are no permanent walking tracks, caravan sites, or camping spots on public land.

The Latrobe River in the extreme northwest of the shire is used for canoeing, but this is of minor importance.

During the spring, wildflowers in the bushland on sandy soils in the study area provide a brilliant display. This could become an important tourist attraction in the future.

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Wind erosion around a house built on the crest of a foredune

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AGRICULTURE

The dominant agricultural industries of the district are irrigated dairying in the Nambrok-Denison area and beef, lamb, and wool production in the remainder. Other industries include vegetable production (977 ha or 2,415 ac in 1969/70), dairying on the higher-rainfall western margin, and pig production.

Table 11

LAND USE IN THE SHIRE OF ROSEDALE

	1960/61	1969/70
Number of rural holdings	784	780
Number resident on rural holdings	3,525	3,002
Total area occupied (ac)*	419,651	363,644
Area under crop or fallow	15,883	16,903
Area of sown pasture	137,472	223,044
Area of native pasture	133,135	79,842
Balance	133,161	43,855

* 1 hectare = 2.47 acres

The dairy cattle population has been stable at about 50,000 head for the past 6 years and the associated pig enterprise has varied from 8,000 to 10,000 head. In contrast, the beef herd has more than doubled in the same period (see Figure 1), whereas sheep and lamb numbers have remained around 300,000. The 1972 drought and recent price changes may slow this trend towards beef production. There is no indication that dairying will be replaced as the major industry on irrigated land.

Honey

Apiculture is not an important industry within the study area. Estimates place the number of bee sites within the shire at only about 20. On public land, local apiarists regard white stringybark, yellow stringybark, yertchuk, manna gum, but but, mealy stringybark, and forest red gum as the best producers of pollen. Saw banksia and coast banksia are very good sources of nectar, and coast beard heath produces good nectar and is a source of pollen.

The honey produced in the study area does not command a high price. This may be because much of the nectar is obtained from banksias, which produce a dark-coloured astringent honey. Another

disadvantage for honey production is the general absence of surface water on most public land.

Potential for Further Development of Alienated Lands

Table 11 shows a considerable increase in the area recorded as sown pasture and a decrease in the area of native pasture and balance (mainly scrub) during the 1960s. After adjustment for undeveloped land, it is estimated that the pasture lands of the shire support about 3.5 dry-sheep equivalents (d.s.e.) per acre. It is difficult to estimate the proportion of maximum land potential that this

Clearing of the eastern Strzelecki range for agriculture - Gormandale, with ring-barked forest in the background.

Early farming in the Callignee district

represents. About 10% of pasture land is irrigated, but the remaining area covers quite diverse land of many different potentials.

In recent years about 64,750 ha (160,000 ac) of pasture have been fertilized annually with about 13,600 metric tons (286,000 cwt) of fertilizer, mainly superphosphate. As about one-third of the alienated land is still classified as native pasture and balance, clearly some potential for further agricultural improvement remains. The extent to which such improvement occurs will largely depend upon economic factors. Probably, in the absence of taxation considerations, the further development

Dryland grazing of sheep near Rosedale

of most existing holdings would prove more profitable than the establishment of new farms.

Outlook for Agricultural Products

The livestock industries are the only feasible agricultural use of most of the unalienated lands of the shire. It is hard to predict market prospects for farm products, but the long-term pospects naturally affect decisions on rural land use.

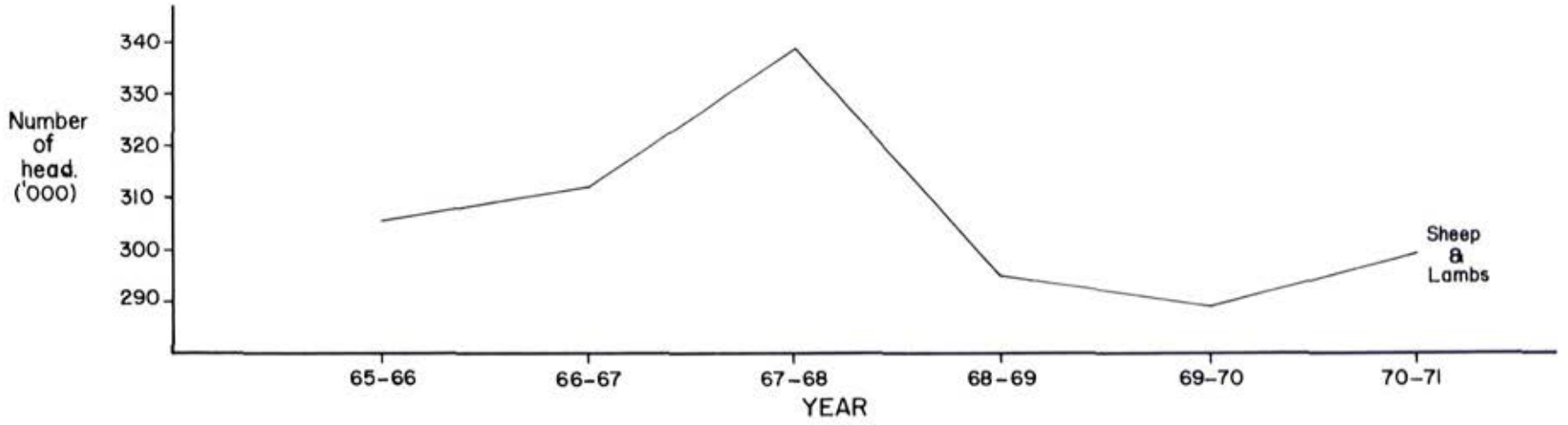
Australian beef production is expected to increase substantially following a widespread build-up in the beef cattle population. In early 1971 this totalled 20 million, or almost 50% more than 4 years earlier. Most of the increase has occurred in Victoria and New South Wales.

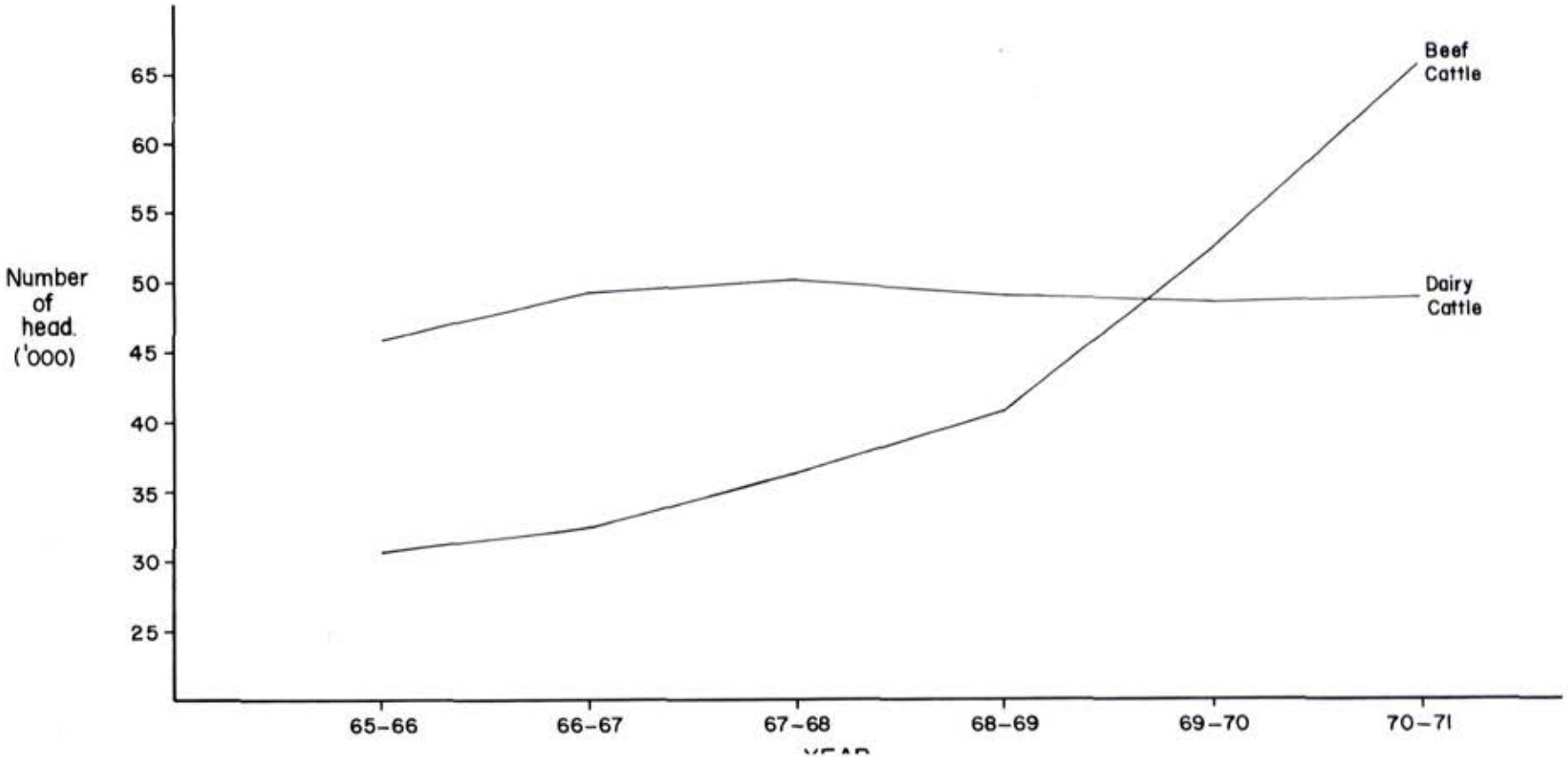
Domestic consumption has shown no clear trend in the last decade and is unlikely to increase at more than a fraction of the rate of production. Prices have been well maintained at high levels, but will increasingly depend on export opportunities. Fortunately, the American, Japanese, and other markets seem likely to demand our export surplus at satisfactory prices. The market outlook for beef appears very favourable, but widespread agreement on this will draw additional supplies wherever possible and continued access to the main markets depends on political decisions in those countries or blocs.

Lamb

In the late 1960s, the decline in wool prices and introduction of wheat quotas led to increased emphasis upon lamb production. In 1970/71, it rose by 11% to a record 342,000 long tons. Mating statistics indicated that further increases were planned for 1972, but a

Fig. I. TRENDS IN LIVESTOCK POPULATIONS. Shire of Rosedale





poor lambing and a lack of rain led to scarcity in winter 1972.

As retail prices fell relative to beef and pork, domestic lamb consumption had increased and took 83% of total production in 1970/71. Export prospects are poor for Australian lamb and prices will tend to move to balance production and local consumption. However, expansion of the beef enterprise, continued strength in the wool market, and increased wheat quotas would act to dampen the trend towards lamb production and so cushion a retreat from the recent high lamb prices.

Mutton

In the 2 years to 1970/71, mutton production increased by more than 20% to a record 448,000 long tons. This unusually rapid increase has been ascribed to the decline in wool prices and consequent efforts to reduce flocks kept primarily for wool production. It does not seem likely that production would be maintained at this level in the long term, especially if the recent higher wool prices persist.

A rapid decline in mutton production seems inevitable in the next 12 months. Domestic mutton consumption has been declining and, unless the prices of other meats soar, this trend is expected to continue. Export demand for mutton and live sheep is very strong, but price levels are such that mutton production is likely to remain a secondary aim of other sheep enterprises.

Wool

Australian wool production has declined since 1969/70 and the Bureau of Agricultural Economics expects a further drop of 9% in the 1972/73 output. This is a consequence of the fall in prices (by more than one-third) between the mid 1960s and 1970/71. However, in 1972, demand has increased very strongly, stocks have fallen, and in early October prices were more than double those of mid 1971. In 1972/73, prices should remain markedly above the average price level of 1971/72. The extent and duration of this recovery in prices may be tempered by uncertainty about international exchange rates and price competition from other fibres.

The longer-term prospects are not clear, but in general the cost of inputs will tend to rise in line with general Australian price levels, while competition from other fibres will influence the upper limit of wool prices.

Dairy products

Although Australian dairy cow numbers have continued to decline, the Victorian component has increased slightly. The trend is towards a smaller number of efficient farms concentrated in the most favourable environments, such as the irrigation areas of this district. Milk

Dryland dairying along Merriman's Creek, upstream from Gormandale.

production fell in 1970/71, but not far below the record level of the previous year. Future production will be adjusted to the quantity demanded at acceptable price levels by one of the proposed quota schemes.

Although export price levels have receded from the peaks of 1971/72, the short-term outlook for dairy products remains favourable. However, in the longer term, demand for fresh milk and butter within Australia will grow only slightly. Unless the European Economic Community changes its agricultural policy drastically, it seems likely that Australian dairy exports will decline in price and volume after 1973. In this event, a quota scheme will be implemented to share the Australian market between existing producers or factories.

Minor industries

In general the horticultural industries appear to face very poor market prospects. However, vegetable production under irrigation should remain profitable. The short-term outlook for most grades of honey is very favourable.

In short, market prospects for beef appear to be very favourable, but demand for other meats has not been consistently strong at attractive price levels. Wool and dairy products are currently enjoying higher prices than those of recent years, but substantial production increases may reverse this trend.

Agricultural Potential of Public Lands

Physical factors (such as rainfall, topography, and soil type) and economic ones (including the costs of development and maintenance and the potential returns) should be considered in assessing land capability for agriculture. This study has not covered the economics of individual farm development in

detail. The general assessments of part IV concentrate upon the development of pastures and ignore the use of land for special crops.

Most of the remaining public land in the district consists of leached sands of very low fertility. These require specialized treatment for pasture establishment, including the use of lime, superphosphate, potash, and trace elements. The total cost of new farm development on these soils is of the order of $345-445 per ha ($140-180 per ac), and the likely carrying capacity of the pastures is low. Pasture maintenance would be costly and would involve regular applications of potash and trace elements, in addition to superphosphate. Most of the public land in this class receives an average annual rainfall between 600 and 750 mm.

Public land that does not consist of chemically poor leached sands is located on the eastern Strzelechi range and the foothills of the eastern highlands. In the former case slopes are generally too steep for agricultural production. Much of this land was farmed prior to the 1920s and 1930s, but farms were later abandoned.

The foothills of the eastern highlands within the shire are unsuitable for agricultural development because of steep slopes and the presence of shallow stony soils.

Irrigated dairying - Nambrok-Denison area.

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TIMBER PRODUCTION

The first settlers cleared the open woodland vegetation that existed over the more fertile flats and valleys. From about 1890, large-scale clearing for settlement had moved into the high-quality forests of the main Strzelecki range, a small portion of which occurs in the south-western corner of the study area. By 1920 forests mainly occupied land that was considered unsuitable for agriculture.

In the Strzelecki range, the land was being farmed until the 1920s and early 1930s, and during this period and afterwards nearly all farms were abandoned because of the inability of farmers to gain a satisfactory living. The reasons for this were both environmental and economic and included steep terrain, frequent bush fires, and low prices for agricultural produce.

Large areas of the Strzelecki range have been returned to forestry during the past 50 years, as the Forests Commission and A.P.M. Forests Pty. Ltd. have purchased marginal and abandoned farms. A.P.M. Forests has also purchased other land within the Shire for pine plantations.

Hardwood Timber

The hardwood forests in the study area are generally of moderate to poor quality except for those in the south-west of the Shire, which have a high potential productivity. Output of sawlogs from the study area has averaged less than 1 million super feet per year.

Capability

Table 12 broadly categorizes forests in terms of productivity. Existing productivity has been estimated and therefore is only approximate. It is lower than potential productivity because of factors outlined below.

Category A stands

These are confined to the portion of the eastern Strzelecki range within the study area where the rainfall exceeds 40 in. a year. Abandoned farmland has been planted with mountain ash and the small well-stocked patches of regrowth have been retained and protected.

Potential productivity of sawlogs and pulp may be as high as 200 cubic ft per

Table 12

HARDWOOD TIMBER PRODUCTIVITY

Category	Tree species	Mature stand height (ft)	Rainfall (in.)	Productivity cu.ft./acre/year**
A	Mountain ash	120+	40+	Potential M.A.I.* high, 150-200; sawlogs and pulp
B	Messmate, grey gum, blue gum	90-120	35-45	Estimated M.A.I. approx. 50; potential M.A.I. about 70; sawlogs and pulpwood
C	Various stringybarks and gums	50-90	25-35	Estimated M.A.I. about 20; potential M.A.I. about 50; sawlogs, poles, and minor forest produce; pulpwood depending on suitability of species
D	Shining peppermint, yertchuk, and saw banksia	15-50	20-35	M.A.I. very low; only suitable for firewood

* Mean annual increment = $\frac{\text{Total volume production in cu.ft.per acre}}{\text{No. of years in rotation}}$

** 1 cu. metre per hectare = 14.29 cu. ft. per acre.

acre per annum. Actual productivity is hard to estimate, because few stands have reached rotation age.

Category A stands: mountain ash regrowth

Category B stands: messmate and silvertop regrowth

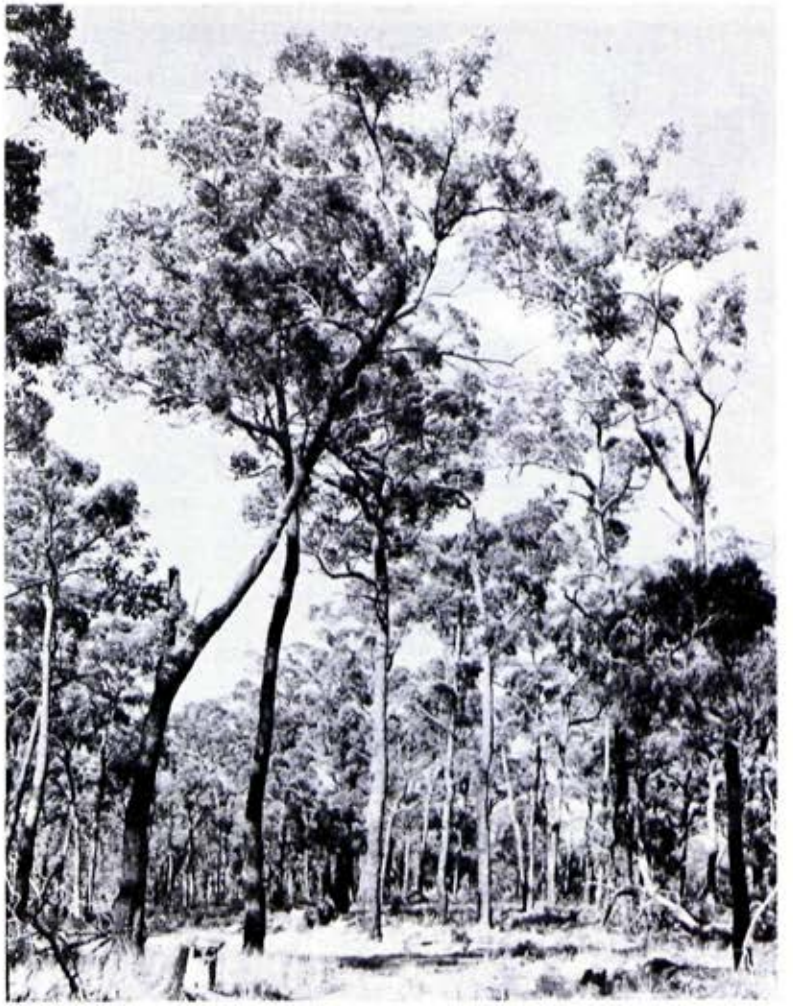
Category B stands

The drier areas of the eastern Strzelecki range support category B stands. Eucalypt species include messmate, grey gum, and blue gum. Mature stands seldom exceed 120 ft in height. Estimated productivity is of the order of 50 cubic ft per acre per annum, but under intensive management for logs and pulp these forests could produce up to 70 cubic ft per acre each year.

Category C stands

These include most of the mixed-species forests on the foothills of the eastern highlands within the study area. Eucalypts include yellow stringybark, white stringybark, silvertop, yertchuk, mountain grey gum, blue gum, messmate, and some red box and red ironbark.

A small area of 538 hectares (1,330 ac) west of Eaglehawk Creek lies within the Forests Commission's Boola working-plan area. Operations of the Commission and A.P.M. Forests Pty Ltd on the 16,000 hectare (40,000-acre) Boola working-plan area have produced on an average about 25 cubic ft of pulpwood and sawlogs per acre per annum during the past 24 years. They have done this by removing remnants of good stands that years of selective logging have degraded. It is possible that, once vigorous regrowth has been established, category C stands could produce 50 cubic ft or more per/acre per annum.



Category C stands: white stringybark open forest II

Isolated forest areas comprising mainly white stringybark, growing on duplex soils developed on Tertiary sediments, can be regarded as category C stands.

Category D stands: shining peppermint, yertchuk, and saw banksia woodland

Category D stands

These woodlands generally grow to less than 50 ft and often less than 30 ft. The most common trees are shining peppermint, yertchuk, and saw banksia.

Productivity is very low, and trees are of such poor form as to be suitable only for firewood, however the demand for this product is negligible in the study area.

Hazards

Fire

Fire is discussed in more detail later in the chapter. Significantly, however, the scrub and woodlands around the Gippsland Lakes have had only one major fire in the last 20 years and consequently are in a highly inflammable condition during the summer. They contrast with similar country further inland, which is subject to frequent fuel-reduction burning to reduce this hazard.

Mountain ash log cut from the forests of the eastern Strzelecki range in the late 19th Century

Phytophthora

This die back disease shows a preference for yertchuk, white stringybark, and messmate, while but but - a species that grows in association - shows little sign of damage.

Its causal fungus *(Phytophthora cinnamoni)* is transmitted by means of movement in soil moisture, and it attacks the fine root hairs of many species of plants, including some commercially valuable ones.

Phytophthora has killed the yertchuk, but has not affected but but.

Softwood Timber

Outlook

In 1967/68, Australia consumed 544.8 million cubic ft of wood, expressed as the volume of logs used. Net imports provided 154.8 million cubic ft (28%) of this total. Projected demand for the year 2000 is of the order of 1,200 million cubic ft.

The Commonwealth Government has accepted that Australia's forest resources should be increased to cater for greater demand and to decrease the proportion of imported wood consumed. The Commonwealth gives financial assistance to the State forest services to encourage softwood planting, the target being 1.2 million ha (3 million ac) by the year 2000. It does not assist private companies.

Australian consumption of paper and paper products, expressed as the volume of logs used in their manufacture, was 122.5 million cubic ft. Net imports provided 85.8 million (68%) of this total. In 1971, Jacobs estimated projected consumption for the year 2000 as 578 million cubic ft.

These figures indicate that a present Australian imports two-thirds of its requirements of these products, and that

Mechanical harvesting of radiata pine for pulp in A.P.M. plantations

demand for them will increase five-fold in the next 30 years.

The capacity of the Australian pulp and paper industry is growing to keep pace with demand. In Gippsland, the Maryvale pulp mill has steadily increased its output since its establishment in 1939. A semi-chemical pulp mill opened in 1968 doubled its capacity in 1971, a new paper machine has been built, and a bleaching plant is under construction.

This expansion requires increased supplies of pulpwood. For pine plantations, planting of additional areas must take place at least 10-15 years in advance of increases in wood requirements in order to have stands ready for first thinning.

State softwood production

The Latrobe zone, which includes portion of the study area on the eastern Strzelecki range, is one of the Forests Commissions eight softwood plantation development zones.

The Commission's current annual planting rate for the whole Latrobe zone is 680 ha (1,700 ac), and up to December 1971 it had established approximately 5,200 ha (13,000 ac).

Within the study area, 1040 ha (2,600 ac) have been planted to radiata pine and at least 400 ha (1,000 ac) will be planted within the next 5 years.

Private enterprise softwood production

The study area contains 13,600 ha (34,000 ac) of commercial pine planta-

tions, stretching from Longford towards Traralgon. Radiata pine *(Pinus radiata)* is the major species, with some small areas of maritime pine *(P. pinaster)*. About 800 ha (2,000 ac) are planted each year.

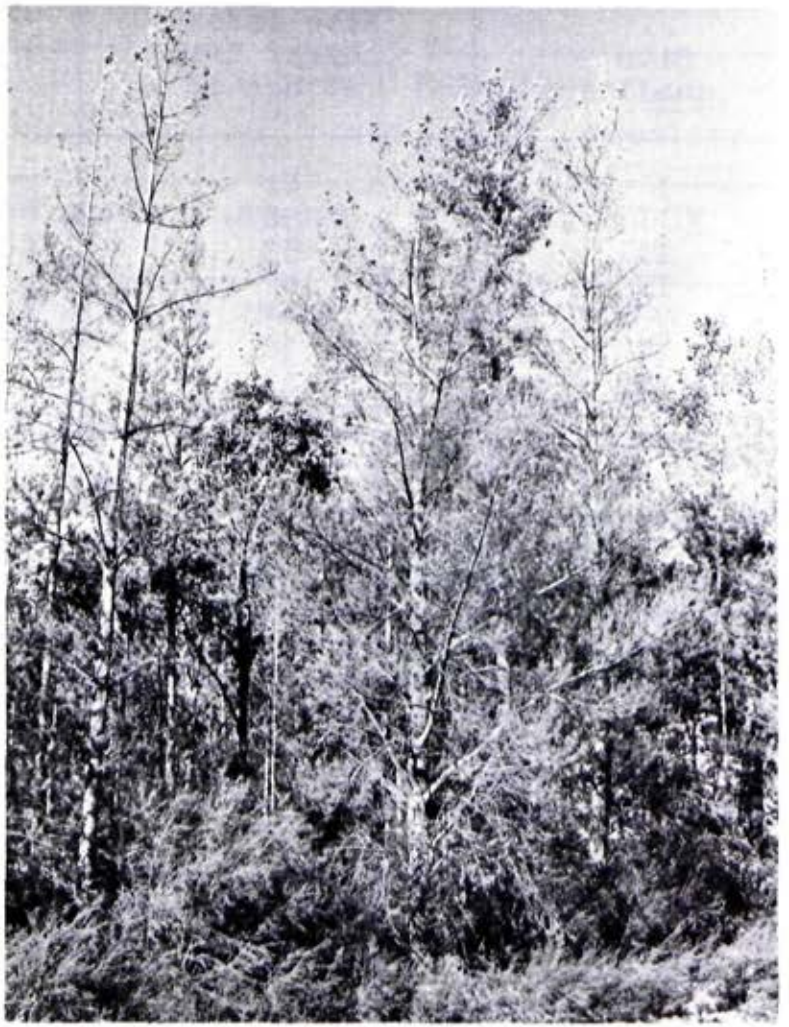
A.P.M. Forests Ltd, a subsidiary of A.P.M. Ltd, owns the majority of the plantations. A.P.M. Ltd is a large Australian company whose main products are wrapping papers and carton and corrugated boards for packaging. Net sales of the company in 1971 were $138 million.

A.P.M. Forests Ltd was formed in 1951 to supply wood for A.P.M. Ltd's pulp mills. It has established plantations and secured rights to long-term supplies of eucalypt-wood State forests. In Gippsland, the company supplies pulpwood to the large pulp mill at Maryvale, near Morwell, and with C.S.R., jointly operates a particle-board plant at Rosedale, which consumed 15 million cubic ft of pine thinnings in 1970.

In 1970, the pulp mill produced 160,000 tons of kraft and semi-chemical pulps. It consumed 21.7 million cubic ft of wood comprising 7.8 million cubic ft of pine and 13.8 million cubic ft of eucalypt.

Capability

Capability of land for growing radiata pine can be expressed by site quality, which is based on total volume of production. Seven site quality classes are generally recognized and vary from extremely good (I) to very poor (VII).



Radiata pine killed by Diplodea *following hail damage in A.P.M. plantations*

Table 13

SITE QUALITY FOR RADIATA PINE

Site quality	Site index height (ft) at age 10	Volume (cubic ft) at age 26	Mean annual increment (cubic ft) to 26 years
I	61	12,090	460
II	56	10,640	410
III	53	9,240	380
IV	49	7,900	305
V	45	6,430	245
VI	38	4,540	190
VII	32	3,190	123

The native vegetation varies in composition and structure as site factors change. The capability of a site to grow various plants (including pines) depends upon the way in which climate, parent material, topography, and soils interact. Native vegetation can thus provide an indicator of site potential for radiata pine. Table 14 sets this out in a broad way.

Site quality ratings given in Table 14 in general apply to sites that have been treated in various ways to encourage the growth of pines. These techniques vary from one category to another, and include ploughing, ridging, application of fertilizers, and spraying with chemicals to control weed growth.

It is interesting to contrast Category B with Category F. In both cases the annual rainfall can be between 25 and 30 in. and the soils are leached sands. However, the latter has a cemented layer while the former has none. Category B can produce almost double the volume of timber.

A dramatic increase in site potential has been demonstrated on red gradational soils with an annual rainfall of 35-40 in. that had been under improved pasture prior to planting. Site quality increased from V to almost II. This effect has not been explained.

Leached sands with a cemented layer less than 50 cm from the surface are wide-

Table 14

CAPABILITY FOR RADIATA PINE

Category	Original vegetation	Soils	Rainfall (in.)	*MAI, 26-year rotation	Site quality
A	Mountain ash open forest IV	Brown and red gradational soils	40-50+	305-410	II-IV
B	Narrow-leaf peppermint open forest II and manna gum woodland	Leached sands without a cemented layer	25-30	245-305	IV-V
ØC	Messmate open forest III	Brown and red gradational soils	35-40	245	V
D	Stringybark open forest II	Duplex	22-30	190-245	V-VI
E	Yertchuk open forest II	Leached sands with cemented layer more than 50 cm from the surface	22-30	120-190	VI-VII
F	Shining peppermint, yertchuk, and banksia woodland	Leached sands with cemented layer less than 50 cm from the surface	22-30	120	VII

* Mean annual increment = $\frac{\text{Total volume production cubic ft per acre}}{\text{No. of years in rotation}}$

Ø M.A.I. on land under improved pasture prior to planting pine is 360-400, i.e. up to S.Q. II.

spread on public land and only poor-quality pines can be grown, however the production of hardwood from native vegetation on these sites is almost negligible. Although slower growing than radiata pine, maritime pine is probably better suited biologically to planting on such sites.

Economic considerations

Transport costs are critical, and road haulage costs of approximately 15 cents per 100 cubic ft per mile generally make any supplies further than about 60 miles from the mill uneconomic.

It is desirable that land be fairly flat in order that operations can be carried out by machines, and that plantations be established in large compact blocks in order to achieve economy in planting, managment, and protection.

Because of these considerations it can be more profitable to grow poor-quality stands closer to the mill than high-quality stands further from it.

Hazards

The most important hazards to pine growing in the study area are outlined below.

Fire

The inflammable understorey of the woodlands surrounding A.P.M. pine plantations present a high fire hazard. In an effort to reduce this risk and to protect nearby farmland, the Forests Commission and A.P.M. Forests carry out periodic fuel-reduction burns.

These measures are vital because it appears that many wildfires in this area are deliberately lit.

Site deterioration

Experience on leached sands in South Australia has shown a loss of productivity of about 25% in the second rotation compared with the first. It is possible that burning slash could cause this. In South Gippsland on leached

Fire crossing Golden Beach road on the edge of Lake Reeve

sands, slash is incorporated in the soil rather than burning it.

Moisture stress

In an effort to offset the effect of moisture stress in soils with a low moisture storage capacity, regular thinnings are carried out to keep the basal area to a range between 60-80 sq ft per ac.

Hail damage

Recently, hail caused the death of about 2,000 acres of radiata pine near Longford. Death was apparently due to attack by the fungus *Diplodea*, which invaded the tissues of trees following mechanical damage by hail (see page 75).

Wind throw

Maintaining the vigour of trees by regular thinning and fertilizer treatment minimizes damage due to wind throw.

Sirex

The wood wasp was discovered in A.P.M. plantations in 1962. However, this has not had any significant effect on silvicultural treatment other than encouraging early thinning, which has always been a feature of A.P.M. Forests operations.

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MINING

The main mineral resources of the study area are brown coal and limestone - no occurrences of metallic minerals are known. Four areas contain coal suitable for exploitation by open-cut methods, and large reserves of limestones suitable for cement manufacture and agricultural lime are present. Gravel and sand abound, and are extracted from numerous small pits. Oil and gas from off-shore wells are piped to a terminal and treatment plant near Longford before being piped to Melbourne and Western Port.

Brown Coal

Gippsland's Latrobe Valley contains one of the world's largest deposits of brown coal. The total economic reserves of coal readily winnable for major power generation purposes by open-cut methods are estimated to be 10,000 million tonnes.

The coal was formed from thick deposits of vegetable matter, which accumulated as peat in swamps in Lower Tertiary (Eocene-Oligocene) times. Following burial, these deposits were upgraded to thick seams of brown coal. Subsequently uplift with faulting and folding warped the coal seams and preserved them in the broad trough of the Latrobe Valley. Erosion has brought the seams close to the surface in two main areas - the Morwell-Yallourn and Loy Yang fields.

Reserves

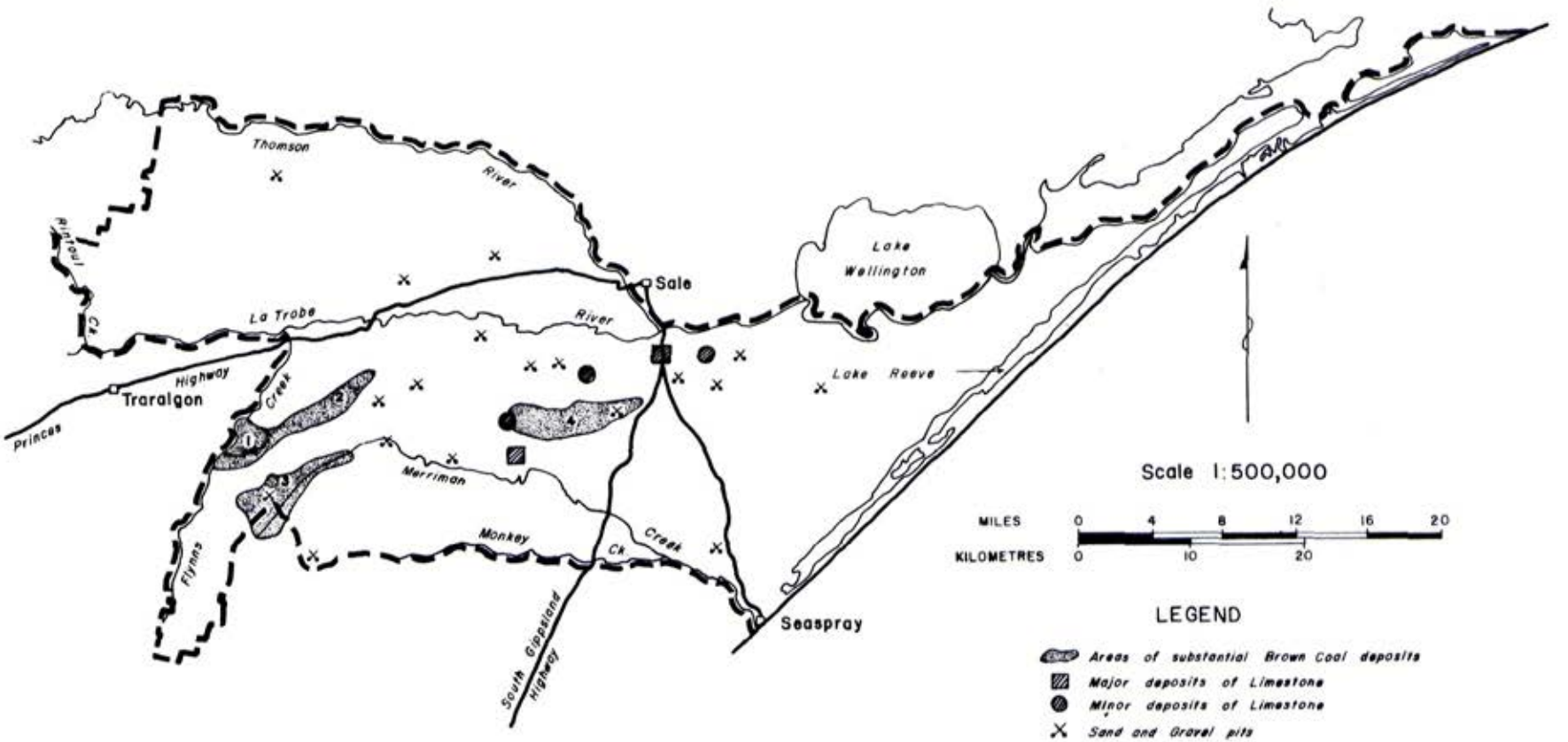
While coal seams lie beneath most of the Shire of Rosedale, the State Electricity Commission's drilling programme has delineated the large economic deposits from those that lie beneath deep overburden or are split. Four areas containing valuable reserves of brown coal have been found in the study area (see the minerals map opposite).

Area No. 1

This area is the easterly extension of the large Loy Yang Field across Flynn's Creek, and would form part of the possible future development of the Loy Yang Open Cut, which has a total economic mining reserve of 3,400-4,700 million tonnes. Within the Shire of Rosedale geological reserves (which normally considerably exceed mining reserves) are approximately 900 million tonnes with a vertical thickness coal to overburden ratio of 3.1:1.

MINERAL DEPOSITS

LAND CONSERVATION COUNCIL
VICTORIA
SOUTH GIPPSLAND AREA
DISTRICT 1



Adapted from Mineral Deposits map, Mines Department and special map of areas of substantial Brown Coal deposits, State Electricity Commission.

Area No. 2

The Rosedale Monocline provides a narrow block, some 16 kilometres (10 miles) in length, in which coal seams dip to the north-west at angles rather steeper than in existing open-cut areas. The total volume of coal in the area is large, but the steeper dip and multiple seams would create mining problems. Geological reserves are of the order of 1,800 million tonnes with a vertical coal to overburden ratio of 2.5:1.

Area No. 3

This field, which is centred around the township of Gormandale, contains the major development of the Traralgon Group of coal seams - the oldest in the Latrobe Valley. Geological reserves within the Shire of Rosedale are approximately 3,200 million tonnes, with a vertical coal to overburden ratio of 1.0:1. Mining reserves of coal from this area with a coal to overburden ratio of 1.4:1 exceed 750 million tonnes. (In this case, overburden ratio is coal in tonnes: overburden in cubic metres).

Area No. 4

This is known as the Coolungoolun Field and contains coal with a calorific value rather higher than that of the major open cuts in the Latrobe Valley. Geological reserves of 400 million tonnes with a vertical coal to overburden ratio of 1:1.5 have been proved for part of the areas. Further exploration could significantly increase these reserves.

Quality of coal

The table opposite lists the coal reserves, coal to overburden ratios, average moisture contents, and net wet calorific values (N.W.C.V.) of the coals found in the four areas defined in the paragraphs above.

Outlook

Since 1920, the State Electricity Commission has developed the brown coal deposits of the Latrobe Valley to generate electricity for State-wide distribution. At present more than 80% of Victoria's power is drawn from some 2,200-MW of base-load generating plant burning Latrobe Valley brown coal.

A further 1,400-MW brown-coal-fired base load power station will be progressively brought into service from 1972 and will be completed in 1980. A 1,000-MW gas-fired power station, using oil fuel in emergency, will be installed in the Melbourne area in two stages in 1976 and 1978.

By 1975 the development of the Snowy Mountains Hydro-electric Scheme will be completed, and Victoria's share of peak-load power from that project will reach a maximum. In 1979 a 150-MW hydro-

Table 7

DESCRIPTION OF COAL FIELDS*

SHIRE OF ROSEDALE

Area	coal reserves (million tonnes)	Thickness ratio, coal to overburden	Average moisture content %	Average N.W.C.V.	
				(Kj/kg)	(Btu/lb)
1. Flynn's Creek	900	3.1:1	63	7,650	3,300
2. Rosedale Monocline	1,800	2.5:1	62	7,550	3,250
3. Gormandale	3,200	1.0:1	55	8,950	3,860
4. Coolungoolun	400	1:1.5	51	11,300	4,850

* Approximate values, subject to review

electric power station at Dartmouth Dam should commence service.

Large amounts of additional base-load plant will be required in the 1980s. Oil, gas, nuclear fuel, or brown coal could be used to fuel these plants. The future economic implications of base-load generation using fuel other than brown coal are not year clear.

Present economics indicate that generation using nuclear or oil fuel would be more expensive than that from brown coal, and only limited reserves of natural gas have been proved. Apart from pumped storage hydro-electric projects, which could be required in the 1980s, there is little scope for further hydro development for electricity purposes.

By the year 2000, oil and other fuel would probably be used to generate power in Victoria, but the use of these fuels would be additonal to brown coal. Thus Latrobe Valley brown coal is likely

Limestone quarry on Merriman's Creek

to remain a major fuel for power generation, at least until the end of this century. Long-term investigations into the development of brown coal resources in the Latrobe Valley for power generation indicate that some of the reserves in the study area could be required for that purpose.

In addition to the use of brown coal for power generation, reserves of coal could also be required for the extraction of significant amounts of synthetic oil and in the manufacture of industrial char.

Public land

The Loy Yang, Rosedale Monocline, and Gormandale coal fields lie beneath private land. The Coolungoolun field lies largely beneath public land in the eastern part of the Holey Plains block. Development of this field would require the use of additional large areas of public land as service areas.

The possibility that this area could be required for power generation and other purposes places an important constraint on land use.

Limestone

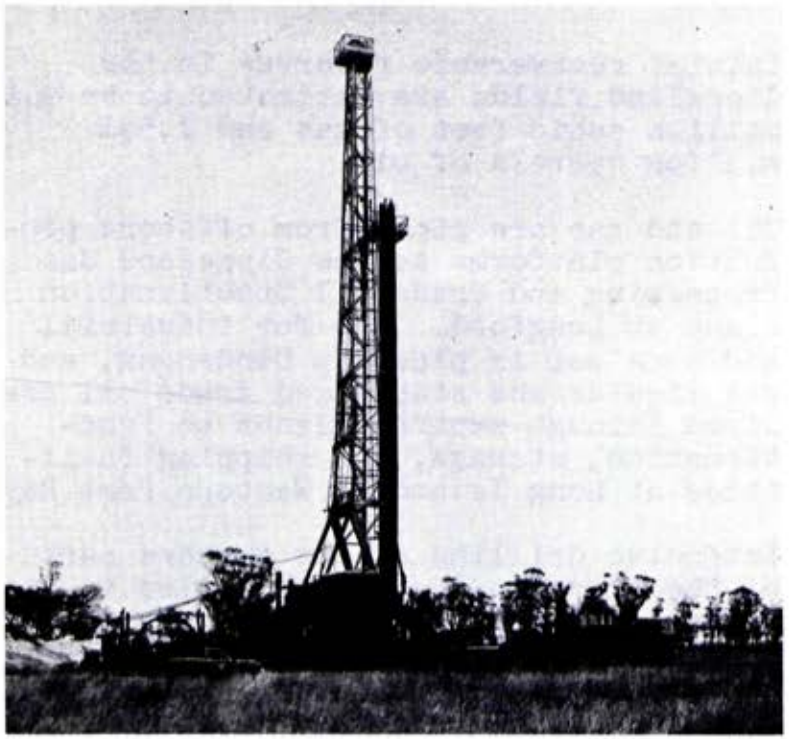
Tertiary limestones of the Gippsland Group outcrop on the flanks of the east-west trending Baragwanath Anticline south of Sale. On the northern flank, the limestone occurs at shallow depth or outcrops for 12 miles along the strike west of Longford. On the southern flank, the deposits extend for 8 miles along Merriman's Creek and two small areas outcrop near Holey Hill (see the Geology map at the back of this report). All known deposits occur on private land. They vary from calcareous mudstone to almost pure limestone. The area contains large reserves.

The limestones have been used for agricultural lime for many years, and many small pits have been opened. Some are still worked intermittently. Marly (clayey) limestone is suitable for cement manufacture, and Gippsland Lime and Cement Pty Ltd quarries large quantities of this material from pits on Merriman's Creek.

Sand and Gravel

Tertiary and Quaternary sands and gravels are worked in many shallow pits, but no records of production are available. The study area contains large quantities of these materials on public and private lands.

Erosion on the sides of a gravel pit in the Holey Plains Block



Drilling for oil and natural gas near the the Gippsland Lakes

Oil and Gas

Offshore drilling in the Gippsland Basin resulted in the discovery of commercial quantities of gas in 1965, and oil in 1967. During the next 4 years, one gas field, one oil and gas field, and two oil fields were developed, and these now service 94% of Victoria's gas consumers and 62% of Australia's current refinery requirements.

As a result of these discoveries,

initial recoverable reserves in the Gippsland fields are estimated to be 9.5 million cubic feet of gas and 1,591 million barrels of oil.

Oil and gas are piped from offshore production platforms to the Gippsland Gas Processing and Crude Oil Stabilization Plant at Longford. Gas for industrial and home use is piped to Dandenong, and gas liquids and stabilized crude oil are piped through separate lines to fractionation, storage, and shipping facilities at Long Island in Western Port Bay.

Intensive drilling of the onshore part of the Gippsland Basin has failed to find commercial quantities of hydrocarbons. Offshore exploration is continuing.

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PART IV BLOCK DESCRIPTION

HOLEY PLAINS

A. General

1. Location

North of Merriman's Creek and west of the Sale-Seaspray Road to Flynn's Creek. The public land comprises one large parcel of 12,018 ha (29,696 ac) and several small parcels of 2,442 ha (6,034 ac), the total area being 14,460 ha (35,730 ac). Parishes of Rosedale, Tong Bong, Willung, Stradbroke, Giffard, Holey Plains, Coolungoolun, and Wulla Wullock.

2. Present tenure

Crown land (unreserved): 12,018 ha (29,696 ac).
Crown land (reserved): 417 ha (1,029 ac).
Crown land under plantation area lease: 2,025 ha (5,005 ac).

3. General description

In general the area consists of low sandy hills with no permanent streams. The most widespread vegetation is shining peppermint and saw banksia with dense bracken in the understorey.

Recently burned shining peppermint - saw banksia woodland with austral grass tree in the understorey.

4. Present use

About 2,000 ha (5,000 ac) have been planted with radiata pine by A.P.M. Forests Ltd. The Rosedale recreation reserve is used as a motor-racing circuit and there are several small water reserves. The bulk of the public land is not used for any particular purpose, although small areas within it are suitable for hardwood production.

B. Nature of the Land

1. Climate

Rainfall varies from 30 in. to less than 24 in.

2. Geology and physiography

In general the area consists of sandy hills with moderate drainage density and moderate relief (less than 30 m). Most of the deposits are of Tertiary age, but those towards the east are Quaternary.

Small outcrops of Tertiary limestone occur at Holey Hill.

3. Soils

The most widespread soils are leached sands with cemented sand or gravel in the B horizon. Small areas of leached sands without an impeding horizon occur. Duplex soils, although not widespread, occur occasionally on flat ridge-tops and sometimes in swales.

Sticky boronia in Holey Plains Block

4. Vegetation

Most of the vegetation can be classified as woodland, in which shining peppermint and saw banksia are the most common trees. Shining peppermint woodland and yertchuk woodland are confined to leached sands that have a cemented layer relatively close to the surface. On higher ground on duplex soils, stringybark open forest II occurs. Manna gum and narrow-leaf peppermint grow on leached sands with no impeding horizon. There are many species intermixed with these, the most common being but but and yertchuk on well-drained sites and apple box and mealy stringybark on the poorly drained situations.

Common bronzewing

Echidna

Dense bracken characterizes the understorey and tends to obscure the great variety of native plants. These include spike and sweet wattle, various other legumes, saw banksia, silver banksia, sticky boronia, golden grevillea, silky tea-tree, and broom heath.

5. Fauna

The major habitat type is woodland with a dense understorey and this can provide food and shelter for many animals. Common birds include emu, common bronzewing, crimson rosella, pallid and fan-tailed cuckoos, tawny frogmouth, kookaburra, and various thornbills and honeyeaters.

Mammals include the grey kangaroo, swamp wallaby, brush and ring-tailed possums, bush rat, swamp rat, sugar glider, and koala.

C. Capabilities

1. Flora

The area has a relatively high capability for flora conservation, mainly because it contains large areas of shining peppermint - saw banksia woodland, which has very limited occurence outside the study area. Sticky boronia and golden grevillea, although widespread, are localized in occurrence albeit common in this area.

2. Fauna

The capability for fauna conservation is probably moderate. Frequent fires in the area almost certainly have an adverse effect on fauna. However, woodlands with a dense understorey provide habitat for many animals.

3. Other features

Toms Cap is a lookout point of interest, being the point from which Angus McMillan in 1841 first sighted Port Albert. A cairn has been erected on this point and access can be gained by walking several hundred yards from a forest track.

4. Recreation

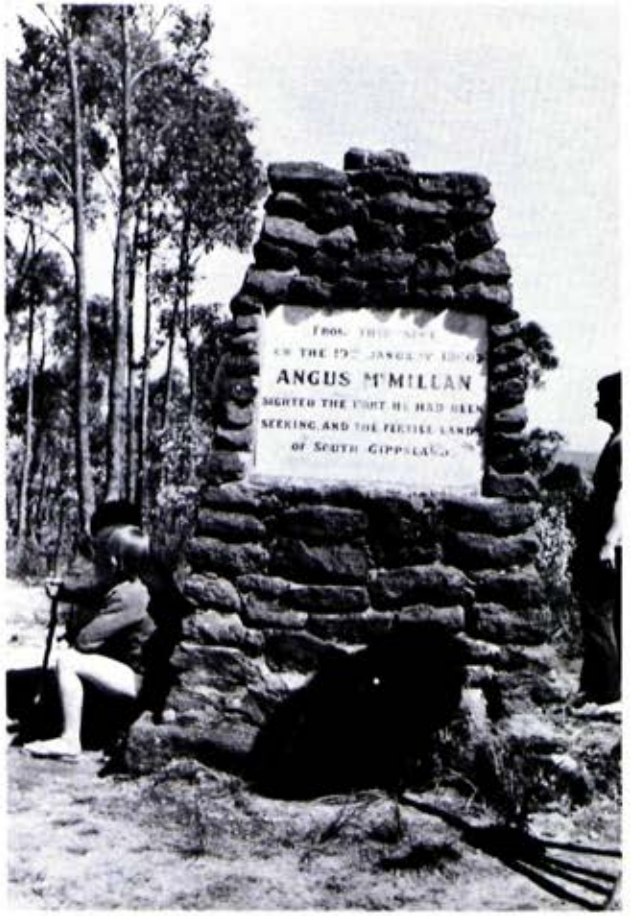
Recreational capability during most of the year is low, however, brilliant display of wildflowers that takes place during spring could well be a tourist attraction in the future.

5. Agriculture

Capability is low because the soils are extremely infertile.

6. Softwoods

The capability for pine-growing is low. Leached sands with a cemented horizon relatively near the surface are widespread and it is unlikely that pines with a site quality rating higher than



The McMillan Monument at Tom's Cap

VII can grow on such land. However, these may still be economic because of generally flat terrain and closeness to Maryvale mill.

Where manna gum and narrow-leaf peppermint occur, soils are deep sands

ERRATUM

Page 90 Toms Cap is located in the Stradbroke block, not the Holey Plains block as indicated.

and radiata pine with a site quality rating IV-V can be grown. However, the block contains only small patches of this type of land. The small areas of duplex soils carrying white stringybark would support radiata pine of site quality VI to VII.

A.P.M. have established pine plantations on public land in this block where soils are duplex or the cemented layer in leached sands is at considerable depth.

7. Hardwood

This area has a generally low capability for hardwood production. Some sawlogs have been cut from the white stringybark open forest II.

8. Honey

Capability for honey production is moderate; however, honey produced from the area commands a relatively low price because it is dark and astringent.

9. Minerals

Substantial brown coal deposits exist beneath public land in the east of this block. Capability is moderate at present, but may become high in the future. Two small deposits of limestone outcrop near Holey Hill. Sands and gravels are widespread.

10. Water

The area has a low capability as surface water catchment but high capability for recharge of quifers.

D. Hazards and Conflicts

The most significant hazard in this block is fire, and fuel-reduction burning is carried out in order to reduce this. Utilization of coal deposits in the area or establishment of additional pine plantations will result in destruction of native vegetation. It is also possible that, if large areas are planted to pine, recharge of aquifers may be reduced because of increased evapotranspiration.

E. Significance

The Holey Plains block contains relatively large areas of shining peppermint - saw banksia woodland, which has very limited occurrence outside the study area. The brown coal deposits at Coolungoolun may be significant in the future.

STRADBROKE

A. General

1. Location

East of the Gippsland highway, north of Monkey Creek, and south of Merriman's Creek, except for one parcel north of Callignee and south-west of Gormandale.

The public land comprises one large parcel of 6,682 ha (16,512 ac), a smaller parcel of 1181 ha (2,918 ac), and three small parcels amounting to 135 ha (333 ac), totalling about 8,000 ha (19,763 ac). Parishes of Callignee, Tong Bong, Willung, and Stradbroke.

2. Present tenure

Crown land (unreserved): 6,682 ha (16,512 ac).
Crown land (reserved): 135 ha (333 ac).
Reserved forest: 1,181 ha (2,918 ac).

3. General description

Stradbroke block resembles Holey Plains, except that linear ridge and swale topography of low relief with swamps occurs in the south-eastern corner of the block.

4. Present use

Little of the public land is used for any specific purpose, only small areas within it being suitable for hardwood production.

B. Nature of the Land

1. Climate

Rainfall varies from 35 in. to 24 in.

2. Geology and physiography

Generally the area consists of sandy hills with moderate drainage density and moderate relief on Tertiary sediments, while a tendency towards linear sand ridge and swale topography exists on Quaternary sediments.

3. Soils

As for Holey Plains

4. Vegetation

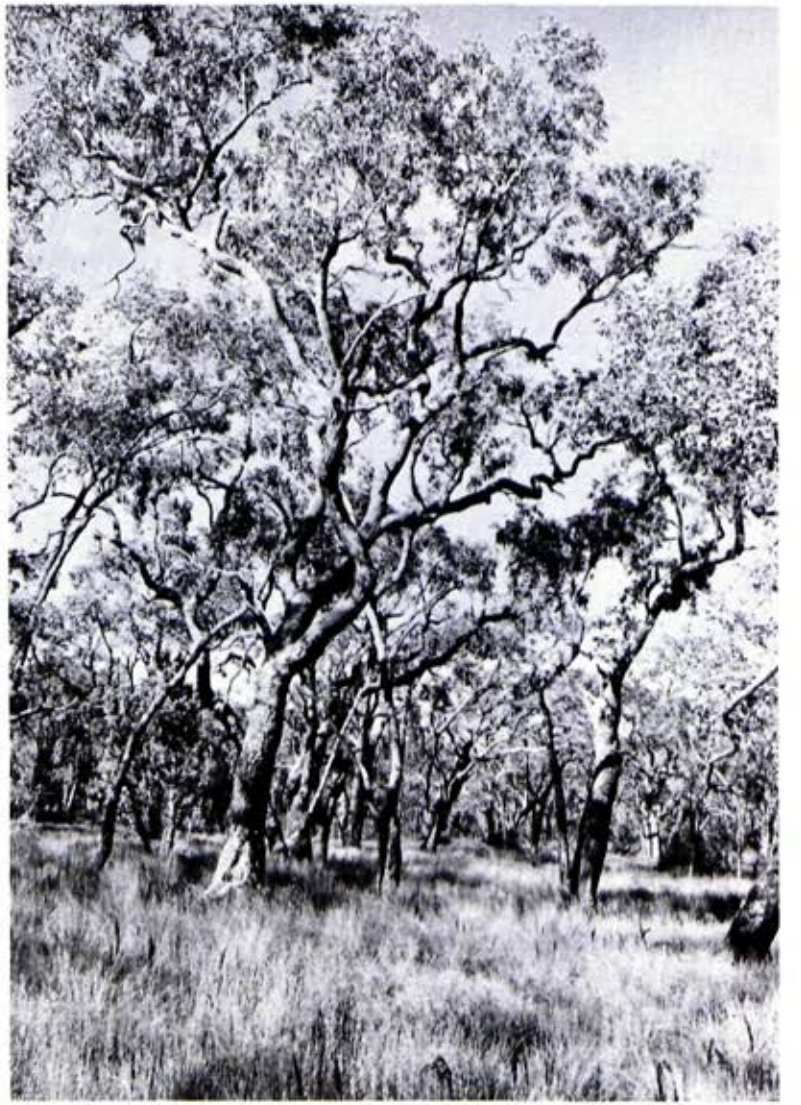
As for Holey Plains, except that public land in the south-eastern corner of the block carries woodland of almost pure

mealy stringybark on poorly drained sites together with numerous swamps.

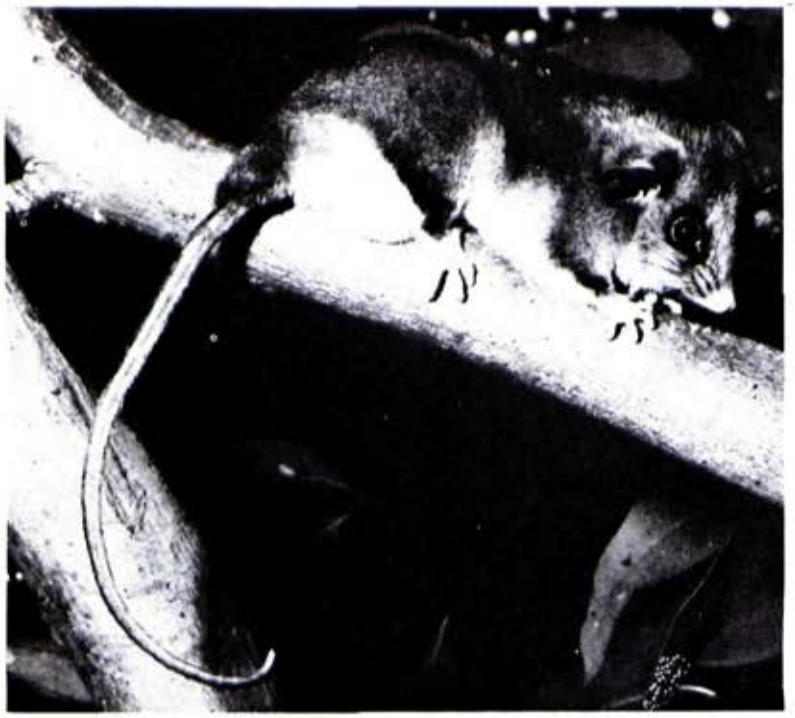
5. Fauna

As for Holey Plains, except that the numerous small swamps provide important habitat for water birds.

Swamp on Stradbroke block, with swamp gum in the foreground



Mealy stringybark open forest I with rushes and sedges in the understorey



Ring-tailed possum

C. Capabilities

1. Flora

As for Holey Plains.

2. Fauna

As for Holey Plains.

3. Other features

None

4. Recreation

As for Holey Plains.

5. Agriculture

As for Holey Plains.

6. Softwood

Capability is generally low. It is unlikely that the public land in this block can support radiata pine stands with a site quality rating greater than VI.

7. Hardwood

Generally, the stands are slightly better than those of the Holey Plains block, but still poor.

8. Honey

As for Holey Plains.

9. Minerals

No significant coal deposits lie beneath the public land. Limestone occurs near the surface in south of this block and is mined south of public land on Merriman's Creek.

10. Water

Many of the numerous small swamps present carry water throughout the year, but the area has a low capability as

water catchment. However, capability for recharge of aquifers is high.

D. Hazards and Conflicts

The most significant hazard is fire, and fuel-reduction burning is carried out to lower this. The land in this block has little potential for any use other than recreation and conservation, so no obvious conflicts appear.

E. Significance

As for Holey Plains

Rough mint bush in Stradbroke Block

CALLIGNEE

A. General

1. Location

Immediately south of Callignee. Public land comprises one parcel of 1,712 ha (6,700 ac). Parish of Callignee.

2. Present tenure

Reserved forest: 2,712 ha (6,700 ac).

3. General description

Wet mountain forests, scrub or grass and bracken on gradational soils have developed on deeply dissected Mesozoic sediments.

4. Present use

The block can support highly productive forests. Scrubland and poorly stocked areas are being planted with mountain ash. Radiata pine plantations are also being established.

B. Nature of the Land

1. Climate

Annual rainfall varies from 35 to 50 in.

2. Geology and physiography

Deeply dissected Mesozoic sediments are interspersed with patches of older basalt.

3. Soils

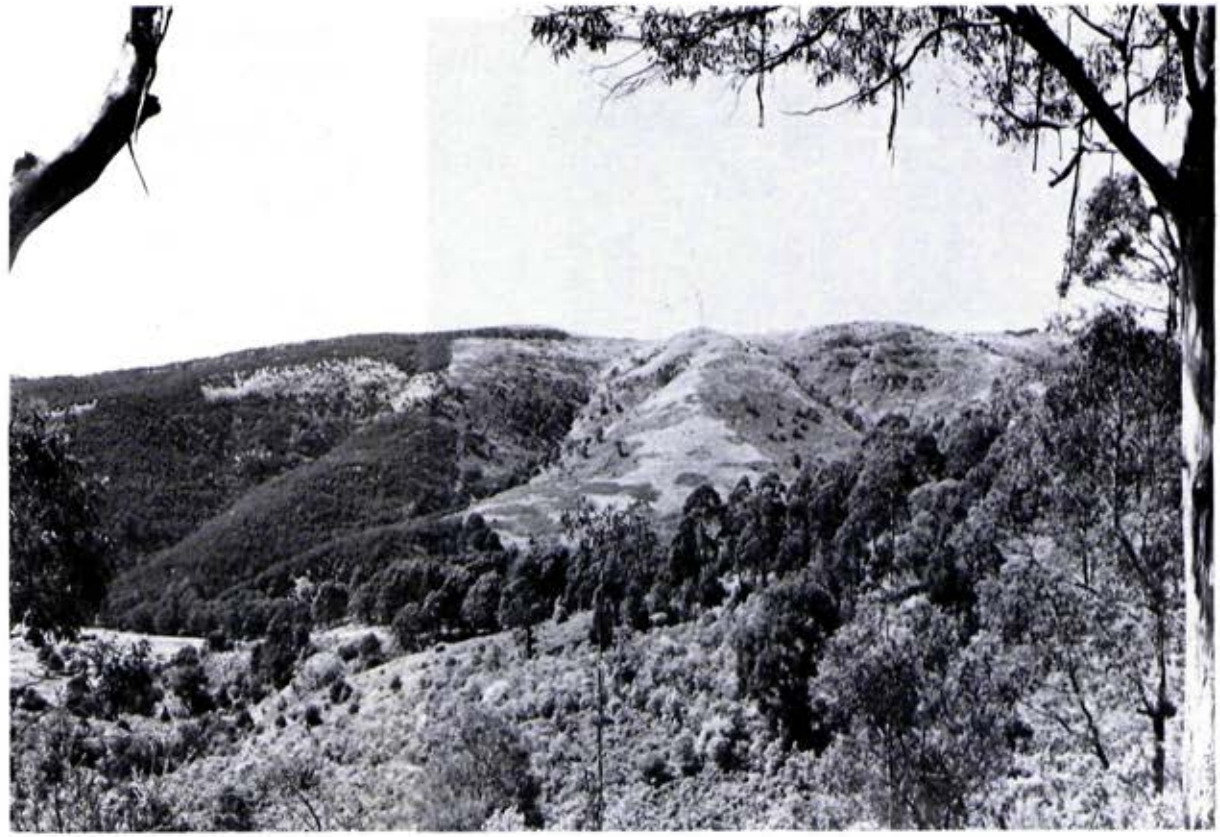
Brown gradational soils have developed on Mesozoic sediments and red gradational soils on older basalt.

4. Vegetation

Wet mountain forest contains mountain ash, together with blue gum, messmate, and mountain grey gum. The understorey is dense and tall; conspicuous species include blanket leaf, musk daisy-bush, silver wattle, blackwood, wire grass, and ferns. The scrub patches occurring on abandoned farmland include several of the understorey species as well as blackberries and ragwort.

5. Fauna

The fauna is typical of that of open forest III and IV, i.e. wet mountain forest. Common species of birds include gang gang cockatoo, sulphur-crested cockatoo, eastern rosella, tawny frog-



Abandoned farmland, scrub, radiata pine plantations, and mountain ash regrowth on the eastern Strzelecki range.

mouth, kookaburra, black-faced cuckoo shrike, superb blue wren, buff-tailed thornbill, southern yellow robin, rufous fantail, white-eared honeyeater, white-naped honeyeater, and lyre-bird.

The most common mammals would include wombat, brown phascogale, swamp wallaby, and bush rat.

C. Capabilities

1. Flora

Public land within this block does not have a high capability because little of the forested land remains in its natural condition.

Superb lyre-bird

2. Fauna

The forests and scrub, although not in their natural condition, have a moderate to high capability for fauna because of the diversity of habitats.

3. Other features

While not productive, the abandoned farmland mixed with forests on these hills forms an attractive landscape.

4. Recreation

The area has moderate potential for recreation. Merriman's Creek provides sport for fishermen.

5. Agriculture

Capability for agriculture is generally low because of the steepness of terrain and the difficulty of controlling weeds, especially ragwort.

6. Softwood

The area has a high capability for growth of softwoods. On some of the abandoned farmlands it would be possible to grow site quality II stands of radiata pine. Competition from weeds and scrub poses a problem in early establishment of seedlings.

7. Hardwood

The area has a very high capability for growth of hardwoods. Competition from weeds and scrub again poses a problem in early establishment of seedlings.

8. Honey

Callignee block has a low capability for honey production.

9. Minerals

Black coal seams occur in the Mesozoic sediments, but not in sufficient quantity to be utilized. The basalt is old and strongly weathered, and is thus not suitable for mining.

10. Water

The capability for water catchment is high. Surface-run off in this area can be as much as 20 in. around the headwater of Merriman's Creek.

D. Hazards and Conflicts

Land slips occur, especially on slopes greater than 25° from which native vegetation has been removed. Much of the abandoned farmland is infested with ragwort, a noxious weed.

There do not appear to be obvious conflicts.

E. Significance

This small black is the only part of the study area that can support high-quality forests.

Landslip in valley of Merriman's Creek

TOONGABBIE

A. General

1. Location

One area south of the Thomson River and north of Eaglehawk Creek and the other immediately south of Eaglehawk Creek. The block contains two parcesl of 2,953 ha (7,296 ac) and 497 ha (1,229 ac) respectively, totalling 3,450 ha (8,525 ac). (The Dennison block, which adjoins Toongabbie to the east, contains almost no public land.) Parishes of Toongabbie North, Toongabbie South, and Boola Boola.

2. Present tenure

Crown land: 497 ha (1,229 ac).
Reserved forest: 2,953 ha (7,296 ac).

3. General description

The mostly deeply dissected country carries a mixed-species open forest.

4. Present use

A small area of 538 ha (1,330 ac) lies within the Forests Commission's Boola working plan area, from which large volumes of pulpwood and sawlogs have been harvested.

The remainder of the area is not used intensively, but produces small volumes of sawlogs, poles, and fencing timbers. Railway sleepers are cut from time to time.

B. Nature of the Land

1. Climate

Annual rainfall averages about 30 in.

2. Geology and physiography

Deeply dissected Palaeozoic sediments predominate over smaller areas of deeply dissected Mesozoic sediments and occasional cappings of Tertiary sands and gravels and patches of older basalt.

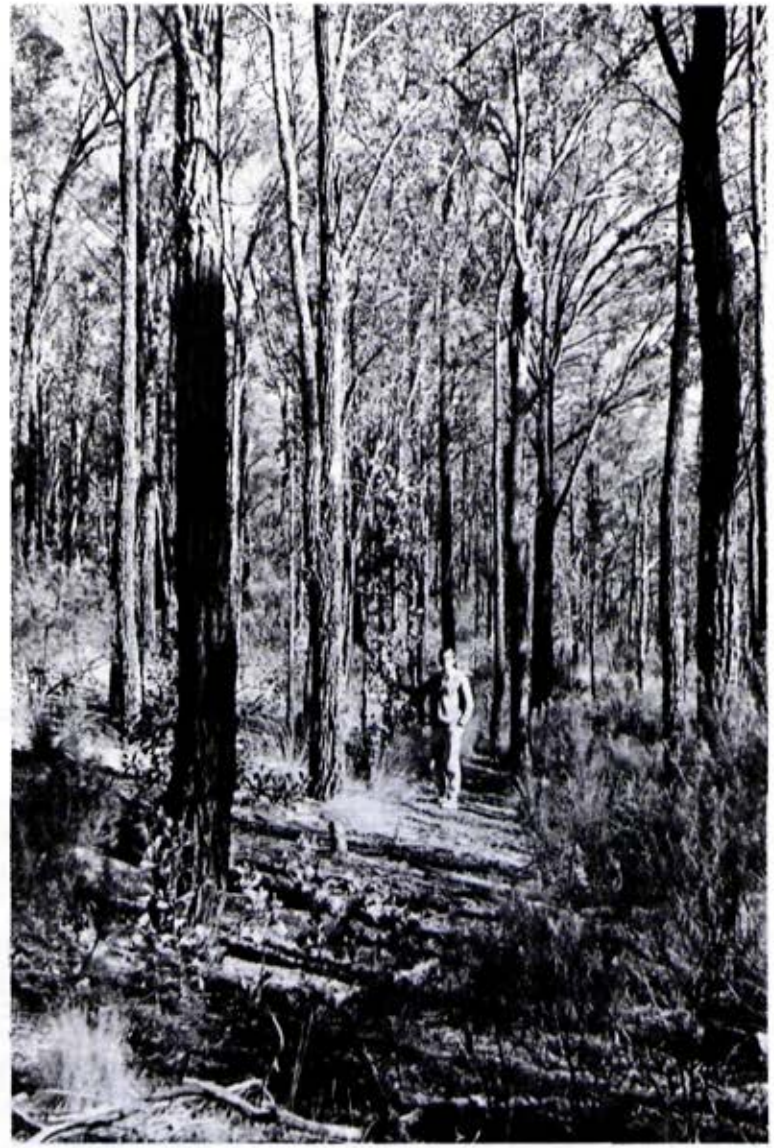
3. Soils

Shallow stoney soils and duplex soils on Palaeozoic sediments are interspersed with brown gradational soils on Mesozoic sediments and leached sands with a cemented layer in the B horizon on Tertiary cappings.

4. Vegetation

Typical vegetation comprises open forest II of mixed species, including yellow stringybark, white stringybark, silver-top, messmate blue gum, grey gum, red ironbark, red box, and yertchuk.

The understorey is moderately dense under the stringybark gum forests and common plants include sunshine wattle, spreading wattle, golden wattle, varnish wattle, narrow-leaf wattle, various



Red ironbark open forest II, with sparse understorey, contrasts with the stringy-bark open forest II pictured above left.

other legumes, common heath, cranberry heath, dogwood, and prickly tea-tree.

A relatively open understorey exists under the box ironbark forests and common plants include spreading wattle, golden wattle, various other legumes, ground berry, bursaria, dogwood, hop goodenia, burgan, and rough-leafed mint bush.

5. Fauna

The animals are typical of those found in mixed-species foothill forests. Common birds include wedge-tailed eagle, common bronzewing, gang gang cockatoo, crimson rosella, fantailed cuckoo, golden-bronze cuckoo, tawny frogmouth, superb blue wren, striated thornbill, scarlet and pink robins, golden whistler, and various honeyeaters.

Brown phascogale

The most common mammals would include echidna, brown phascogale, common wombat, brush-tail possum, ring-tail possum, swamp wallaby, and long-nosed bandicoot.

C. Capabilities

1. Flora

The area has moderate capability, as it is typical of the large areas of mixed-species foothill forests of Victoria.

2. Fauna

The fauna capability resembles that for flora.

3. Other features

None.

4. Recreation

Capability for recreation is moderate. The generally steep terrain offers a challenge to bush-walkers. Although the Thomson River has a high capability for fishing, access is difficult. It is used by white-water canoeists, who enter upstream where access is better.

5. Agriculture

Capability is low, as slopes are too steep and soils often too shallow.

6. Softwood

It is possible that some of the block has a moderate capability for growing radiata pines. However, none have been planted in the areas so the capability is difficult to judge.

7. Hardwood

Capability is moderate to low. It appears likely that the productivity of the area could be improved by better management techniques, however a market must exist for products before drastic alteration of management practices would become practical.

8. Honey

Capability for honey production is moderate, but usage is low.

9. Minerals

Capability is generally low, but sandstone quarrying has some potential.

10. Water

The Thomson River flows through public land in this block. However, run-off in the study area makes only a very small contribution to its total flow.

D. Hazards and Conflicts

Erosion occurs if natural vegetation is removed. Fire hazard is moderate to high in the summer because of the inflammable understorey.

E. Significance

No specially significant features occur.

GIPPSLAND LAKES

A. General

1. Location

East of the Sale-Seaspray Road, south of the Latrobe River and Lake Wellington, and east of Lake Victoria and Lake King. The public land consists of one large parcel of 28,367 ha (70,097 ac) and a small parcel of 860 ha (2,124 ac), totalling 29,227 ha (72,221 ac). Parishes of Glencoe, Glencoe South, Wulla Wullock, Dulungalong, Booran, Seacombe, and Boole Poole.

2. Present tenure

National Park: 2,120 ha (5,238 ac).
Crown land (unreserved): 8,998 ha (22,234 ac).
Crown land (reserved): 8,951 ha (22,118 ac).
Crown land vested in the Latrobe Valley Water and Sewerage Board: 4,103 ha (10,138 ac).
Freehold land vested in the Latrobe Valley Water and Sewerage Board: 5,056 ha (12,492 ac).

3. General description

The block comprises mostly dune and swale topography and low-lying saltmarsh. Leached sands support a heathy woodland and scrub, and saline areas carry saltmarsh vegetation and scrub.

4. Present use

The Gippsland Lakes are used intensively for recreation. The national park, the bed of Lake Reeve, and areas around the southern shore of Lake Wellington are used for nature conservation. At Dutson Downs, the Latrobe Valley Water and Sewerage Board uses public land for the disposal of sewage and effluent by irrigation.

B. Nature of the Land

1. Climate

Rainfall averages about 22 in., but is as high as 26 in. at Lakes Entrance and as low as 20 in. near McLennans Strait.

2. Geology and physiography

The area is of low relief and deposits are of Quaternary age. Around the Lakes, dunes, terraces, and estuarine deposits form low lake-side beaches and lake floors. Further inland the topog-

Swamp paperbark on the shores of Lake Victoria

Marram grass and coastal scrub on the foredunes of 90-mile beach

raphy consists of plains, sandy hills, or linear ridges. Calcareous dunes fringe the coast.

3. Soils

Calcareous sands occur on the foredunes along 90-mile beach. Leached sands are widespread, with a tendency for a cemented horizon in the profile to be generally present in inland areas but absent near the coast. Duplex soils occur generally, together with leached sands in the north-west and south-west corners of the block. Black organic clay loams have been formed in low-lying areas that are often inundated with salt water.

4. Vegetation

The seaward sides of the dunes along the coast support a specific vegetation dominated by marram grass. On the crests and windward sides of these

Golden grevillea

dunes, a dry scrub of coast tea-tree grades into a woodland of coast banksia.

On low areas that are periodically inundated, a wet scrub of swamp paperbark grades into rushes and sedges and then into salt-tolerant plants such as glass worts.

Forest red gum occurs along the coast on leached sands where the water table is near the surface, whereas higher ground, where the leached sands are drier, carries heathy woodlands of shining peppermint and manna gum near the coast and yertchuk further inland. These woodlands are floristically rich, and conspicuous species include saw banksia, coast banksia, silver banksia, coast tea-tree, silky tea-tree, common fringe myrtle, ribbed thryptomene, showy bossaea, common aotis, prickly broom heath, pine heath, common heath, common beard-heath, pink beard-heath, blue dampierea, austral grass-tree, wedding bush, spike wattle, and sweet wattle.

3. Fauna

The characteristic animals are those that frequent coastlines, wetlands, scrub, and heath woodlands.

Some of the birds commonly seen on wetlands include pelican, white ibis, straw-necked ibis, black cormorant, spur-winged plover, swamp hen, yellow-billed spoonbill, white-faced heron, swamp harrier, silver gull, mountain duck, and black swan.

In scrub and heath woodlands the common birds include various honeyeaters, common bronzewing, crimson rosella, fan-tailed cuckoo, hooded robin, superb blue wren, and brown thornbill.

Common mammals include the grey kangaroo, black-tailed wallaby, ring-tailed possum, brush-tailed possum, wombat, and koala. Ceylonese hog deer occurs in the national park.

The rare New Holland mouse occurs over several thousand acres of heath woodland near Loch Sport.

White egret with nesting material at Dowd's Morass

C. Capabilities

1. Flora

The block has a high capability because it contains a number of different environments, each with its characteristic assemblage of plants. Most floristically rich are the heath woodlands, but wet and dry scrub, saltmarsh, and swamps all contain numerous species of plants. It is significant to note that mahogany gum is at the southern extremity of its range on public land in this block, and that ribbed thryptomene

Short-nosed bandicoot

Beaded glasswort growing on the edge of Lake Reeve

is confined to land around the Gippsland Lakes in Victoria.

2. Fauna

Capability is high because of the variety of different habitats. The wetlands and surrounding vegetation are particularly valuable as a habitat for water birds. The scrub and heath woodlands support a diverse population of animals, the rare New Holland mouse being of particular interest.

3. Other features

Geomorphic studies of Gippsland Lakes region carried out by Dr. E.C.F. Bird show clearly how ecological factors have influenced the evolution of dune formation and the shaping of lagoon shores, illustrating the importance of the vegetation factor in geomorphology.

4. Recreation

Capability for recreation is high and is discussed in more detail in chapter 12. The area is popular with holiday-makers from Melbourne and Gippsland, and the population of the area during summer can be as high as 25,000.

5. Agriculture

Public land in this block has a low capability for agriculture because of low rainfall and poor sandy soils. Agricultural development tends to be confined to areas of duplex soils. The Dutson Downs sewerage farm, which is on public land, is a special case. This farm was established with the prime aim of disposing of sewage effluent, and irrigated pastures carry up to 10 dry sheep equivalents per acre.

6. Softwood

The area has low capability for softwoods. There are no pine plantations in the block and if any were established it is unlikely that they would be better than site quality VII.

7. Hardwood

Capability for hardwood production is

Control of wave erosion following destruction of shoreline vegetation by saline water

very low. Trees are stunted and probably generally only suitable for firewood.

8. Honey

The area appears to have a moderate capability for honey production as banksia is abundant and there is plenty of water. However, apiarists seem to make little use of the area.

9. Minerals

This block in general has a low capability for mineral production. Quartz sand and gravels are widespread, but there are no other mineral resources of significance.

Effluent pondage at the Latrobe Valley Water and Sewerage Board farm, Dutson

10. Water

Water in the Gippsland Lakes is unsuitable for direct consumption, but extremely important as a resource for swimming, boating, angling, and wildlife habitat.

D. Hazards and Conflicts

Increased salinity of the lakes has resulted in the destruction of salt-intolerant shoreline vegetation, allow-

ing wave erosion. Activities of holiday-makers, especially amateur fishermen and drivers of dune buggies, have resulted in destruction of vegetation on dunes, also resulting in soil erosion.

Eutrophication, already occuring in Lake Wellington, will probably spread to other lakes in the system, detracting from their recreational and conservation values. Raw sewage entering the lakes is becoming an increasingly serious problem.

During the summer the fire hazard in the area is high, and it is surprising that no serious fires have occurred in past few years.

While the area has a high potential for recreation, it also has a high potential for conservation and these two uses would come into conflict.

E. Significance

Most of the block has a significant potential for conservation of fauna and flora. The rare New Holland mouse is found near Loch Sport. Much of the area is already extremely popular for recreation.

APPENDIX I

LIST OF COMMON PLANTS

This list includes only the most common plant species in the study area and indicates the blocks in which they have been recorded.

* indicates alien species

T - Toongabbie
C - Callignee
H - Holey Plains
S - Stradbroke
G - Gippsland Lakes

	T	C	H	S	G
PTERIDOPHYTA (ferns)					
Adiantaceae					
Adiantum aethiopicum	X				
Pellaea falcata	X				
Aspidiaceae					
Polystichum proliferum	X	X			
Aspleniaceae					
Asplenium flabellifolium	X				
Blechnaceae					
Blechnum cartilagineum	X				
" *fluviatile*		X			
" *minus*		X			
" *nudum*		X			
Doodia aspera	X				
Cyatheaceae					
Cyathea australis		X			
Dennstaedtiaceaa					
Culcita dubia	X	X			
Histiopteris incisa		X			
Pteridium esculentum	X	X	X	X	X

	T	C	H	S	G
Gleicheniaceae					
Gleichenia circinnata			X	X	
Lindsayaceae					
Lindsaya linearis	X	X	X	X	
Lycopodiaceae					
Lycopodium deuterodensum				X	
Osmundaceae					
Todea barbara		X			
Selaginellaceae					
Selaginella gracillima					X
" *uliginosa*			X	X	X
ANGIOSPERMAE (flowering plants)					
MONOCOTYLEDONS					
Centrolepidaceae					
Centrolepis fascicularis			X	X	
" *strigosa*			X	X	X
Commelinaceae					
**Tradescantia fluminensis*	X				

	T	C	H	S	G
Cyperaceae					
Baumea acuta			X	X	
" *articulata*			X		
" *rubiginosa*			X	X	
" *juncea*					X
" *tetragona*			X	X	
Carex breviculmis	X				
" *gaudichaudiana*		X			
Caustis flexuosa	X				
" *pentandra*			X	X	X
Chorizandra cymbaria			X		
Eleocharis acuta					X
" *atricha*			X		
" *gracilis*			X		
" *pusilla*					X
" *sphacelata*			X	X	
Gahnia clarkei			X	X	
" *radula*	X	X	X	X	
" *sieberana*				X	
" *trifida*					X
Lepidosperma concavum		X	X	X	X
" *laterale*	X	X		X	
" *longitudinale*		X	X	X	X
Schoenus apogon			X		
" *brevifolius*			X	X	X
" *imberbis*					X
" *maschalinus*	X	X	X	X	X
" *nitens*					X
" *tenuissimus*			X		
" *tesquorum*		X	X		
Scirpus americanus					X
" *antarcticus*					X
" *cernuus*					X
" *inundatus*			X	X	X
" *nodosus*					X
Tetraria capillaris		X			
Gramineae					
Agrostis avenacea		X	X		X
" *rudis*					X
* " *tenuis*		X	X		
**Aira caryophyllea*			X		X
* " *praecox*					X

	T	C	H	S	G
Gramineae cont'd					
**Ammophila arenaria*					X
Amphipogon strictus			X		
Anisopogon avenaceus			X	X	X
**Briza maxima*			X		
Cynodon dactylon					X
**Dactylis glomerata*		X	X		
Danthonia caespitosa					X
" *geniculata*	X		X	X	X
" *longifolia*	X				
" *racemosa*	X	X	X	X	X
" *setacea*		X	X	X	X
" *sp.*	X				
Deyeuxia benthamiana	X				
" *quadriseta*			X	X	X
Dichelachne sciurea	X	X		X	
Distichlis distichophylla					X
**Echinochloa crus-galli*					X
Entolasia marginata			X	X	
Eragrostis brownii				X	X
Hemarthria uncinata		X	X	X	X
**Holcus lanatus*	X	X	X		
**Hordeum hystrix*					X
Imperata cylindrica			X		X
**Koeleria phleoides*					X
Microlaena stipoides	X	X	X	X	X
**Parapholis incurva*					X
Paspalum distichum			X		X
**Pennisetum clandestinum*			X		X
Phragmites communis			X		X
**Poa annua*					X
" *clelandii*			X		
" *labillardieri*	X	X			X
" *poiformis*					X
" *sieberana*	X	X	X	X	X
" *tenera*	X				
**Polypogon monspeliensis*					X
Spinifex hirsutus					X
**Sporobolus africanus*			X		
" *virginicus*					X
**Stenotaphrum secundatum*					X
Stipa elatior					X
" *hemipogon*			X	X	X

	T	C	H	S	G
Gramineae cont'd					
Stipa muelleri		X		X	
" *nervosa*	X				
" *semibarbata*				X	
Tetrarrhena juncea	X	X			
Themeda australis			X	X	X
Zoisia macrantha					X
Hypoxidaceae					
Hypoxis hygrometrica				X	
Iridaceae					
Patersonia longiscapa			X		
" *sp.*			X	X	
Juncaceae					
Juncus bufonius		X	X		X
" *fockei*				X	
" *maritimus*					X
" *pallidus*			X	X	X
" *pauciflorus*	X				
" *planifolius*		X	X	X	X
" *procerus*				X	
" *sp.*			X		
Juncaginaceae					
Triglochin procera					X
" *striata*			X		X
Liliaceae					
Burchardia umbellata	X	X	X	X	
Dianella revoluta		X		X	
" *tasmanica*		X			
Laxmannia sessiliflora			X		X
Lomandra filiformis	X	X	X	X	
" *glauca*		X	X	X	X
" *longifolia*	X	X	X	X	X
Stypandra caespitosa			X		
" *glauca*	X				
Thysanotus patersonii					X
Xanthorrhoea australis			X		X
" *minor*	X	X	X	X	

	T	C	H	S	G
Orchidaceae					
Acianthus exsertus			X		
" *reniformis*			X		
Caladenia carnea			X		
" *latifolia*					X
Chiloglottis reflexa			X	X	
Cryptostylis subulata		X			
Dipodium punctatum	X				
Glossodia major			X		
Lyperanthus nigricans			X		
Pterostylis concinna					X
" *nutans*			X		X
" *parviflora*			X	X	
" *pedunculata*					X
Restionaceae					
Calorophus lateriflorus			X	X	
Hypolaena fastigiata			X	X	X
Leptocarpus brownii					X
" *tenax*			X	X	X
Lepyrodia muelleri		X	X	X	
Restio tetraphyllus			X	X	
Ruppiaceae					
Ruppia sp.					X
Typhaceae					
Typha sp.				X	X
Xyridaceae					
Xyris gracilis			X	X	
Zosteraceae					
Zostera muelleri					X
DICOTYLEDONS					
Aizoaceae					
**Carpobrotus aequilaterus*					X
Disphyma australe					X
Tetragonia implexicoma					X
" *tetragonioides*					X

	T	C	H	S	G
Boraginaceae					
Cynoglossum latifolium		X			
Myosotis australis					X
Brunoniaceae					
Brunonia australis			X		
Campanulaceae					
Wahlenbergia gracilenta			X		
" *quadrifida*	X	X	X	X	
" *stricta*	X				
" *tadgellii*		X			
Caryophyllaceae					
Stellaria flaccida	X	X			
" *palustris*					X
" *pungens*	X		X		X
Casuarinaceae					
Casuarina paludosa			X	X	X
" *pusilla*					X
" *stricta*					X
Chenopodiaceae					
Arthrocnemum halocnemoides					X
**Atriplex hastata*					X
Chenopodium glaucum					X
Hemichroa pentandra					X
Rhagodia baccata					X
" *hastata*	X				
" *nutans*					X
Salicornia quinqueflora					X
" *blackianum*					X
Suaeda australis					X
Compositae					
Brachycome aculeata			X		
" *angustifolia*			X		
" *graminea*					X
" *multifida*					X
Calocephalus brownii					X
" *lacteus*					X
**Carduus pycnocephalus*					X

	T	C	H	S	G
Compositae cont'd					
Cassinia aculeata		X			
" *longifolia*	X	X			
Centipeda minima				X	
**Cirsium vulgare*		X			X
**Conyza bonariensis*			X		X
Cotula coronopifolia					X
" *reptans*					X
Gnaphalium indutum					X
" *candidissimum*			X	X	X
" *involucratum*			X		X
" *japonicum*	X	X	X	X	X
" *purpureum*			X	X	X
Helichrysum cuneifolium	X				
" *dendroideum*	X	X			X
" *obcordatum*	X				
" *obtusifolium*			X		
" *scorpioides*	X		X		
" *semipapposum*	X				
**Hypochaeris radicata*	X	X	X	X	X
Lagenophora gracilis	X	X	X	X	
" *stipitata*					X
**Leontodon taraxacoides*					X
Leptorhynchos linearis			X		
Microseris scapigera			X	X	
Olearia argophylla	X	X			
" *lirata*		X			
" *myrsinoides*	X				
" *phlogopappa*		X			
Senecio hispidulus				X	
* " *jacobaea*		X	X	X	X
" *linearifolius*	X	X			
" *minimus*		X			X
" *spathulatus*					X
" *vagus*		X			
Sigesbeckia orientalis	X				
Convolvulaceae					
Dichondra repens	X	X	X	X	X
Wilsonia backhousei					X
" *rotundifolia*					X

	T	C	H	S	G
Crassulaceae					
Crassula helmsii					X
" *sieberana*					X
Cruciferae					
Cakile edentula					X
" *maritima*					X
Cardamine debilis					X
**Sisymbrium officinale*					X
Dilleniaceae					
Hibbertia aciculares		X	X	X	X
" *astrotricha*				X	
" *fasciculata*					X
" *obtusifolia*	X				
" *procumbens*		X		X	
" *sericea*					X
" *stricta*			X	X	X
" *virgata*				X	X
Droseraceae					
Drosera binata				X	
" *planchonii*			X	X	
" *pygmaea*		X	X	X	
" *spathulata*			X	X	X
" *whittakeri*			X		
Epacridaceae					
Acrotriche prostrata	X				
" *serrulata*	X		X	X	X
Astroloma humifusum	X		X	X	
" *pinifolium*					X
Brachyloma daphnoides			X		X
Epacris impressa	X	X	X	X	X
Leucopogon collinus				X	
" *ericoides*		X	X	X	X
" *parviflorus*					X
" *virgatus*			X	X	X
Monotoca elliptica					X
" *scoparia*		X	X	X	X
Sprengelia incarnata			X		

	T	C	H	S	G
Euphorbiaceae					
Amperea xiphoclada	X	X	X	X	X
Phyllanthes hirtellus			X		
Poranthera microphylla			X		
Pseudanthes ovalifolius					X
Ricinocarpos pinifolius			X	X	X
Frankeniaceae					
Frankenia pauciflora					X
Gentianaceae					
**Centaurium minus*	X	X	X	X	X
* " *pulchellum*	X	X	X		
" *spicatum*					X
Goodeniaceae					
Dampiera stricta	X		X	X	X
Goodenia elongata	X	X			
" *humilis*			X	X	
" *ovata*	X	X			X
" *paniculata*			X	X	X
Scaevola hookeri			X		X
" *ramosissima*		X			
Selliera radicans			X		X
Haloragaceae					
Haloragis micrantha		X	X	X	X
" *tetragyna*	X		X	X	X
" *teucriides*		X		X	X
Myriophyllum propinquum			X	X	
Hypericaceae					
Hypericum gramineum	X	X			
Labiatae					
Ajuga australis	X				
Prostanthera denticulata	X				
Prunella vulgaris	X	X			
Teucrium corymbosum	X				
Lauraceae					
Cassytha glabella	X		X	X	

	T	C	H	S	G
Lauraceae					
Cassytha melantha					X
" *pubescens*				X	
Lentibulariaceae					
Utricularia dichotoma			X	X	
" *lateriflora*			X	X	
Lobeliaceae					
Lobelia alata					X
Loranthaceae					
Amyema pendulum		X			
Malvaceae					
Lawrencia spicata					X
Menyanthaceae					
Villarsia exaltata			X	X	X
" *reniformis*			X		X
Mimosaceae					
Acacia botrycephala	X		X		
" *dealbata*		X		X	
" *diffusa*	X		X	X	
" *falciformis*	X				
" *longifolia*					X
" *mearnsii*			X		X
" *melanoxylon*		X			
" *mucronata*	X	X		X	
" *oxycedrus*		X	X	X	X
" *pycnantha*	X				
" *suaveolens*			X		X
" *verniciflua*	X	X			
" *verticillata*			X		
Myrtaceae					
Baeckea ramosissima					X
Calytrix alpestris					X
" *tetragona*			X		X
Eucalyptus aromaphloia			X	X	X
" *botryoides*					X
" *bridgesiana*	X		X	X	

	T	C	H	S	G
Myrtaceae cont'd					
Eucalyptus cephalocarpa	X			X	
" *consideniana*	X	X	X	X	
" *cypellocarpa*	X	X			
" *elata*	X				
" *globoidea*			X	X	
" *globulus*		X			
" *muellerana*	X			X	
" *nitida*		X	X	X	X
" *obliqua*	X	X		X	
" *ovata*			X		X
" *polyanthemos*	X	X	X		
" *radiata*		X		X	
" *regnans*		X			
" *sideroxylong*	X				
" *sieberi*	X	X			
" *st.johnii*	X				
" *tereticornis*					X
" *viminalis var.*			X	X	X
Leptospermum juniperinum	X	X	X	X	X
" *laevigatum*					X
" *lanigerum*				X	
" *myrsinoides*		X	X	X	X
" *phylicoides*	X		X		X
Melaleuca ericifolia			X	X	X
" *squarrosa*		X	X	X	X
Thryptomene micrantha					X
Onagraceae					
Epilobium cinereum	X	X			
Oxalidaceae					
Oxalis corniculata					X
Papilionaceae					
Aotus				X	
Bossiaea cinerea		X	X	X	X
" *heterophylla*			X		X
" *prostrata*				X	
Daviesia latifolia		X			
" *mimosoides*	X				
" *virgata*	X				
Dillwynia glaberrima	X	X	X	X	X

	T	C	H	S	G
Papilionaceae cont'd					
Dillwynia sericea			X	X	X
Glycine clandestina					X
Gompholobium latifolium		X	X	X	
Goodia lotifolia		X			
Hardenbergia violacea	X				
Hovea heterophylla		X			
Kennedia prostrata			X	X	
Lotus corniculatus					X
Platylobium formosum	X		X	X	
" *obtusangulum*			X	X	
Pultenaea dentata					X
" *gunnii*	X	X		X	
" *hispidula*				X	
" *paleacea*			X		
" *retusa*			X		
" *scabra*	X				
**Trifolium repens*		X			X
Pittosporaceae					
Bursaria spinosa	X				
Marianthus procumbens	X			X	
Plantaginaceae					
**Plantago coronopus*			X	X	X
" *debilis*	X	X			
* " *lanceolatus*			X		
" *varia*	X				
Polygonaceae					
**Polygonum aviculare*					X
**Rumex acetosella*			X		X
Primulaceae					
**Anagallis arvensis*	X				
samolus repens					X
Proteaceae					
Banksia integrifolia					X
" *marginata*		X	X	X	X
" *serrata*			X	X	X
" *spinulosa*	X				
Grevillea chrysophaea			X	X	
Hakea nodosa				X	

	T	C	H	S	G
Proteaceae cont'd					
Hakea teretifolia			X		
Lomatia ilicifolia		X	X	X	
Ranunculaceae					
Clematis glycinoides	X	X			
Ranunculus sessiliflorus					X
Rhamnaceae					
Pomaderris aspera		X			
" *racemosa*			X		
Rosaceae					
Acaena anserinifolia		X			X
**Rubus procerus*		X			
Coprosma quadrifida		X			
Galium propinquum		X			X
Opercularia varia	X	X	X	X	
Pomax umbellata	X				
Rutaceae					
Boronia anemonifolia			X	X	
Correa reflexa		X	X	X	
Sapindaceae					
Dodonaea cuneata	X				
Scrophulariaceae					
Gratiola peruviana		X		X	
Mazus pumilio				X	
Mimulus repens					X
Veronica plebeia	X				
Solanaceae					
**Solanum nigrum*		X			
" *prinophyllum*	X				
Stylidiaceae					
Stylidium graminifolium	X				
Thymelaeaceae					
Pimelea humilis	X	X	X	X	
" *linifolia*				X	

	T	C	H	S	G
Tremandraceae					
Tetratheca ciliata			X		
" *pilosa*		X	X	X	
Umbelliferae					
Apium prostratum					X
Centella cordifolia	X	X	X	X	X
Hydrocotyle hirta	X	X	X	X	X
" *laxiflora*	X				
" *pterocarpa*				X	
" *sibthorpioides*			X		X

	T	C	H	S	G
Umbelliferae cont'd					
Lilaeopsis polyantha			X		X
Platysace heterophylla				X	
" *lanceolata*	X				X
Urticaceae					
Australina muelleri	X	X			
Urtica incisa	X	X			X
Violaceae					
Viola hederacea	X	X	X	X	X

APPENDIX II

ANIMALS OF THE STUDY AREA

This appendix contains a list of native birds and mammals recorded in the area, with an indication of the habitats in which they are most likely to be observed and their status. Species recorded in the area only as accidental, vagrant, or beach-washed specimens have not been included in the list, as land use changes in the study area will have no significant effect on the populations of these species. A list of reptiles known to occur in the area is included.

Species that have special significance in this area and that are referred to in Chapter 10 are indicated with an asterisk (*). Horizontal lines are used to separate families.

HABITAT

1. Ocean
2. Coastline (beaches, headlands, reefs, estuaries, salt marsh)
3. Wetland (swamp communities, sedgeland, rivers, lakes)
4. Sand Dune Complex (dunes, scrub, heath)
5. Woodland - Shinning peppermint and heath
6. Open forest I & II - red gum, red ironbark, red box
7. Open forest I & II - mixed eucalypts, stringybarks and gums
8. Open forest III & IV - messmate, mountain ash
9. Semi-cleared areas and forest margins
10. Grassland
11. Air

STATUS

The codes given below denote status or manner of occurrence, on a relative basis, with reference to available habitat within the study area. The estimates are based on general experience rather than actual counts. The situation is changing constantly.

The first letter in the code indicates distribution of suitable habitat:

W = habitat widespread in the study area
R = habitat restricted to relatively few parts of the study area

The second letter in the code indicates population density within areas of suitable habitat:

C = commonly observed
U = uncommonly observed
R = rarely observed
N = nomadic, number observed varying greatly from time to time
SD = survival in the study area doubtful

Additional letters may be used to indicate:

S = migratory species observed in the study area during summer
W = migratory species observed in the study area during winter
H = commonly uses hollows in trees for nest site

	1	2	3	4	5	6	7	8	9	10	11	Status
Emu				X	X				X	X		RC
Wandering albatross	X											RU
Black-browed albatross	X											
White-capped albatross	X											
Yellow-nosed albatross	X											
Giant petrel	X											RU
Cape petrel	X											
Medium-billed prion	X											
Thin-billed prion	X											
Fairy-prion	X											
Sooty shearwater	X											
Short-tailed shearwater	X											RCS
Fluttering shearwater	X											RU
White-faced storm-petrel	X											
Diving petrel	X											
Australian pelican		X	X									WC
Australian gannet	X											RC
Darter			X									WR
Black cormorant		X	X									WC
Little black cormorant		X	X									WC
Pied cormorant		X	X									WC
Little pied cormorant		X	X									WC
Black-faced cormorant		X										
Little grebe			X									WC
Hoary-headed grebe		X	X									WU
Great crested grebe		X	X									WR
White-necked heron			X									WC
White-faced heron		X	X									WC
Cattle egret			X									WU
White egret		X	X									WC
Little egret		X	X									
Plumed egret			X									
Nankeen night heron			X									RU
Brown bittern			X									RU
White ibis			X									WC
Straw-necked ibis			X									WC
Glossy ibis			X									
Royal spoonbill		X	X									WR
Yellow-billed spoonbill		X	X									WC
Black swan		X	X									WC
Mountain duck		X	X									WU,H
Black duck		X	X									WC
Grey teal		X	X									WC
Chestnut teal		X	X									WC,H
Blue-winged shoveler			X									WU
Pink-eared duck			X									
White-eyed duck			X									WU
Wood duck			X									H
Blue-billed duck			X									RU
Musk duck			X									RC

	1	2	3	4	5	6	7	8	9	10	11	Status
Black-shouldered kite									X	X		
Whistling eagle				X	X				X			WC
Australian goshawk						X	X	X	X			WC
Australian little eagle					X				X			WU
Wedge-tailed eagle						X	X	X	X			WC
White-breasted sea eagle		X	X									RU
Spotted harrier			X						X	X		
Swamp harrier			X							X		WC
Black falcon										X		
Peregrine falcon					X	X	X	X	X			WR
Little falcon					X	X	X	X	X			WR
Nankeen kestrel									X	X		WC
Brown hawk				X					X	X		WC
Stubble quail										X		WC
Brown quail			X							X		WU
Painted quail					X	X				X		WR
Lewin water rail			X									
Banded landrail			X									WU
Marsh crake			X									
Australian spotted crake			X									RR
Black-tailed native hen			X									WN
Dusky moorhen			X									WC
Swamphen			X									WC
Coot			X									WC
Pied oystercatcher		X										RU
Sooty oystercatcher		X										
Spur-winged plover		X	X							X		WC
Banded plover			X							X		WU
Hooded dotterel		X										RC
Red-capped dotterel		X	X									WC
Double-banded dotterel		X										RU,W
Black-fronted dotterel			X									WC
Grey plover		X										
Eastern golden plover		X										
Japanese snipe			X							X		WC,S
Whimbrel		X										
Eastern curlew		X										RU,S
Greenshank		X	X									RU,S
Sharp-tailed sandpiper		X	X									WC,S
Red-necked stint		X	X									RC,S
Curlew sandpiper		X	X									
Bar-tailed godwit		X										RU,S
White-headed stilt		X	X									RC
Banded stilt		X	X									RU,S
Southern skua	X											RR,W
Arctic skua	X											RU,S
Pacific gull		X										RC
Silver gull		X	X									WC
Whiskered tern			X									WU,S
Caspian tern		X										RU
Gull-billed tern			X									WR
White-fronted tern		X										
Little tern		X										RU
Crested tern		X										RC

	1	2	3	4	5	6	7	8	9	10	11	Status
Peaceful Dove						X				X		WR
Common bronzewing				X	X	X	X	X	X			WC
Brush bronzewing				X	X							RC
Rainbow lorikeet				X	X	X	X		X			WN,H
Musk lorikeet				X	X	X	X	X	X			WN,H
Purple-crowned lorikeet				X	X	X	X	X	X			WN,H
Little lorikeet				X	X	X	X	X	X			WN,H
Swift parrot					X	X	X	X	X			WN,H
Yellow-tailed black cockatoo					X	X	X	X	X			WC,H
Gang-gang cockatoo							X	X	X			WC,H
Sulphur-crested cockatoo									X	X		WC,H
Galah									X	X		
King parrot								X				RU,H
Crimson rosella					X	X	X	X	X			WC,H
Eastern rosella									X	X		WC,H
Red-rumped parrot									X	X		
Blue-winged parrot				X					X	X		WU,H
Ground parrot				X								RR
Pallid cuckoo					X	X			X			WC
Brush cuckoo				X			X	X				
Fan-tailed cuckoo					X	X	X	X	X			WC
Horsfield bronze cuckoo					X	X			X			WC
Golden bronze cuckoo							X	X				WC
Powerful owl							X	X				WR,H
Boobook owl					X	X	X	X	X			WU,H
Barn owl					X	X	X	X	X	X		WU,H
Sooty owl								X				
Tawny frogmouth					X	X	X	X	X			WC
Owlet-nightjar					X	X	X		X			WU,H
White-throated nightjar					X	X						
Spine-tailed swift											X	WC,S
Fork-tailed swift											X	
Azure kingfisher		X	X									RU
Laughing kookaburra					X	X	X	X	X			WC,H
Sacred kingfisher			X		X	X	X					WC,SH
Rainbow bee-eater					X				X			
Dollar bird						X			X			WR,SH
Superb lyrebird								X				RC
Singing bushlark										X		
Welcome swallow											X	WC
Tree-martin					X				X		X	WC,SH
Fairy-martin											X	WC
Australian pipit				X						X		WC
Black-faced cuckoo-shrike					X	X	X	X	X			WC
Little cuckoo shrike					X	X	X		X			WR
Australian ground-thrush				X				X				RU
Spotted quail-thrush					X	X	X					WU

	1	2	3	4	5	6	7	8	9	10	11	Status
Golden-headed fantail warbler			X									WC
Little grassbird			X									WC
Reed warbler			X									WC,S
Brown songlark										X		WU,S
Rufous songlark						X			X			WU,S
Superb blue wren				X	X	X	X	X	X			WC
Southern emu-wren				X	X							RU
Striated thornbill					X	X	X	X	X			WC
Little thornbill				X	X	X	X		X			WU
Brown thornbill				X	X	X	X	X	X			WC
Buff-rumped thornbill					X	X			X			WC
Yellow-rumped thornbill									X	X		WC
White-browed scrub wren				X	X	X	X	X	X			WC
Heath wren				X	X							
Field wren				X	X							RU
Speckled warbler						X						
Pilot bird								X				
White-fronted chat			X							X		WU
Jacky winter						X			X			WC
Scarlet robin					X	X	X			X		WC
Flame robin									X	X		WC,W
Pink robin				X			X	X				WU,W
Rose robin								X				
Hooded robin					X	X						RU
Southern yellow robin				X	X	X	X	X	X			WC
Grey fantail				X	X	X	X	X	X			WC
Rufous fantail								X				RU,S
Willie wagtail									X	X		WC
Leaden flycatcher				X	X		X	X				WU,S
Satin flycatcher							X	X				RU,S
Restless flycatcher						X			X			WU
Golden whistler					X	X	X	X	X			WC
Rufous whistler					X	X	X	X	X			WC
Oliver whistler								X				RU
Grey shrike-thrush					X	X	X	X	X			WC
Shrike-tit							X	X				WU
Eastern whipbird				X			X	X				RC
Orange-winged sittella					X	X	X	X	X			WU
Brown tree-creeper						X			X			RC
White-throated tree-creeper					X	X	X	X	X			WC,H
Red-browed tree-creeper								X				
Mistletoe bird					X	X	X	X	X			WC
Spotted pardalote					X	X	X	X	X			WC
Yellow-tipped pardalote					X	X	X		X			
Eastern striated pardalote					X	X	X		X			WC
Grey-breasted silvereye				X	X	X	X	X	X			WC

	1	2	3	4	5	6	7	8	9	10	11	Status
Scarlet honeyeater				X					X			
Yellow faced honeyeater				X	X	X	X	X	X			WC
White-plumed honeyeater									X			RC
White-eared honeyeater				X	X	X	X	X	X			WC
Yellow-tufted honeyeater						X						
Brown-headed honeyeater					X	X	X		X			WC
White-naped honeyeater					X	X	X	X	X			WC
Noisy friarbird							X		X			WU
Little friarbird				X								WR
Crescent honeyeater				X				X				RC
New Holland honeyeater				X	X							WC
Tawny-crowned honeyeater				X								RU
Regent honeyeater				X		X	X		X			WN
Eastern spinebill				X	X	X	X	X	X			WC
Bell miner							X					
Noisy miner						X						RC
Spiny-cheeked honeyeater				X	X							RC
Little wattle-bird				X	X							RC
Red wattle-bird				X	X	X	X	X	X			WC
Beautiful firetail				X								RR
Diamond firetail						X			X			RU
Red-browed finch				X	X	X	X	X	X			WC
Olive-backed oriole						X	X	X	X			WU,S
Magpie lark			X						X	X		WC
White-winged chough					X	X	X	X				WC
Masked wood-swallow					X	X			X			WU,S
White-browed wood-swallow					X	X			X			WU,S
Dusky wood-swallow					X	X			X			WC
Pied currawong					X	X	X	X	X			WC
Grey currawong					X	X	X		X			WC
Grey butcher-bird					X	X	X	X	X			WU
White-backed magpie				X	X				X	X		WC
Australian raven		X		X	X	X	X	X	X	X		WC
Little raven				X	X				X	X		WC

MAMMALS

	1	2	3	4	5	6	7	8	9	10	11	Status
Echidna				X	X	X	X		X			WC
Platypus			X									
Tiger cat							X	X				
Brown phascogale					X		X	X				WC,H
Dusky phascogale					X		X	X				RC
Common sminthopsis						X	X		X			
White-footed sminthopsis				X	X		X		X			
Long-nosed bandicoot				X	X		X	X	X			
Short-nosed bandicoot				X	X		X	X	X			
Common wombat							X	X				WC
Koala					X		X		X			WU
Feathertail glider				X	X	X	X	X				
Pigmy possum				X	X		X	X				WU,H
Ringtail possum				X	X	X	X	X	X			WC,H
Sugar glider					X		X	X	X			WU,H
Yellow-bellied glider							X	X	X			
Greater glider							X	X	X			
Brushtail possum				X	X	X	X	X	X			WC,H
Grey kangaroo					X	X			X	X		WC
Swamp wallaby				X	X		X	X				WC
Potoroo				X	X							
Bush rat					X		X	X	X			WC
Swamp rat					X		X	X	X			RC
Eastern water rat			X									RC
New Holland mouse					X							RR
Greater long-eared bat												H
Lesser long-eared bat												H,caves
Bent winged bat												caves
Little bat												H,caves
Goulds wattled bat												H,caves
Chocolate bat												
Tasmania pipistrelle												
Large-footed myotis												caves

AMPHIBIANS

Scientific Name	Common Name
Hyla aurea aurea)	green and gold frogs
" *aurea raniformis*)	
" *citropa*)	
" *ewingi*)	tree frogs
" *jervisiensis*)	
" *lesueuri*	rocky river frog
" *maculata*)	
" *peroni*)	tree frogs
" *phyllochroa*)	
" *verreauxi verreauxi*)	
" *verreauxi alpina*)	
Crinia hasselli)	
" *laevis*)	
" *signifera*)	froglets
" *victoriana*)	
Heleioporus australiacus	spiny toad
Limnodynastes dorsalis	
inaularis	bull frog
" *peroni*)	
" *tasmaniensis*)	marsh frogs
Mixophyes balbus	barred river frog
Pseudophryne dendyi)	
" *semimarmorata*)	toadlets
Uperoleia marmorata)	

REPTILES LIKELY TO BE RECORDED IN THE SHIRE OF ROSEDALE

Scientific Name	Common Name	Distribution	Biological Characteristics	Habitat
Chelodina longicollis	Long necked tortoise	W	TO	Lakes and rivers
Amphibolurus barbatus	Bearded dragon	W	HO	Open forested areas
" *diemensis*	Mountain dragon	C	HO	
" *muricatus*	Tree dragon	W	HO	
Physignathus lesueuri	Gippsland water dragon	W	HO	
Tympanocryptis lineata	Earless dragon	W	HO	
Phyllodactylys marmoratus	Marbled gekko	W	TO	
Aprasia striolata	Worm lizard	W	TO	Burrowing, subterranean
Delma impar	Spinifex lizard	W	TO	
Anotis maccoyi	Yellow bellied skink	C	TO	Litter layers of wet forest
Carlia macoooeyi		W	HO	
Ctenotus robustus		W	HO	
" *taeniolatum*	Copper tailed skink	W	HO	
Hemiergis decresiensis		W	TV	
" *peronii*	Four toed skink	W	TV	
Leiolopisma delicata		WC	TO	
" *entrecasteauxi*	Grass skink	C	TV	
" *guichenoit*	Garden skink	WC	HO	
" *metallicum*	Metallic skink	C	HV	
" *mustelinum*	Weasel skink	WC	TO	
" *trilineatum*	Tree lined skink	WC	HO	
" *weekesae*		C	HV	
Lerista bougainvilli	Bougainville's skink	W	TV	
Pseudemoia spenceri		C	HV	Rocks, large dead eucalypts
Sphenomorphus tympanum	Southern water skink	WC	HV	Water courses
Egernia cunninghami	Cunningham's skink	W	HV	Large rock outcrops
" *luctuosa*	Mourning skink	W	HV	Swampy areas
" *saxatilis*	Black rock skink	WC	HV	Under rocks, granite outcrops
" *whitei*	White's skink	WC	HV	Forested areas under logs and rocks
Tiliqua casuarinae	Oak skink	WC	HV	
" *nigrolutea*	Southern blue tongue	C	HV	
" *rugosa*	Stumpy tail	W	HV	
" *scincoides*	Common blue tongue	W	HV	
Varanus varius	Lace lizard	W	HO	Forested areas
Morelia argus argus	Diamond python	W	TO	Coastal woodlands
Demansia textilis	Brown snake	W	HO	Generally hilly drier areas
Denisonia coronoides	White lip snake	C	HV	Under rotting logs
" *flagellum*	Little whip snake	W	TV	Rocky areas, particularly basalt
" *nigrescens*	Small eyed snake	W	TV	Rocky areas, particularly granite
" *superba*	Copperhead snake	C	HV	Generally wetter areas
Notechis scutatus	Tiger snake	WC	HV	Favours swampy areas
Pseudechis porphyriacus	Black snake	W	HV	Fringes of creeks and rivers

T = Thigmotherm (non basking reptiles): maintain body temperature during activity by selecting suitable temperatures in shaded situations.

H = Heliotherm (basking reptiles): use solar radiation to maintain body temperature during activity

O = Oviparous: young hatch from egg

V = Viviparous: young born alive

W = Warm temperate (elevations generally below 1,000 ft, average annual rainfall generally below 30 in.)

C = Cool temperate (elevations generally above 1,000 ft, average annual rainfall generally above 30 in.)

By Authority : C. H. Rixon, Government Printer, Melbourne

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SOUTH GIPPSLAND AREA
DISTRICT 1

GEOLOGY

Scale 1:250,000

MILES 0 2 4 6 8 10
KILOMETRES 0 5 10

		PLAN	SECTIONS		
QUATERNARY		Q_1		Recent Alluvium and Colluvium	
		Q_2		Dunes and Beach Deposits and Sand Sheets	
		Q_3		High Level Terraces	
	PLIOCENE	Tp		Haunted Hills Gravels	
				Boisdale Beds	
TERTIARY	MIOCENE	Tml		Gippsland Limestone	GIPPSLAND GROUP
				Lakes Entrance Formation	
	OLIGOCENE	Tvo		Latrobe Valley Coal Measures (Upper)	LATROBE VALLEY COAL MEASURES
	EOCENE–PALEOCENE	Tnr		Narracan Group includes Thorpdale Volcanics and Childers Formation	
CRETACEOUS		Kl	K K K	Strzelecki Group – Mesozoic Sediments	
DEVONIAN–ORDOVICIAN		Dl–S	P P P	Walhalla Group – Palaeozoic Sediments	

SECTION A - A

SECTION B - B

HORIZONTAL SCALE 0 4 8 12 MILES; 0 5 10 15 KILOMETRES

VERTICAL SCALE 0 2000 4000 6000 FEET; 0 500 1000 1500 METRES

Information obtained from Geological Survey of Victoria including a special report by B.R. Thompson, Mines Department.

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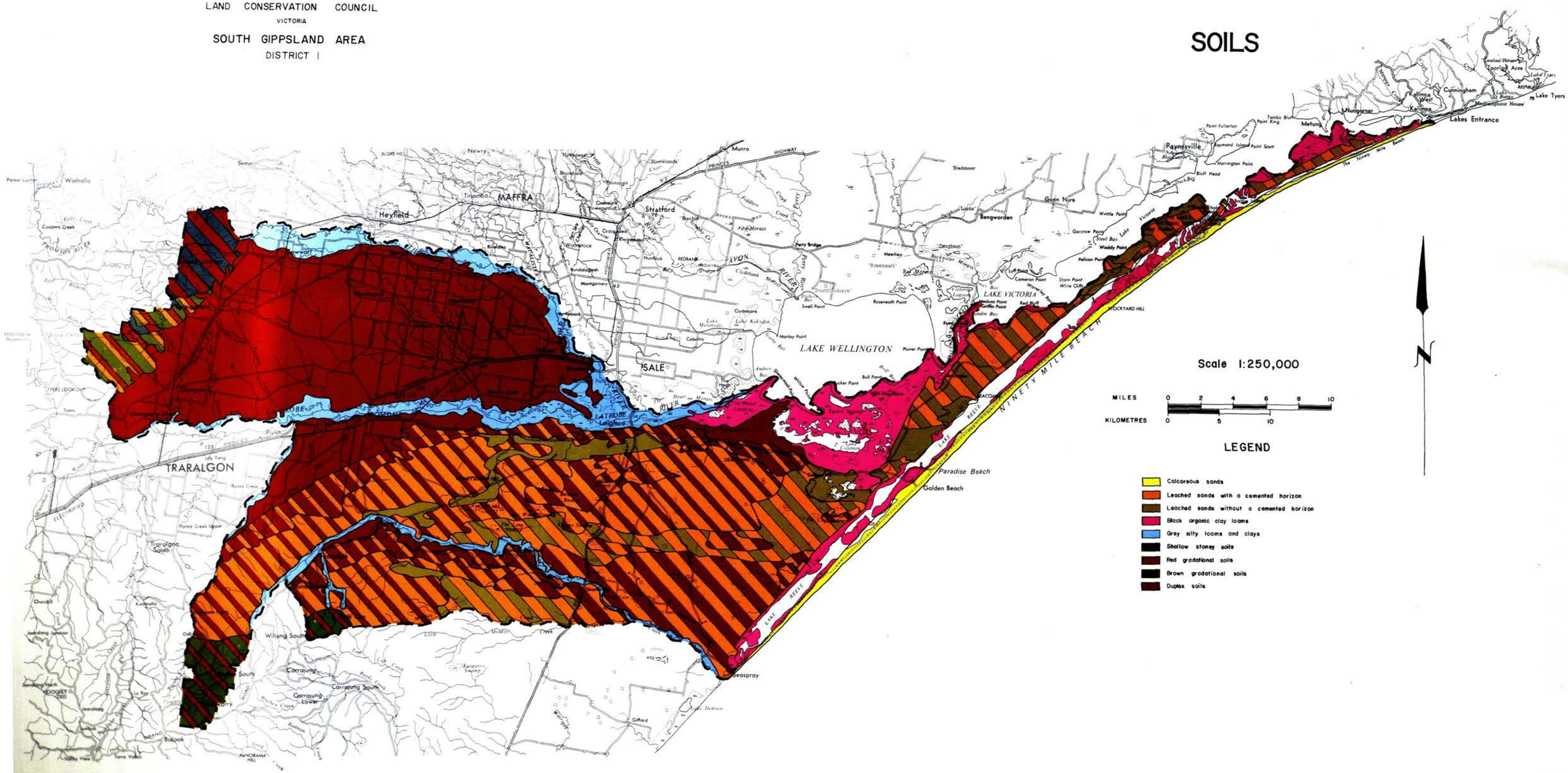
SOUTH GIPPSLAND AREA
DISTRICT 1

SOILS



Modified from a Soils-Land Unit map prepared by R.K. Rowe Soil Conservation Authority.

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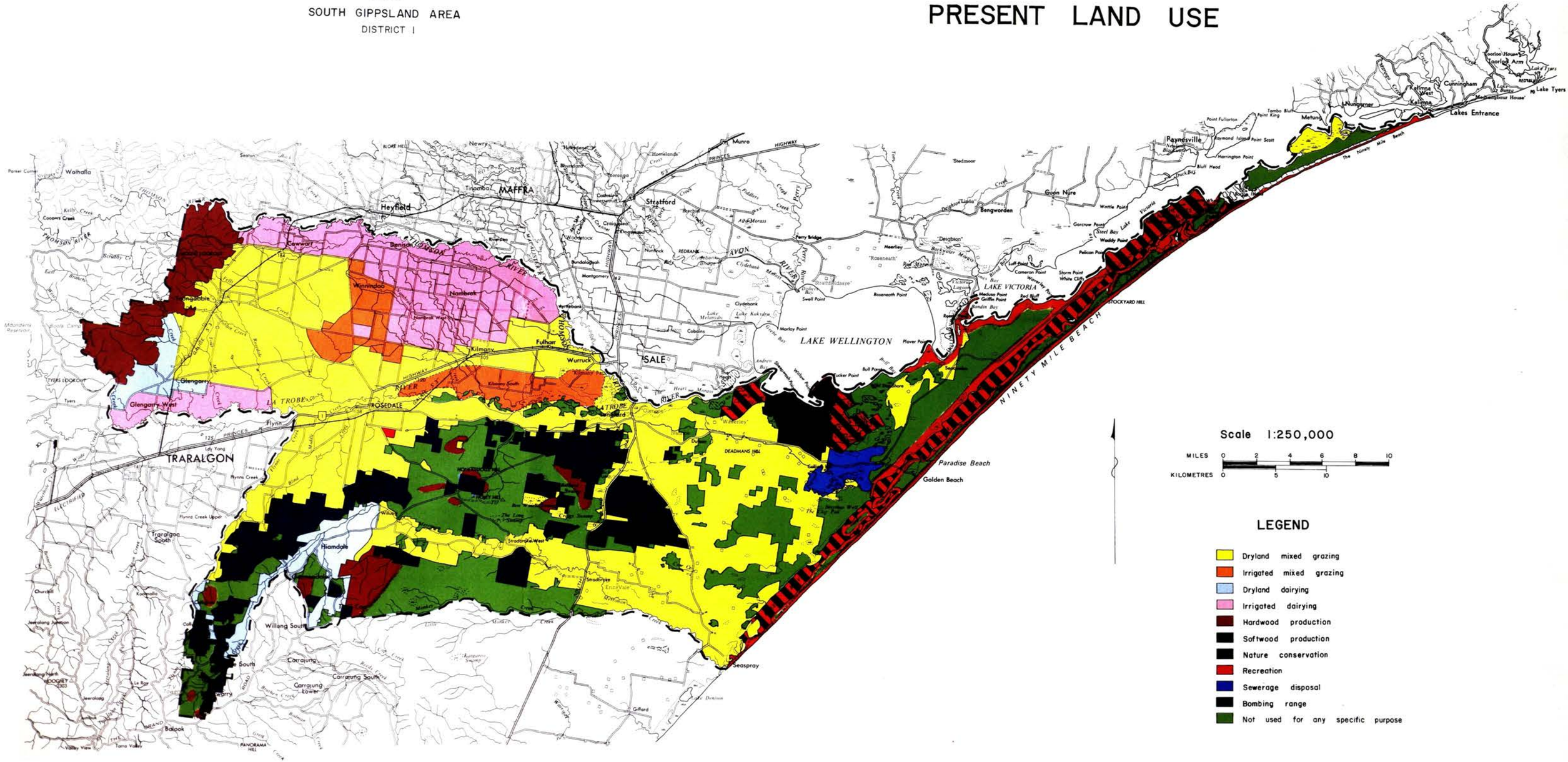
SOUTH GIPPSLAND AREA
DISTRICT 1

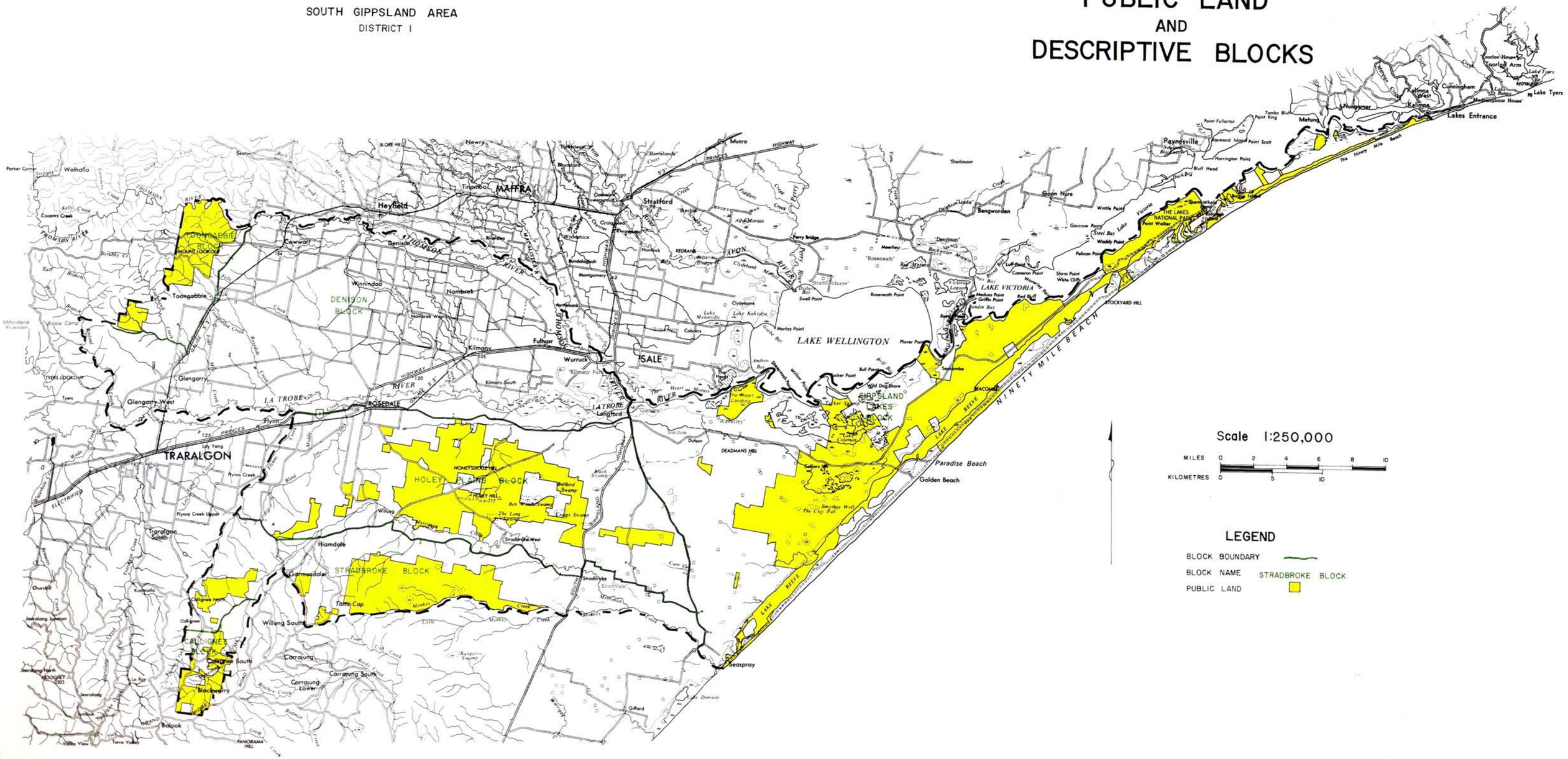
PRESENT LAND USE



LAND CONSERVATION COUNCIL
VICTORIA

SOUTH GIPPSLAND AREA
DISTRICT 1

PUBLIC LAND AND DESCRIPTIVE BLOCKS



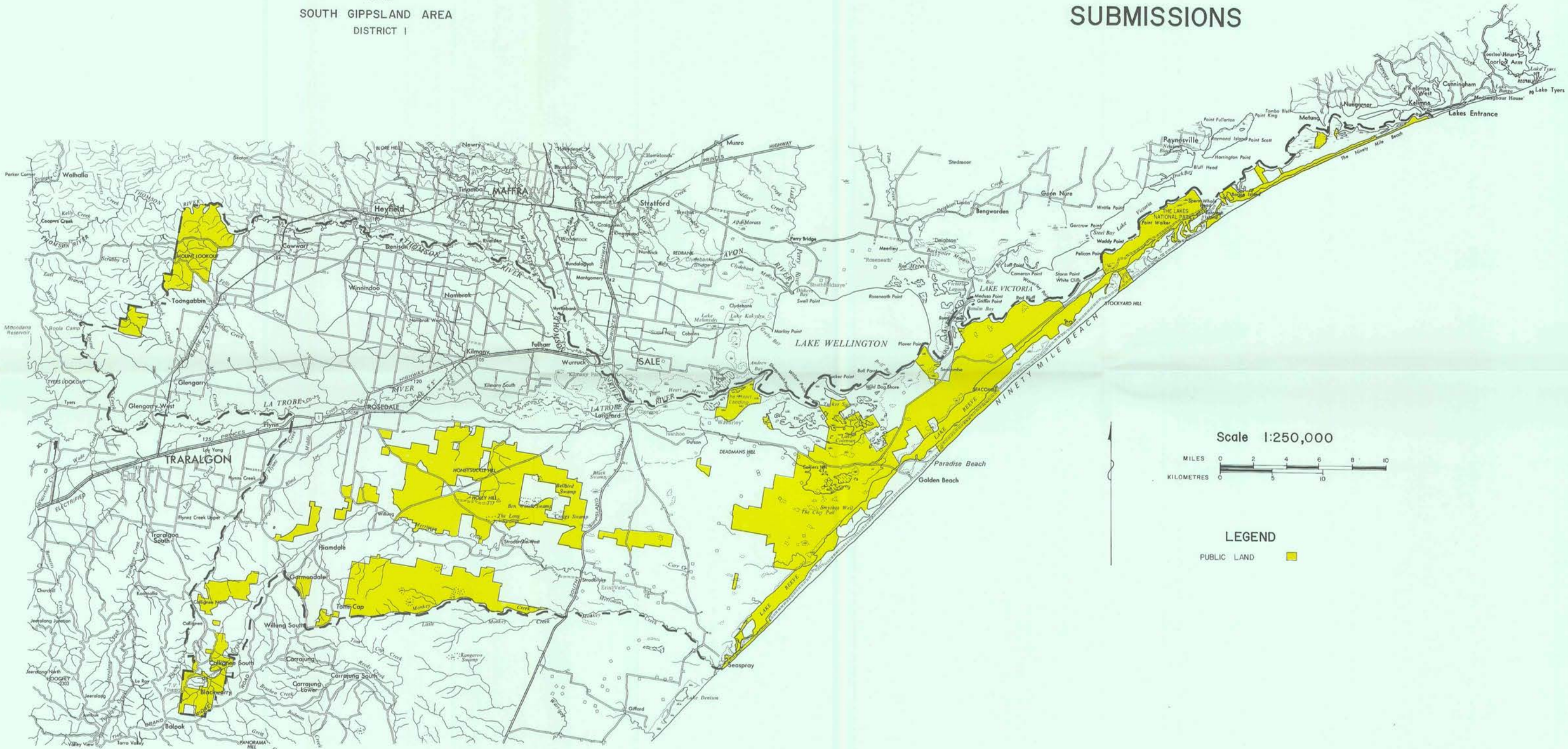
LAND CONSERVATION COUNCIL

VICTORIA

SOUTH GIPPSLAND AREA

DISTRICT 1

SUBMISSIONS



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MILES 0 2 4 6 8 10

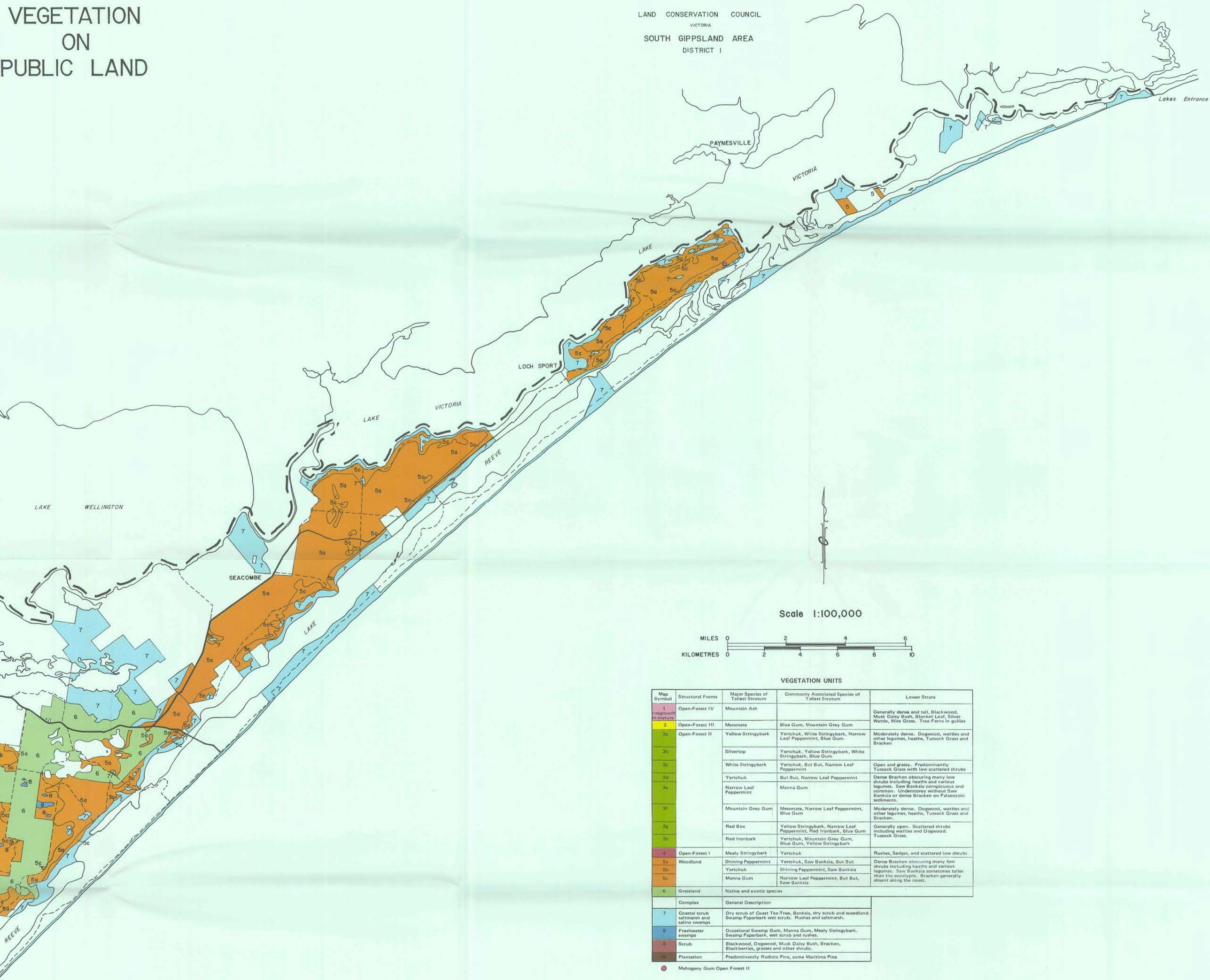
KILOMETRES 0 5 10

LEGEND

PUBLIC LAND

VEGETATION ON PUBLIC LAND

LAND CONSERVATION COUNCIL
VICTORIA
SOUTH GIPPSLAND AREA
DISTRICT I



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MILES 0 2 4 6
KILOMETRES 0 2 4 6 8 10

VEGETATION UNITS

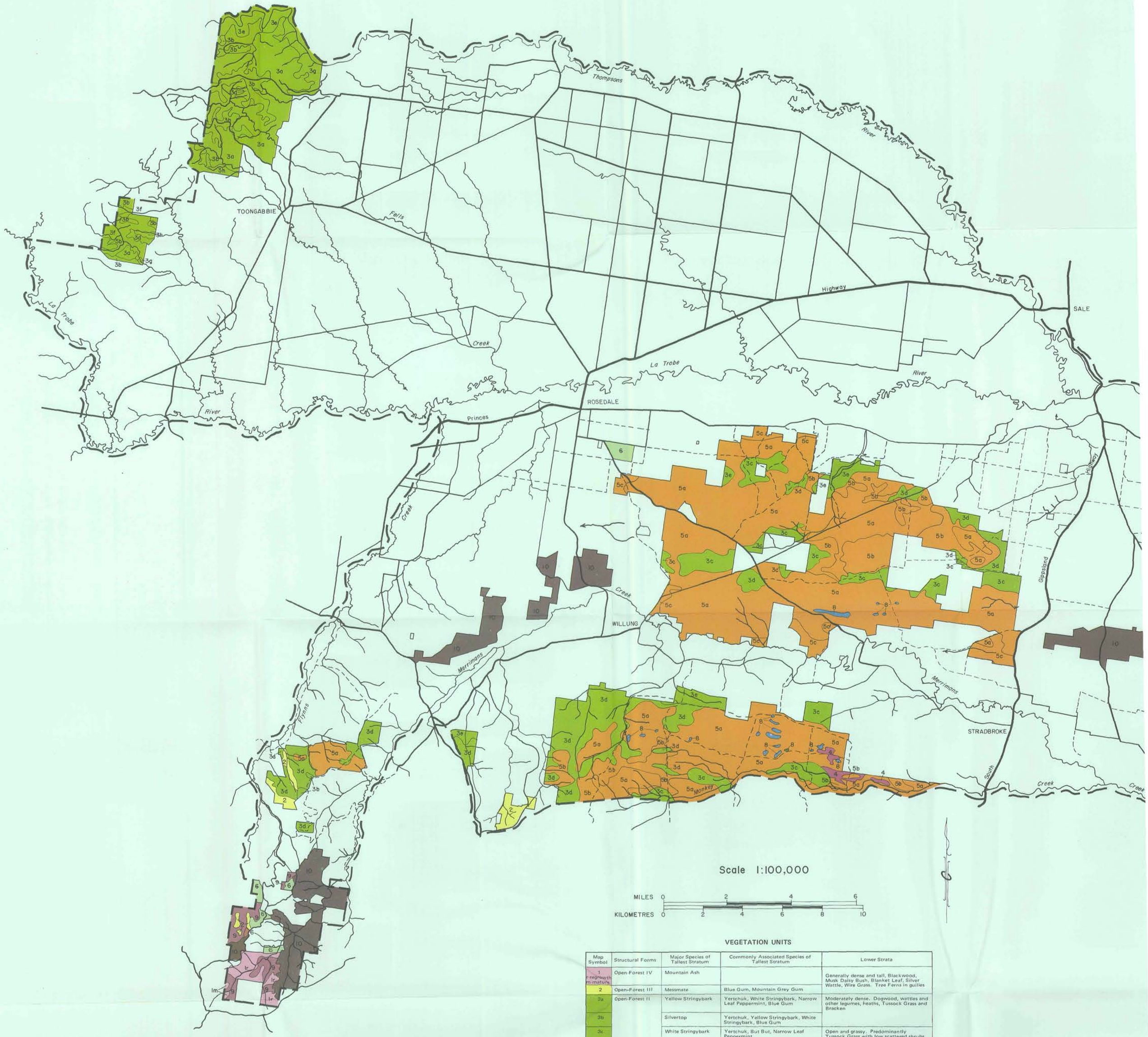
Map Symbol	Structural Forms	Major Species of Tallest Stratum	Commonly Associated Species of Tallest Stratum	Lower Strata
1 r-regrowth n-mature	Open-Forest IV	Mountain Ash		Generally dense and tall, Blackwood, Musk Daisy Bush, Blanket Leaf, Silver Wattle, Wire Grass. Tree Ferns in gullies
2	Open-Forest III	Messmate	Blue Gum, Mountain Grey Gum	
3a	Open-Forest II	Yellow Stringybark	Yertchuk, White Stringybark, Narrow Leaf Peppermint, Blue Gum.	Moderately dense. Dogwood, wattles and other legumes, heaths, Tussock Grass and Bracken
3b		Silvertop	Yertchuk, Yellow Stringybark, White Stringybark, Blue Gum	
3c		White Stringybark	Yertchuk, But But, Narrow Leaf Peppermint	Open and grassy. Predominantly Tussock Grass with low scattered shrubs
3d		Yertchuk	But But, Narrow Leaf Peppermint	Dense Bracken obscuring many low shrubs including heaths and various legumes. Saw Banksia conspicuous and common. Understorey without Saw Banksia or dense Bracken on Palaeozoic sediments.
3e		Narrow Leaf Peppermint	Manna Gum	
3f		Mountain Grey Gum	Messmate, Narrow Leaf Peppermint, Blue Gum	Moderately dense. Dogwood, wattles and other legumes, heaths, Tussock Grass and Bracken.
3g		Red Box	Yellow Stringybark, Narrow Leaf Peppermint, Red Ironbark, Blue Gum	Generally open. Scattered shrubs including wattles and Dogwood. Tussock Grass.
3h		Red Ironbark	Yertchuk, Mountain Grey Gum, Blue Gum, Yellow Stringybark	
4	Open-Forest I	Mealy Stringybark	Yertchuk	Rushes, Sedges, and scattered low shrubs.
5a	Woodland	Shining Peppermint	Yertchuk, Saw Banksia, But But	Dense Bracken obscuring many low shrubs including heaths and various legumes. Saw Banksia sometimes taller than the eucalypts. Bracken generally absent along the coast.
5b		Yertchuk	Shining Peppermint, Saw Banksia	
5c		Manna Gum	Narrow Leaf Peppermint, But But, Saw Banksia	
6	Grassland	Native and exotic species		
	Complex	General Description		
7	Coastal scrub saltmarsh and saline swamps	Dry scrub of Coast Tea-Tree, Banksia, dry scrub and woodland. Swamp Paperbark wet scrub. Rushes and saltmarsh.		
8	Freshwater swamps	Occasional Swamp Gum, Manna Gum, Mealy Stringybark. Swamp Paperbark, wet scrub and rushes.		
9	Scrub	Blackwood, Dogwood, Musk Daisy Bush, Bracken, Blackberries, grasses and other shrubs.		
10	Plantation	Predominantly Radiata Pine, some Maritime Pine		

Mahogany Gum Open Forest II

Modified from maps prepared by F.W.Noble, Forests Commission and B.M.Nicholson, Soil Conservation Authority

VEGETATION ON PUBLIC LAND

LAND CONSERVATION COUNCIL
VICTORIA
SOUTH GIPPSLAND AREA
DISTRICT I



Scale 1:100,000

MILES 0 2 4 6
KILOMETRES 0 2 4 6 8 10

VEGETATION UNITS

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3a	Open-Forest II	Yellow Stringybark	Yertchuk, White Stringybark, Narrow Leaf Peppermint, Blue Gum	Moderately dense. Dogwood, wattles and other legumes, heaths, Tussock Grass and Bracken
3b		Silvertop	Yertchuk, Yellow Stringybark, White Stringybark, Blue Gum	
3c		White Stringybark	Yertchuk, But But, Narrow Leaf Peppermint	Open and grassy. Predominantly Tussock Grass with low scattered shrubs
3d		Yertchuk	But But, Narrow Leaf Peppermint	Dense Bracken obscuring many low shrubs including heaths and various legumes. Saw Banksia conspicuous and common. Understorey without Saw Banksia or dense Bracken on Palaeozoic sediments.
3e		Narrow Leaf Peppermint	Manna Gum	
3f		Mountain Grey Gum	Messmate, Narrow Leaf Peppermint, Blue Gum	Moderately dense. Dogwood, wattles and other legumes, heaths, Tussock Grass and Bracken.
3g		Red Box	Yellow Stringybark, Narrow Leaf Peppermint, Red Ironbark, Blue Gum	Generally open. Scattered shrubs including wattles and Dogwood. Tussock Grass.
3h		Red Ironbark	Yertchuk, Mountain Grey Gum, Blue Gum, Yellow Stringybark	
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Modified from maps prepared by F.W.Noble, Forests Commission