2

GEOGRAPHY

PROTECTION OF THE ENVIRONMENT

Ministry for Conservation

Establishment and functions

The Victorian Government is endeavouring in its overall policies to lift the "quality of life" as well as to enhance the more material achievements or rewards which can be realised in the community. In pursuance of this aim the Ministry for Conservation was proclaimed in January 1973 by an Act which brought together the Environment Protection Authority, the Fisheries and Wildlife Department, the Port Phillip Authority, the Soil Conservation Authority, the Land Conservation Council, and the National Parks Service. Each of these government agencies is concerned with special facets of the Government's activities directed towards the achievement of conservation.

The functions of the Ministry are to achieve the protection and the preservation of the environment, and to arrange the proper management and utilisation of the land and living aquatic resources of the State. These two apparently conflicting requirements are, in fact, complementary. The Ministry brings together a wide range of technical expertise available through its component parts. Since the problems of conservation range very widely, the Act allows for co-operation between the Victorian and Australian Governments.

Responsibilities

In the exercise of its own function of conservation planning, and through the co-ordination of its component agencies which have responsibilities in one or more areas of environmental activity, the Ministry can meet most of its total responsibility in environmental matters and in the achievement of conservation. The main responsibilities are, first, the role of environment protection, that is, the management of waste and the control of pollution; second, environment management or the understanding of the land and its use to prevent soil erosion and to protect water catchments and coastlines; third, environment preservation, that is, the care of flora and fauna, the use and management of living resources, and the maintenance of national parks and conservation reserves; and finally, environmental assessment, which may well become the principal specific activity of the Ministry. Environmental assessment is the organisation of inter-disciplinary studies as the basis for multi-resource planning

and as background information by which to judge what information should be provided by developers so that an assessment can be made of the likely environmental effects.

Associated with the organisation of inter-disciplinary studies is the direction of the work such as through the Western Port Bay Environmental Study. The objective of this Study is to find guidelines which, if followed, would guarantee the quality of the water indefinitely. The direction of a study such as this emphasises the co-ordinating role of the Ministry.

While preservation and protection may well be integral parts of conservation, conservation does not necessarily include preservation. On the other hand, proper management and utilisation are an integral part of conservation. Conservation is an embracing concept, that of fitting man into his whole environment. Man must exercise his technological and other skills to maintain an environment which is a worthwhile habitat for human beings. The way to achieve this lies in the proper use and management of resources to provide for man's needs now and in the future in an ecologically satisfactory way.

Conservation requires new attitudes by man to his surroundings. Its achievement imposes on scientists and technologists the task of integrating technical information into working systems. It also imposes on governments the task of providing adequate legislation so that administrators can ensure that the use and management of resources is based on proper technical considerations and that the long-term interests of the community are not overlooked.

Environment Protection Authority

Before the establishment of the Environment Protection Authority, pollution control responsibility in Victoria was spread among numerous State and local government agencies. This fragmentation raised considerable problems of co-ordination. It also created confusion, partly because some agencies had insufficient jurisdiction. It was not long before it became evident that Victoria needed a central body to control all wastes entering the environment, and to act as a watchdog on air, water and land pollution, and against excessive noise and litter. Appropriate environmental legislation was therefore introduced into Parliament. Several drafts were prepared dealing initially only with water pollution and finally a Bill was presented covering all wastes, noise, and litter.

The Environment Protection Act was passed by Parliament in December 1970. On 15 March 1971, those sections of the Act were proclaimed which established the Environment Protection Authority, the advisory seventeen member Environment Protection Council, the policy-making procedures, and some of the " housekeeping " powers of the Authority. The remaining parts of the Act came into operation on 1 March 1973. In May 1972 the Act was amended to provide for appeals by the general public against licensing decisions of the E.P.A. and its delegated agencies, and to empower the E.P.A. to settle disputes over the responsibilities for control of pollution situations.

In broad terms the Authority's main powers may be divided into two areas. These are the waste licensing system, and the pollution control

powers. The licensing system provides for all waste discharged directly into the air, into water, or onto land to be licensed by the E.P.A. or one of its agencies; while the general pollution control powers cover emergency problems such as chemical spills, and other types of pollution not caused by regular waste discharges.

Licensing system and appeals

Under the Act anyone who discharges waste directly into the air, into water, or onto land, needs to apply for a waste discharge licence, unless the discharge has been specifically exempted. Regulations to control noise are to be introduced progressively, and initially there will be no requirement for noise licences.

From the date of full operation of the Environment Protection Act, on 1 March 1973, existing dischargers were given three months in which to apply for a waste discharge licence, and the Authority had four months from receipt of that application in which to deal with it. For new dischargers, a licence must be obtained before the discharge begins. Applications for a licence may be refused if the Authority feels that the discharged waste may have a harmful enough effect on the receiving environment. Alternatively it may be granted with conditions specifying discharge standards which must be met. People may be prosecuted for breach of licence conditions, or for making a waste discharge without a licence. Maximum penalties are $5,000 for a single offence, and $2,000 a day for a continuing offence.

There are two sorts of appeal allowed under the Act : one from licence applicants who are dissatisfied with the decisions of the E.P.A. or its agencies, and the other from third parties who feel they may be adversely affected by a licence discharge. Licences and licence applications are available for public review and third parties who disagree with licensing decisions have two lines of appeal—first to the E.P.A. itself, sitting as an Appeal Tribunal, and second, to the Environment Protection Appeal Board. Licence applicants who are dissatisfied with E.P.A. or Agency decisions can appeal directly to the Appeal Board, a three man tribunal comprising a legal expert and two environmentalists.

Agencies

The E.P.A. has delegated tasks to five other government agencies—the Latrobe Valley Water and Sewerage Board, the Melbourne and Metropolitan Board of Works, the Dandenong Valley Authority, the State Rivers and Water Supply Commission, and the Commission of Public Health. These agencies carry out licensing and enforcement functions according to guidelines laid down by the E.P.A. The responsibilities of these agencies are specified below :

(*a*) Latrobe Valley Water and Sewerage Board—licences in the field of water, air, and land waste for the Latrobe valley and for East Gippsland as far as the New South Wales border.

(*b*) Melbourne and Metropolitan Board of Works—licences for discharges to water within the Melbourne metropolitan area.

(*c*) Dandenong Valley Authority—licences for discharges to water within its area.

(*d*) State Rivers and Water Supply Commission—licences for discharges to inland water for the rest of the State.

(*e*) The Commission of Public Health—licences for discharges to land, for the whole of Victoria except the area covered by the Latrobe Valley Water and Sewerage Board.

The E.P.A. handles directly all air licences for the State except for the Latrobe Valley Water and Sewerage Board area, water licences for coastal waters including Port Phillip and Western Port Bays, and all of the noise control programme.

Environment protection policies

One of the E.P.A.'s responsibilities is the setting of broad policies for environmental quality throughout the State. Draft policies issued to date cover water quality in Port Phillip Bay, the Yarra River and its tributaries, the streams of the Dandenong valley, and the Maribyrnong River and tributaries.

Each policy sets out the beneficial uses of the water which the E.P.A. proposes to protect from the harmful effects of pollution and waste discharges. Different beneficial uses, such as drinking water supplies, or fishing and boating, require different water qualities. Water that is used for drinking, for instance, needs to be very much cleaner than water which is used solely for boating.

Policies are placed on public review for at least two months. After all comments have been considered and policies amended where necessary, they are forwarded to the Governor in Council. After this the matter, if adopted, becomes State environment protection policy. All E.P.A. licensing decisions must be in accordance with declared policies.

In December 1973 a draft noise control policy was issued. It sets out acceptable noise levels for the City of Richmond and is the first in a series of such policies intended to cover initially the Melbourne metropolitan area, and eventually the whole of the State of Victoria. Although the policy covers only the City of Richmond the standards and methods of assessment contained in it are applicable throughout the State. It covers environmental noise from stationary sources only. Transportation noise is thus not dealt with, although this is recognised as a major noise problem within the community. A separate programme aimed at controlling transportation noise is to be initiated by the Environment Protection Authority in due course.

The draft policy was placed on public review until 31 March 1974 during which period comment was invited from the public and interested bodies. After consideration of this comment, a final draft is likely to be prepared and presented to the Governor in Council for declaration as State environment protection policy, pursuant to Section 16 of the *Environment Protection Act* 1970.

Environmental studies

Richmond was chosen for an initial study of the problems of noise control since it is an area of multiple land-use. An interim report on a noise survey made of Richmond was published recently. The policy contains noise standards which set out a method for determining acceptable noise levels in various community situations. A method has also been devised to obtain a measured noise level in a given situation and for making further adjustments depending on the character of the noise. If the adjusted measured noise level exceeds the acceptable level, the emitted noise does not

comply with State environment protection policy. The noise emissions standards and assessment procedures specified in this policy are based on the Australian Standard AS1055 *Noise Assessment in Residential Areas*, and the target date for the full attainment of all the objectives and standards of this policy is July 1980.

The E.P.A. is currently undertaking a number of survey programmes and special studies. These include :

(*a*) A bayside survey of the bacterial condition of bathing waters adjacent to popular beaches on Port Phillip Bay.

(*b*) A pilot chemical and biological study of the Gippsland Lakes and their input drains and streams, in conjunction with the Latrobe Valley Water and Sewerage Board.

(*c*) An ambient air monitoring programme at three locations in the Melbourne metropolitan area and at one location in the Latrobe valley. Parameters measured include ozone, total oxides of nitrogen, nitrogen dioxide, nitric oxide, sulphur dioxide, and carbon monoxide. Figures are released daily to the media and monthly reports issued to interested persons.

(*d*) A special study on hydrocarbon emissions from petrochemical works. A gas chromatograph–mass spectrometer (one of the major units to be used in this study) is being commissioned.

(*e*) A programme to monitor lead in ambient air.

(*f*) A study to elucidate the structure of the haze (miasma) which has become more prevalent in the air-shed over Melbourne. Data is being collected on the ambient concentrations of ozone, hydrocarbons, and oxides of nitrogen. Data logging equipment to assist in this study is currently being commissioned.

(*g*) A survey on noise from industrial premises.

(*h*) Special studies on the overall control of domestic noise. These studies will aim at determining the most effective provisions for the control of domestic noise and for suitable authorities to administer them.

(*i*) A study on the psychological effects of noise in the community.

(*j*) A progress report on municipal waste disposal in Victoria—covering the greater metropolitan area initially—is due to be released shortly. Regions which have been developed in conjunction with municipal engineers are proposed in the report.

(*k*) Profile studies of sulphur dioxide and nitrogen dioxide in the ambient atmosphere will commence in the near future.

The Authority also co-operates with the Australian Government and appropriate government instrumentalities in the States and Territories through its work on the committees of the Australian Environment Council.

Land Conservation Council

The Land Conservation Council was established under the *Land Conservation Act* 1970 to implement the Victorian Government's policy of setting aside and permanently reserving substantial areas of public land in order to achieve a balanced use of land in the State. It was considered that the future use of public land should be determined only after a scientific study to ensure that the inherent capability and suitability of the

land for different uses had been thoroughly investigated. The Council considers all possible uses for land, but specifically has regard to those which have been neglected in the past. It has particular regard to the needs of the people of Victoria in relation to the preservation of areas which are ecologically significant ; to the creation and preservation of areas of national parks, reserved forests, bushland recreation reserves, and fish and wildlife reserves ; and to areas of natural interest, beauty, or historical interest. (See also pages 5-6.)

When the investigation of a study area has been completed and a report published, the public are invited to comment on the future use of public land in the area. The intention of the Act is that all persons or bodies having an interest in the future use of public land in the area concerned can obtain and study the same basic information which the Council itself will study, and so make constructive suggestions to the Council for its consideration. The Council has produced four reports, respectively, on the Shires of Portland and Glenelg, the Shire of Rosedale, the Corryong–Tallangatta area, and the Benalla–Mansfield–Euroa area. A report on public land in shires within a radius of approximately 130 kilometres of Melbourne is also being prepared and work has commenced on the Mallee, the Shire of Orbost, and the King, Ovens, and Kiewa valleys and adjacent areas.

In April 1973 the Council presented its final recommendations on the future use of public land in the Shires of Glenelg and Portland ; these recommendations were later adopted by the Victorian Government. In general, the recommendations were that the area of the Lower Glenelg National Park be expanded to 26,000 hectares, that Mount Richmond National Park be expanded, and that three new parks be created.

The Lower Glenelg Park recommended by the Council includes the gorge of the Glenelg River, the Kentbruck Heath, the Bulley Ranges, and examples of other major land types of the region. It was recommended that Mount Richmond National Park be expanded to 1,850 hectares, and that 8,000 hectares of wild beach, dune, lake, and swamp country on the Discovery Bay coast be a coastal reserve under unified management. Other parks were proposed for the scenic valley of the Crawford River, and for the Wilkin area west of Casterton, which is famous for its wildflowers, especially orchids.

Fifteen areas, twelve of which are swamps or lakes, have been recommended for conservation of wildlife and waterfowl. In addition, many small areas were recommended to become flora, scenic, and bushland reserves, and reserved water frontages. Allocations of land were made for hardwood timber production, and for softwood planting up to 1981. Some land was classified as suitable for agricultural development.

The Council recommended that large areas be held as uncommitted land; such uncommitted land should normally have potential for several forms of use and the main aim of management is to keep the land in a completely flexible condition, leaving open all options for future use. The Council has also recommended that a scheme for classifying Victoria's parks be drawn up, using terms such as State Park and Regional Park.

Soil Conservation Authority

As the demands of Victoria's expanding population and industries came to use greater areas of land in increasingly different ways, the practice of soil conservation developed to meet the resulting challenges to land-use. The early recognition of erosion problems, originally prompted by undisciplined settlement in a country of unknown environmental response, was slow. It was realised in the early stages that technical and mechanical improvements alone would not suffice to solve the problems which intensified with the growth of population.

Effective remedies depended largely upon the development of the new soil sciences and a new understanding of Victoria's environment. Long-term research programmes were, therefore, implemented to identify the problems and their causes and to seek appropriate remedies for them.

Early history

Although the occurrence of soil erosion was recognised at an early stage in Victoria's history, awareness of its scale and implications developed more slowly. Concerted action developed even more slowly still.

In 1853 John Robertson, a settler in the Casterton district, wrote to Governor La Trobe complaining of erosion and land deterioration and, in the early 1870s, Mallee sand drift was mentioned at a Royal Commission. In the event, it took the coincidence of adverse seasonal conditions, an increasing population, and the economic recessions of the 1890s and early 1930s to arouse public attention to erosion damage.

Progressive landholders individually handled the problem as best they could, but it was not until 1917 that the first official action was implemented with the formation of an inter-departmental erosion committee. There was little if any beneficial result from this move.

In 1925 the River Murray Commission requested that action be taken to prevent the destruction of forests on Crown lands in the Hume Reservoir catchment to reduce the probability of siltation of the storage. This was the first of many such recommendations by this and other government authorities, but again little practical action resulted. In 1927, following a conference of various Victorian Government departments, a recommendation was made for the appointment of a body to review the position in the various water supply catchments.

In the years before and after the First World War the opening of the newer Mallee brought about increasing wind erosion and drifting sand, already evident to a smaller degree in the older settled parts of the north-west. This was reported upon in 1933 by a committee of departmental officers and landholders. The widespread erosion problems slowly induced a public realisation of what was happening to the State's lands and led to agitation for action to control it.

The first major step was taken in August 1936, in Adelaide, when a conference of Australian and State Ministers asked State Governments to form Soil Erosion Committees. A committee of inquiry was appointed by the Victorian Government. Its *Report of Committee Appointed to Investigate Erosion in Victoria,* dated February 1938, became the first document of importance to assess the State's erosion situation.

In 1939 a series of public lectures was arranged by the Victorian Institute of Surveyors in which many experts gave their views on the causes and effects of soil erosion. The collated lectures were published in 1940 by the Lands Department under the title *Soil Erosion in Victoria.*

As a result of these lectures a committee was formed from representatives of the Victorian Institute of Surveyors, the Institution of Engineers (Australia), the Australian Institute of Agricultural Science, and the Institute of Foresters of Australia. It presented a memorandum to the Victorian Parliament which recommended the creation of a part-time expert advisory authority, the function of which ". . . should be to formulate the principles of soil conservation and . . . of land utilization and . . . to extend . . . these principles through the co-operation of existing authorities . . .". The committee suggested a constitution and organisational structure for the proposed authority and outlined in considerable detail the duties of such a body.

Soil Conservation Board

Almost immediately the Victorian Government passed the *Soil Conservation Act* 1940, in which the recommendations of the joint Institute Committee were closely followed. The Soil Conservation Board was constituted on 24 December 1940.

The functions of the original Board were restricted by comparison with those of the present Authority. It was constituted as an experimental and advisory body only; it was not empowered to undertake other than experimental works, and it had no rights to enforce, correct, or better land usage where such was necessary. It undertook surveys, designed and investigated the effects of remedial measures, carried out experiments and demonstrations, and recorded the results of all these. It disseminated its findings by pamphlets and other means and assisted individual landholders with erosion control and soil conservation. It co-ordinated the policies and activities of those State departments which deal with the alienation, occupation, and utilisation of Crown lands.

With ministerial sanction it could, by agreement with appropriate public bodies and landholders, conduct experiments or demonstrations on their lands and employ workmen from time to time. It could also grant money for conservation projects. Demonstrably it had no real power to effect long-term improvements in land-use. However destructive any particular farmer's methods were, either of his own resources or those of others nearby who might be affected, the Board could only suggest a course of action to him. It could not enforce its requests.

The Board functioned well even under these difficult circumstances, which included five years of war with consequent shortages in staff and materials. The farmers who took advantage of the available services and accepted conservation-based ideas reaped higher returns because of the better usage of their lands.

From this experience of the Board, it became apparent that a reconstituted body would result in much greater benefits. Such a body needed to be given more authority over land use and all that this implied. This led to the passing of the *Soil Conservation and Land Utilization Act* 1947, and a further amending Act in 1949. These Acts provided for the constitution of

an Authority of three full-time members to replace the Board. The Authority was appointed and held its first meeting on 16 February 1950.

Establishment of Authority

The Soil Conservation Authority is a corporate body, appointed by the Governor in Council for three year terms. As initially constituted, the Authority had responsibility for the mitigation and prevention of soil erosion, the promotion of soil conservation, and the determination of matters relevant to the utilisation of all lands, including Crown lands, to attain these objectives. The Authority was given wide powers to undertake soil conservation works and to make grants to assist approved projects. A further important function was to undertake studies of the land to determine why certain problems arise in its use and the most effective curative methods.

The Act also constituted a Land Utilization Advisory Council to make recommendations to the Authority about the constitution and definition of water supply catchment areas and the use of land therein. It consisted of heads of resource departments under the chairmanship of the Authority chairman.

In proclaimed catchment areas the Authority was empowered, after consultation with the Land Utilization Advisory Council, to determine the most suitable use in the public interest of all lands; which lands should be used for forest, pasture, agriculture, or other purposes ; and the conditions under which the various forms of land use would be permitted. The Authority was also charged with co-ordination of the policies and activities of those government departments and public authorities involved in the disposal, occupation, and utilisation of Crown lands.

To help the Authority perform its functions, the Act made possible the establishment of soil conservation districts and the formation of district advisory committees, charged with the responsibility of considering and reporting to the Authority on matters of land utilisation, soil erosion, or conservation within their districts.

Thus, from its inception, the Authority has possessed functions of an administrative, regulatory, investigatory, planning, constructional, and educational nature. It consists of four divisions: administration, field operations, research, engineering, and a publications and information section. These investigate, plan, advise on, and execute remedial and preventive measures on a co-operative basis with landholders and other government departments and public authorities. The Authority's research activities support these services, and undertake land-use studies and agronomic, hydrologic, economic, and similar investigations.

The Authority has always preferred to achieve its objectives by seeking co-operation rather than by use of its wide compulsory powers and the use of planned extension, information, and educational programmes has shown the value of this policy.

Further responsibilities

An increasing number of functions have been added to the Authority's original charter. In 1957, legislation gave the Authority responsibility for the issue of permits and the determination of conditions under which soil and other material may be removed from river flats. A 1962 Act made possible the formation of group conservation areas, a programmed system

of conservation and erosion control conducted on a voluntary and co-operative basis between groups of landholders and the Authority. In 1965, legislation authorised the development of a farm water supply advisory service to landholders outside irrigation areas. This service, providing design and supervision services for farm dams, water reticulation, and irrigation schemes, helps landholders make the most efficient use of their on-farm water resources.

The Authority also became responsible for recommending to the Rural Finance and Settlement Commission for long-term, low interest loans for approved soil and water conservation works proposed by landholders.

The *Extractive Industry Act* 1966 requires the Authority to issue permits for the extraction of soil, sand, or gravel from any site in excess of one fifth of a hectare and under two metres in depth, in association with a statement of conditions for rehabilitation of the extraction area. The Authority also recommends whether or not, and under what conditions, extractive industry should be permitted in a proclaimed water supply catchment.

In 1970, the Land Utilization Advisory Council was replaced by the Land Conservation Council which assumed the former body's responsibilities together with the additional responsibility for investigating and recommending the use of public land to provide for the balanced use of land in Victoria. The chairman of the Authority serves as deputy chairman of the Land Conservation Council.

When the Ministry for Conservation was formed in 1973, with the purpose of assuring a multi-disciplinary approach to the State's environmental problems, the Soil Conservation Authority became an agency of the Ministry.

Conservation concepts

Behind this legislative development there evolved a concept of conservation which embraced the principle of the community assisting landholders with the cost of non-productive erosion control works. These costs were accepted provided the landholder undertook associated productive soil conservation measures and implemented a system of land-use that enabled the land to give sustained productivity without loss of soil or its fertility.

Fundamental to this shared cost system is the concept of community responsibility for historically poor land-use. This has usually arisen during periods of inadequate technology and economic stress under conditions of unknown environmental response, and has been exacerbated by introduced pests, notably the rabbit.

This conservation concept was later to be tested and consolidated in the 900 square kilometre project works in the Lake Eppalock catchment. Until 1958, the Authority operated largely as an advisory organisation, dealing with single erosion problems and individual farmers. In 1959, however, a Parliamentary Public Works Committee inquiry into the proposed Eppalock Reservoir resulted in the allocation to the Authority of $1m over a ten year period to overcome widespread erosion in the catchment. This was the first time in Victoria that funds had been allocated for catchment control works to be undertaken concurrently with the construction of a reservoir.

The notable success of the project exemplified the effectiveness of the newly developed policy of co-operative effort in preference to compulsion and resulted in legislation which enabled group conservation areas to be formed throughout the State. Over 2,200 landholders have, as neighbours in 126 groups, requested the group planning approach on 5,700 square kilometres of land.

Technological improvements

Little progress in soil conservation would have been possible without the technological progress of the late 1940s and early 1950s. The advent of the myxomatosis virus as a means of rabbit control and the isolation of molybdenum as a trace element essential to a legume's nitrogen fixing bacteria were precursors to the establishment of balanced pastures of subterranean clover and deep rooted perennial grasses with their attendant hydrologic and productive benefits.

The increase in soil nitrogen and organic matter, arising from the replacement of the short-rotation crop/fallow system by the medic-ley, resulted in a far more stable farming system in the Mallee. This, coupled with techniques for establishing lucerne on sandhills, reduced dust storms and sand drift to relatively minor and manageable proportions.

Emerging problems

To date the attention of soil conservationists has primarily been focused on the problems of rural areas. However, in the last decade, the growth of the population has drawn attention to a new range of problems which are urban rather than country based.

The initial visual effects of these problems are, in terms of obvious erosion, less dramatic than those occurring in rural areas. Many of them are more significant, however, because the changes in land-use they evoke are often permanent, as is any damage resulting from such changes.

For example, subdivisions into small area farmlets and rural retreats in certain areas pose a threat to the catchments of the urban and outer urban areas with potentially far-reaching effects on the hydrology and water quality, as well as on the aesthetic value of many seaside and country areas.

This growth of population at present appears a major conservation problem of the future. As urban development spreads, land tends to be cleared indiscriminately and erosion problems proliferate.

Urban and holiday housing has to be serviced by roads and walking tracks, water supply and sewerage works, car parks, and recreational facilities. The vegetation so affected cannot always withstand this pressure. This is especially true in the traditional recreation areas of the coastal foreshores and alpine regions where the vegetation—as with the semi-arid inland areas—is particularly sensitive and easily destroyed.

It is noteworthy that, while these are the areas most prized by those with the mobility and leisure to enjoy them, it is this same mobility and leisure which could also destroy them.

To balance these emerging problems there has developed, in the past decade, a public awareness of conservation issues with an attendant demand for environmental education.

Soil Conservation Authority, 1961–1971; Destruction of vermin and noxious weeds, 1963; Soil, land use, and ecological surveys, 1966; Farm water supplies, 1968; Group conservation, 1969; Land Utilization Advisory Council, 1970; Land Conservation Council, 1972, 1974

Port Phillip Authority

The Port Phillip Authority was created by an Act of Parliament in 1966 to advise on methods of preservation and improvement within the Port Phillip area, and on techniques by which its development could be co-ordinated. The Authority comprises a full-time Chairman and representatives of four of the Government departments concerned with the Port Phillip area, whose services are utilised on a part-time basis.

The area controlled by the Authority extends along the coastline from Cape Schanck in the east to Barwon Head in the west and includes Port Phillip Bay. It comprises a belt of public land which is between 200 and 800 metres wide and extends along the shore, the inshore waters, and the sea bed up to a distance of 600 metres. Within this area no works are permitted without the consent of the Authority.

Beach usage survey

In 1970, the Authority completed one of the largest surveys of its kind ever undertaken in Australia. The survey inquired into the popularity of beaches, the numbers of visitors and the areas they came from, and the improvements required by the user. The results of this survey appeared in a report published by the Authority in 1970.

Beach populations study

During the summer of 1972–73 a study was conducted to estimate the number of people who use the beaches of Port Phillip Bay on a typical hot summer day. The study showed that about 250,000 people use the beaches and inshore waters of the bay on such a day. This figure does not include persons engaged in fishing, boating, or exploring foreshore vegetation and rocky coasts.

Restoration experiment

In 1972 the Authority undertook a restoration experiment on a section of outer suburban beach at Seaford. The dune areas and vegetation damaged by over-use were temporarily fenced and planted with grass and trees. Interspersed through these fenced areas were surfaced tracks across the fore-dune to the beach. Visitors have accepted the restricted access, and assistance in tending the area from local groups has been encouraging. The results of the restorations have been excellent and it is anticipated that the public will soon be able to make controlled use of the replanted area.

Nature conservation areas

During 1972 a Committee was established to identify and investigate areas in need of management specifically for reasons of nature conservation. The process was also applied to areas of high scenic value. Submissions were invited from interested conservation groups to identify features of special scientific or educational value in these areas with particular reference to nature conservation.

The response to this Committee has been excellent, and an evaluation of the submissions is being considered. When completed it will be possible to formulate practical management programmes. Scenic evaluation of the coastal areas has been grouped under certain categories. These include areas with high quality natural scenery, those with pleasant coastal scenery, areas

holding potentially pleasant coastal scenery, places where the coastal scenery is of a low quality, and urban areas.

Further reference, 1969

Port Phillip Bay environmental study

Two and a half million people, nearly one fifth of the Australian population, live in an area of about 10,360 square kilometres surrounding Port Phillip Bay. The bay is used for fishing, boating, water skiing, and swimming, and as a commercial shipping lane it provides the link for Melbourne in the chain of world ocean trade. Although the bay is a place of pleasure it is also, by virtue of its location, the final destination for all types of waste flowing from rivers, creeks, and drains in its surrounding areas.

The Melbourne and Metropolitan Board of Works has had the responsibility for Melbourne's sewerage system since 1891, and for years the Werribee farm system treated and disposed of Melbourne's waste. With the passage of time, the existing system became overburdened and the south-eastern sewerage scheme was designed to reduce the load on the Werribee farm, and at the same time cater for the ever-increasing sewerage demands of the eastern and south-eastern suburbs. The scheme originally provided for a main trunk sewer from Kew to a purification plant at Carrum, and an effluent discharge into the bay about three kilometres offshore from the Patterson River estuary.

Although it was believed that the discharge of purified wastewater near the Patterson River would have few short-term effects on the bay, the Board and the Fisheries and Wildlife Department jointly agreed to conduct a comprehensive study of the bay and its tributary region. The aim of the study was to determine the ecological relationships in the bay and to collect data in the vicinity of the proposed outfall. The data was to be combined with results of monitoring tests on the discharge from the purification plant, giving an early warning of any undesirable changes in the characteristics of the bay.

The study of the bay began in 1968, but in 1969 the Government directed that the Bass Strait outfall be built as part of the initial system. This meant that the effluent from the purification plant would now be discharged in Bass Strait, and in effect cancel the need for the study in relation to the purification plant at Carrum. The Board and the Fisheries and Wildlife Department, however, recognised the long-term value of a full study.

The study was designed in two phases, the first of which was completed in 1971 at a cost of $1m; its findings have been made public. In the early stages of the first phase the Board provided the bulk of the finance needed for equipping and conducting the study, but since 1970 the Victorian Government and the Board have provided joint finance. However, the Fisheries and Wildlife Department is assuming the major burden of the cost as the biological studies of the second phase of the study occupy a greater proportion of the work. Other bodies engaged in the study are the Port Phillip Authority, the Health Department, the Ports and Harbors Division of the Public Works Department, the University of Melbourne and Monash University, and a firm of consulting engineers. Because neither the Board nor the Fisheries and Wildlife Department had

sufficient specialists with the necessary qualifications for such a comprehensive study, two years of recruiting were necessary, both in Australia and overseas, to assemble the study team.

The responsibility for the direction and co-ordination of the study has since been transferred to the Ministry for Conservation which has established a special multi-disciplinary staff to exercise these functions. A project director has been appointed to this study (and to each of the other broad-based estuarine environmental studies) and he is responsible to a Director of Environmental Studies.

The study of Port Phillip Bay has been pursued along three lines of investigation and assessment: to ascertain the present physical, chemical, and biological characteristics of the bay in all seasons and under various conditions of tide, wind, and fresh-water inflow; to correlate these conditions with discharges entering the bay (with particular reference to those under the jurisdiction of the Board) and to establish, as far as possible, their effects; and to determine whether it is possible to deduce, from the data collected, future changes in the bay. The overall aim is to obtain accurate information on which to base proper management and environmental policies for the bay. The first phase of the study has provided a broad review of conditions within the bay, which can be used as data in the second phase of the study and for other future special purpose studies; detailed results are now available of physical, chemical, and biological observations and analyses.

The present study is not the first to have been made of the bay, but it is the most comprehensive and costly. Prior to the present study, limited surveys of some aspects of plant and animal life had been made by a number of individual researchers and institutions, the most notable being by the Fisheries and Wildlife Department and the National Museum of Victoria. With the assistance of scientists and amateur groups from Melbourne and other parts of Australia, these bodies carried out a survey on the flora and fauna of the bay and a general study of the bay's chemical and physical characteristics between 1957 and 1963. Because of inherent difficulties in scope, coverage, techniques, and methods of reporting, it is possible in only a few instances to make direct comparisons of information collected in that work and in the present study.

The first phase of the current survey has given a detailed picture of the bay—its winds, tides and currents, animal and plant species, waste inputs from streams and other sources, and the complicated relationships between these factors. A major finding is that the bay " is at present a relatively unpolluted body of water ", but that there are some near-shore concentrations of pollution, notably at the estuaries of the Yarra and Patterson Rivers and Mordialloc Creek, where waste discharges are prominent. The report concludes that these areas are localised and extensive dilution occurs rapidly within a short distance of the point of discharge.

The report also states that phosphates are at a level consistent with polluted bays elsewhere in the world, but the nitrogen level is much lower. While the levels of phosphorous—phosphates originate from human excreta, detergents, some industrial wastes, and a small amount from agricultural activities—are high, there is no discernible adverse effect on the bay. If the total level of nitrogen was increased, it might have a deleterious effect on

the bay by stimulating an excess of animal and plant life. The first phase of the study also found that water in the bay moves about 1.6 kilometres during each 25 hour tidal cycle and that wastes entering the bay take about a year to pass through it. Despite this relatively slow water movement, there is no evidence that the bay as a whole is gravely polluted.

The first phase of the study has revealed that the bay can be divided into nine environmental zones, each having distinctive physical, chemical, and biological characteristics; this information is of major importance in determining future waste treatment programmes which may affect any one or more of the zones.

The second phase of the study, involving several years further work, is in progress. It includes continuation of some of the previous activities as well as detailed studies of effects which changes in the management of water resources might have on the bay and its flora and fauna. When completed the study is expected to give the responsible government organisations information to ensure that the bay's water quality and plant and animal life remain assets for the State.

Further reference, 1974

Western Port Bay environmental study

Western Port Bay is located immediately to the east of the Melbourne metropolitan area in a sunkland of some 2,000 square kilometres. Historically the area was first developed for agriculture; later, urban centres were established and during recent years some heavy industry has commenced operation. The resultant pressures upon transport, water supply, drainage and other community facilties together with changing economic conditions have helped to create the current pattern of activity around Western Port.

The first phase of the Western Port Bay environmental study was completed in December 1974, and advice arising from the study was submitted to the Government early in 1975. A special multi-disciplinary group of officers appointed to the Ministry for Conservation was responsible for the direction and co-ordination of the study. The Victorian Government and industry financed the first phase with the purpose of developing guidelines for the future management of the Bay. The guidelines are based on an understanding of the physical, chemical, biological, social, and economic characteristics of the Bay, its catchment, and the region in which it exists.

The study established that the loads of nitrate nitrogen and soluble phosphorus were low by world standards and that, although the catchment is predominantly used for agriculture, the total pesticide loads which flowed into the Bay were extremely small.

The patterns of water movement in Western Port Bay are very complex and are reflected in the distribution of bottom sediments and the chemical constituents of the water. There is a net clockwise circulation of water around both Phillip Island and French Island.

Western Port Bay is characterised by the diversity, extent, and often unusual nature of many of its vegetation and animal communities. Seagrasses cover a substantial proportion of the Bay's bottom and they are the major source of primary production. These seagrasses, together with the mangroves, are making a significant contribution to nutrient cycling and productivity in the Bay.

The surrounding area is remarkable for the richness of its fauna and the uniqueness of some of its faunal components. Over 1,350 species of invertebrates have been recorded from the Bay and this has been estimated to represent only 50 to 60 per cent of the total members in all invertebrate groups. The study continues to examine this. Two hundred and ninety-five bird species have been reported in Western Port Bay as compared with 437 species for the whole of Victoria and the numbers of breeding seabirds are large compared with other areas.

To obtain an insight into the sensitivity of fauna from Western Port Bay to heavy metals, toxicological studies were carried out in the laboratory. Two large-scale mathematical models have been developed in the study. The first is a land activities model and the second is concerned with water quality. Apart from their contribution to the study, these two models will provide a new service to Victoria.

The Victorian Government has authorised a second phase of the study and this is now proceeding. This will refine the advice coming from the first phase and will substantially enlarge that advice.

Gippsland Lakes environmental study

Planning of an environmental study of the Gippsland Lakes and their catchment has been authorised and work has begun. The Ministry for Conservation is responsible for the direction and co-ordination of the study and a project director and other senior staff have been appointed.

The Gippsland Lakes in eastern Victoria provide a recreational area for the citizens of the nearby La Trobe valley, for Victoria, and indeed for Australia. Substantial industrial development is planned within the catchment area and an essential pre-requisite is an understanding of the Lakes system and their catchment. The study is directed to obtaining this understanding—a complete description of the physical, chemical, and biological nature of the region associated with an understanding of the social and economic issues. This is to be a co-ordinated multi-disciplinary and inter-disciplinary study, involving the universities, governmental agencies, consultants, and industry.

PHYSICAL FEATURES

Area and boundaries

Victoria is situated at the south-eastern extremity of the Australian continent, of which it occupies about a thirty fourth part and covers about 227,620 square kilometres or 22,761,850 hectares.

AUSTRALIA—AREA OF STATES AND TERRITORIES

State or Territory	Area	Percentage of total area
	sq kilometres	
Western Australia	2,527,620	32.88
Queensland	1,730,000	22.47
Northern Territory	1,347,700	17.53
South Australia	984,380	12.81
New South Wales	801,428	10.43
Victoria	**227,620**	**2.96**
Tasmania	68,396	0.89
Australian Capital Territory	2,430	0.03
Total	7,689,574	100.00

Victoria is bounded on the north and north-east by New South Wales, from which it is separated by the Murray River and a boundary about 177 kilometres long running north-westerly from Cape Howe to the nearest source of the Murray River, being a point known as The Springs, on Forest Hill. All the waters of the Murray River are in New South Wales, the State boundary being the left bank of the stream. The total length of the New South Wales boundary is about 1,937 kilometres.

On the west the State is bounded by South Australia and on the south by the Indian Ocean and Bass Strait. Its greatest length from east to west is about 793 kilometres, its greatest breadth about 467 kilometres, and its extent of coastline 1,800 kilometres, including the length around Port Phillip Bay 264 kilometres, Western Port 145 kilometres, and Corner Inlet 80 kilometres. Britain contains 244,803 square kilometres and is therefore slightly larger than Victoria.

The most southerly point of Wilsons Promontory, in latitude 39 deg 8 min S., longitude 146 deg 22½ min E., is the southernmost point of the mainland of Victoria and likewise of the Australian continent; the northernmost point is where the western boundary of the State meets the Murray, latitude 33 deg 59 min S., longitude 140 deg 58 min E.; the point furthest east is Cape Howe, situated in latitude 37 deg 31 min S., longitude 149 deg 58 min E. The westerly boundary lies upon the meridian 140 deg 58 min E., and extends from latitude 33 deg 59 min S. to latitude 38 deg 4 min S.—a distance of 451 kilometres.

Physiographic divisions

The chief physiographic divisions of Victoria are shown on the map (see fig. 1). Each of these divisions has certain physical features which distinguish it from the others as a result of the influence of elevation, geological structure, climate, and soils. The following divisions are recognised :

1. *Murray Basin Plains :*
   - (*a*) The Mallee
   - (*b*) The Murray Valley
   - (*c*) The Wimmera
   - (*d*) The Northern District Plains
2. *Central Highlands :*
   - A. The Eastern Highlands, within which
     - (*a*) the Sandstone Belt and
     - (*b*) the Caves Country may be distinguished from the remainder
   - B. The Western Highlands :
     - (*a*) The Midlands
     - (*b*) The Grampians
     - (*c*) The Dundas Highlands
3. *Western District Plains :*
   - (*a*) The Volcanic Plains
   - (*b*) The Coastal Plains
4. *Gippsland Plains :*
   - (*a*) The East Gippsland Plains
   - (*b*) The West Gippsland Plains

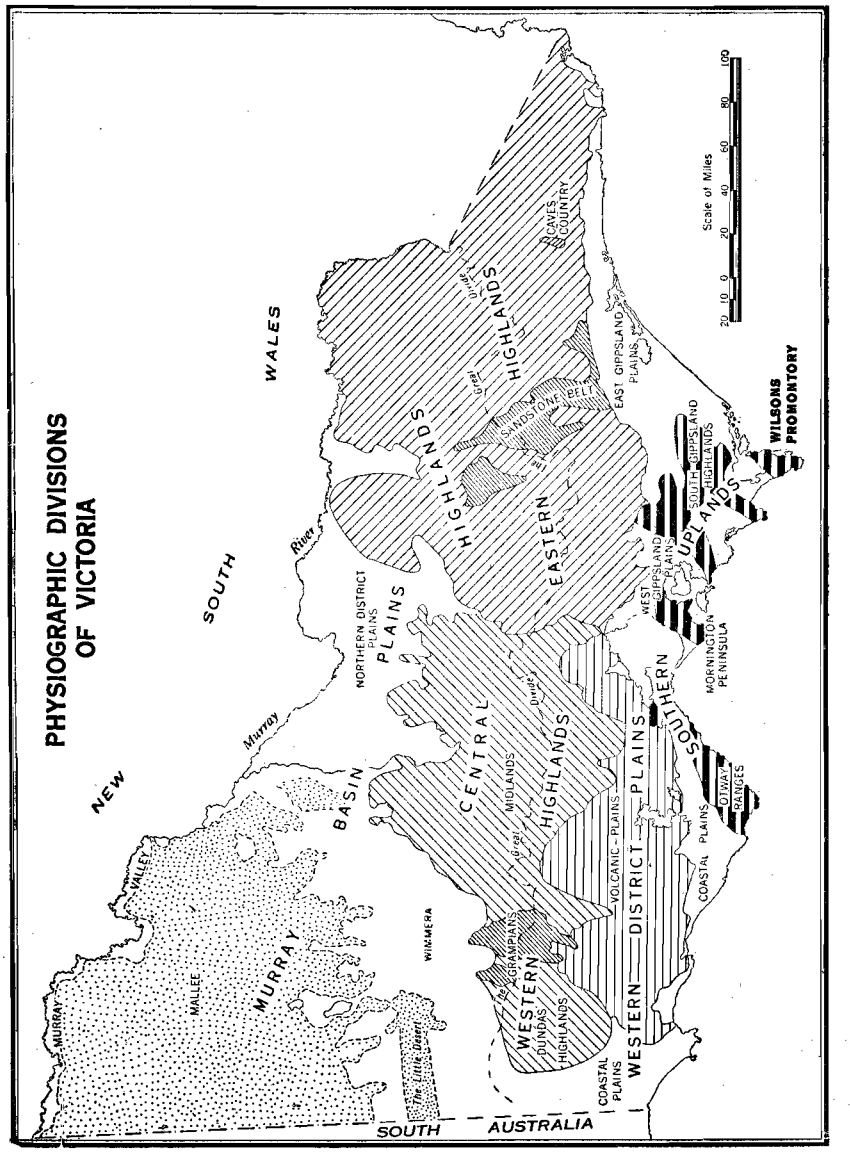


FIGURE 1. Physiographic divisions of Victoria.

5. *Southern Uplands:*
   (*a*) The Otway Ranges
   (*b*) The Barrabool Hills
   (*c*) The Mornington Peninsula
   (*d*) The South Gippsland Highlands
   (*e*) Wilsons Promontory

Murray Basin Plains

These plains include the Mallee, the Wimmera, the Northern District Plains, and the Murray valley itself. The most noticeable distinguishing

features of the Mallee are the soils, vegetation, and topography. It is not a perfect plain, but exhibits broad low ridges and depressions which appear to be due to folding and faulting of the rocks. Sand ridges trending due east and west are an indication of a former more arid climate, but they are now fixed by vegetation. When cleared, the sand distributes itself irregularly without forming new ridges. There is evidence of a succession of former wet and dry periods in the Mallee, but at the present time all the streams entering it lose so much water by evaporation and percolation that they fail to reach the Murray and terminate in shallow lakes, many of which are salt. The Murray valley itself is cut into the higher Mallee land and is subject to periodic flooding by the river.

The Northern District Plains are formed from the combined flood plains of rivers flowing to the Murray, with an average gradient of between 0.6 and 0.9 metres to the kilometre, the surface being almost perfectly flat except where small residual hills of granite rise above the alluvium as at Pyramid Hill.

The Wimmera lies between the Western Highlands and the Mallee and is also composed mainly of river plains, except to the north of the Glenelg where old abandoned river channels contain a succession of small lakes. Most of the lakes of the Murray Basin Plains have crescentic loam ridges (lunettes) on their eastern shores.

Central Highlands

The Central Highlands form the backbone of Victoria, tapering from a broad and high mountainous belt in the east until they disappear beyond the Dundas Highlands near the South Australian border. They were formed by up-warping and faulting. The Eastern Highlands differ from the Western in their greater average elevation, with peaks such as Bogong, Feathertop, and Hotham rising above 1,800 metres, while the Western Highlands are generally lower, the peaks reaching above 900 metres, and the valleys being broader. Also, in the Eastern Highlands patches of Older Volcanic rocks occur, whereas in the Western the volcanic rocks belong mainly to the Newer Volcanic Series. Several well known volcanic mountains are still preserved, Mounts Buninyong and Warrenheip near Ballarat being examples.

Because of the great variety of geological formations in the Central Highlands and the effects of elevation and deep dissection by streams, the features of the country are very varied and there are many striking mountains and gorges. The severe winter climate, with heavy snow on the higher land, is also a special feature of the Eastern Highlands. Included in the area are several high plains such as those near Bogong and the Snowy Plains. Caves are well known in the limestone around Buchan.

In the Western Highlands the Grampians, with their striking serrate ridges of sandstone, may be compared with the belt of sandstone stretching from Mansfield to Briagolong in the east.

The Dundas Highlands are a dome that has been dissected by the Glenelg and its tributaries, the rocks being capped by ancient laterite soils which form tablelands with scarps at their edges.

Western District Plains

Many of the surface features of the Western District Plains are a result of volcanic activity, very large areas being covered with basalt flows of the

Newer Volcanic Series above which prominent mountains rise, many of them with a central crater lake. Some of the youngest flows preserve original surface irregularities practically unmodified by erosion, thus forming the regions known as " stony rises ".

The coastal plains of the Western District are for the most part sandy, the soils being derived from Tertiary and Pleistocene sedimentary deposits, which in places attain a thickness of some 1,500 metres and yield considerable quantities of artesian water.

Gippsland Plains

Continuing the east-west belt of plains on the eastern side of the drowned area represented by Port Phillip Bay and Western Port are the Gippsland Plains. These are underlain by marine and non-marine Tertiary and Pleistocene sedimentary deposits, including the thick seams of brown coal of the La Trobe valley. A notable feature is the Ninety Mile Beach and the lakes and swamps on its landward side. This beach is an offshore bar on which aeolian sand ridges have accumulated.

Southern Uplands

Lying to the south of the plains above mentioned is a group of uplifted blocks for which faulting is mainly responsible, these constituting the Southern Uplands. The Otway Ranges and the South Gippsland Highlands are composed of fresh water Mesozoic and Tertiary sediments with Older Volcanic basalts in south Gippsland, and the Mornington Peninsula is an upraised fault block of complex geology, including granites. The Sorrento Peninsula is entirely composed of Pleistocene calcareous dune ridges which have been responsible for almost blocking the entrance to Port Phillip Bay.

Physical environment and land use

The Central Highland Zone (see fig. 1) is the dominant physiographic region of Victoria. The greatest importance of these Highlands is their influence on the drainage pattern of the State. They act as a drainage division and catchment areas between the long north and north-west flowing rivers that are part of the Murray system and the shorter south flowing rivers. The Highlands are divided into two parts by the 360 metre Kilmore Gap, a natural gateway for transport routes leading north from Melbourne.

Eastern Highlands

To the east, the Eastern Highlands form a broad, rugged region of deeply dissected high plateaux with elevations of up to 1,800 metres. They form a barrier to east-moving air masses, giving rise to heavy orographic rainfall of over 1,300 mm a year in the higher parts. This is the wettest part of the State, and is the coldest region in winter with substantial snowfalls at higher elevations, a factor enabling the development of skiing resorts at locations such as Mt Buffalo, Mt Buller, Mt Hotham, and Falls Creek. Because of the elevation, this is also the coolest part of the State in summer. The rugged topography and dense forest cover of the Eastern Highlands makes them rather inaccessible and of little agricultural potential, so that they are the only large area of Victoria that is very sparsely settled and almost devoid of transport routes. However, the foothill zone adjoining the East Gippsland Plains is an important forestry area, while the lower

slopes and valleys are used for grazing, particularly of cattle. High alpine grassland areas in the north-east, such as the Bogong High Plains, are used for summer grazing, this area being one of the rare cases of a transhumance farming economy in Australia. The high run-off and steep stream gradients have made the Eastern Highlands important for water storage and hydro-electricity generation at Kiewa, Eildon, and Rubicon.

Western Highlands

West of the Kilmore Gap, the Western Highlands are much lower than those to the east. These Highlands culminate in the west in a series of block mountains, of which the Grampians and the Dundas Highlands form the final western outlines of the Highland Zone. Stream gradients are more gentle than in the Eastern Highlands, so that hydro-electricity potential is low. However, the Rocklands Dam and the Eppalock and Cairn Curran Reservoirs are important storages for water supply to farms of the northern plains of Victoria.

The Western Highlands, because of their lower elevation, have a lower rainfall than the Eastern Highlands, and they do not act as a barrier to settlement and transport. The reasonably reliable rainfall of 500 mm to 750 mm a year, cool winters, warm summers, rolling topography, open dry sclerophyll forest and grasslands, and moderately fertile, although thin, volcanic soils offer an environment suitable for sheep grazing for wool and fat lambs, fodder cropping, dairying, and potato growing. Early settlement of the area was stimulated by the gold discoveries of the 1850s and 1860s in the Ballarat and Bendigo districts, and these two cities have developed as important regional centres. Castlemaine, Maryborough, and Clunes are additional service centres.

Murray Basin Plains

North of the Central Highland Zone are the flat Murray Basin Plains (see fig. 1). The western section is comprised of the Mallee–Wimmera Plain, characterised by areas of east-west running sand ridges, grey-brown and solonised Mallee soils, and some areas of sandy wastelands. Rainfall is around 500 mm a year in the southern Wimmera, but it decreases to under 250 mm a year in the north-western Mallee, which is the driest area of the State. As well as being low, rainfall is erratic and unreliable in the Mallee–Wimmera area, but the warm winters and hot summers ensure a year round growing season where water is available. Early farms were too small, and over-cropping led to widespread crop failures and soil erosion. Since the 1930s farming here has become more stable as a result of the provision of adequate and assured water supplies from the Wimmera–Mallee Domestic and Stock Water Supply System, larger farms of over 400 hectares, crop rotations, the development of a crop-livestock farming pattern, the use of superphosphate and growing of legumes to maintain soil fertility, and soil conservation practices. The winter rainfall maximum and dry summer harvesting period, the good rail and road network and bulk handling facilities, and scientific farming techniques have enabled the Wimmera to become a region of high-yielding wheat and mixed farms. The drier areas of the Mallee are characterised more by larger sheep properties.

Of great significance in the Mallee are the irrigation areas of the Mildura–Merbein–Red Cliffs and Swan Hill districts, with close settlement farming growing vines and fruits. Mildura, Ouyen, Swan Hill, Horsham, Warracknabeal, and St Arnaud are the main regional centres of the Mallee–Wimmera Plains.

The Northern District Plains form the narrower eastern section of the Murray Basin Plains. Here rainfall increases from 380 mm a year in the western part to over 750 mm a year in the eastern part of the plain adjoining the Eastern Highlands. Rainfall is more reliable than in the Mallee–Wimmera District. However, there is generally a summer water deficiency which restricts pasture growth, so that the Northern District Plains are characterised by extensive grazing and mixed wheat-sheep farms. Recently there has been increasing emphasis on " ley " farming (i.e., rotation of crops and pastures) in order to increase carrying capacities and productivity. The higher, eastern section of the Northern District Plains with more reliable rainfall is one of the best sheep and cattle grazing areas in the State.

There is a marked contrast in the Northern District Plains between the " dry " farming areas and those closely settled irrigation areas of the Murray and its tributaries, especially in the Kerang, Echuca–Rochester, Kyabram–Shepparton, and Cobram–Yarrawonga areas, using water from the Loddon, Campaspe, Goulburn, and Murray Rivers, respectively. Fruits, vegetables, hops, and tobacco growing with local specialisations, and dairying based on improved pastures are the main activities in the irrigated districts. Shepparton has become an important centre for canned and frozen fruits and vegetables. These areas are also important as suppliers for the metropolitan fresh fruit and vegetable market.

In the Northern District Plains Shepparton, Wangaratta, and Benalla are large and expanding regional centres with manufacturing industries, while Echuca, Rochester, Kyabram, and Wodonga are smaller service centres with a small range of urban functions.

Coastal Region

South of the Central Highland Zone, coastal Victoria is readily divided into three regions.

The first of these is Port Phillip Bay and environs, bounded by the You Yang Range and Keilor Plain in the west, the Central Highlands in the north, the Dandenong Ranges and West Gippsland Plain in the east, and the Mornington Peninsula in the south-east. Melbourne, Geelong, and the developing Western Port area provide port facilities in this region. This region is dominated by the urban areas of Melbourne, which is the hub of the State's transport system, and Geelong. The urban areas are surrounded by intensively farmed rural landscapes in which market gardening is important in addition to cattle and sheep fattening, dairying, and fodder cropping. The bayside beach resorts and the seaside resorts of the Mornington Peninsula are the centre of an important tourist industry.

The second region of coastal Victoria is the extensive volcanic plain stretching westwards from the Port Phillip region. This is possibly the best agricultural region in Victoria. The rolling surface is characterised by volcanic plains and cones, lakes, and stony rises, with rich but shallow

volcanic soils. Rainfall is above 500 mm a year in all areas, with a slight winter-spring maximum, and temperatures are warm in summer and mild in winter so that year round pasture growth and cropping are possible. Western District farms produce cattle, sheep for wool and fat lambs, fodder crops, and potatoes. This is also an important dairying district. Rural population densities, as well as those of the west Gippsland dairying country, are second highest in the State after the northern irrigation districts. Colac, Warrnambool, Portland, Hamilton, and Camperdown are the main regional centres. Portland has modern port facilities.

South of the Western District Plains lie the Otway Ranges, a sparsely populated region of rugged scenery and very high rainfall. The coastline between Anglesea and Apollo Bay has a number of popular tourist resorts.

The third region of coastal Victoria is Gippsland. East of Port Phillip Bay are the West Gippsland Plains, which are sandy in their western section where large areas of swamp have been drained for market gardening. The South Gippsland Highlands, a sparsely populated area of little agricultural potential, is bounded by the West Gippsland Plain and to the east by a fault trough stretching from Warragul to the La Trobe valley (included in East Gippsland Plains in fig. 1). The fault trough with its rolling hills, 750 mm rainfall, and year round pasture, is among the best dairying country on the Australian mainland, supplying the metropolitan wholemilk market. The La Trobe valley towns have experienced rapid post-war development as a result of the brown coal mining operations in the Yallourn–Morwell area.

East of the La Trobe valley, rainfall decreases to below 750 mm a year between Traralgon and the Gippsland lakes. Here the coastline is characterised by sand dunes and lagoons, backed by the riverine plains of the La Trobe, Macalister, Avon, and Mitchell Rivers. The relatively low rainfall necessitates irrigation for cropping. Irrigated farming in the Sale–Maffra, Bairnsdale, and (further east) Orbost districts is based on maize, bean, potato, and fodder growing. Elsewhere the main land use is cattle and sheep grazing.

The plains narrow east of Lakes Entrance when the coastline becomes one of alternating river valleys and hilly headlands where the Eastern Highlands protrude south to the sea. Forestry is the main activity here, with some grazing and fodder cropping in the valleys and foothills. Tourism is important in the area around Lakes Entrance, which is also a fishing port. Gippsland is linked with Melbourne by the Princes Highway and by rail as far east as Orbost.

Mountain regions

The mountainous regions of Victoria comprise the Central Highlands and a belt known as the Southern Uplands lying to the south and separated from the Central Highlands by plains.

The Central Highlands form the backbone of Victoria, tapering from a broad and high mountainous belt in the east until they disappear near the South Australian border. In the eastern sector patches of Older Volcanic rocks occur and peaks rise over 1,800 metres, while in the western sector the volcanic rocks belong mainly to the Newer Volcanic Series and the peaks reach 900 metres.

The Highlands descend to plains on their southern and northern flanks. On the south are the Western District Plains and the Gippsland Plains, and beyond these again rises a group of uplifted blocks constituting the Southern Uplands. The Otway Ranges and the hills of south Gippsland are composed of fresh water Mesozoic sediments and Tertiary sands and clays with Older Volcanic rocks in south Gippsland, and the Mornington Peninsula is an upraised fault block of complex geology, including granites.

By 1875 the mountainous areas of the State were embraced by a geodetic survey which had been started in 1856. This was the first major survey, although isolated surveys had been carried out as early as 1844. Further surveys were carried out by the Australian Survey Corps during the Second World War, and by the Department of Lands and Survey in the post-war years. Most recent values for some of the highest mountains in Victoria are Mt Bogong, 1,986 metres ; Mt Feathertop, 1,922 metres ; Mt Nelse North, 1,883 metres ; Mt Fainter South, 1,877 metres ; Mt Loch, 1,874 metres ; Mt Hotham, 1,861 metres ; Mt Niggerhead, 1,843 metres ; Mt McKay, 1,843 metres ; Mt Cobberas No. 1, 1,838 metres ; Mt Cope, 1,837 metres ; Spion Kopje, 1,836 metres ; and Mt Buller, 1,804 metres.

Victoria's mountain regions, 1962

Rivers

Stream discharges

Water is a limited resource and a major factor in the development of the State, hence a knowledge of its water resources is essential to their optimum use. Tabular data giving the mean, maximum, and minimum discharges at selected gauging stations are published by the State Rivers and Water Supply Commission in *Victorian River Gaugings to 1969,* containing records of 299 gauging stations.

An average value such as the mean annual discharge is a useful relative single measure of magnitude, but variability is equally important. A crude measure of variability is given by the tabulated values of the maximum and minimum annual discharges ; however, the difference between these extremes, termed the " range ", will increase with increasing length of record.

Drainage areas and lengths

Other characteristics relating to streams are the size of the catchment and the lengths of the rivers. Drainage areas of gauged catchments are given in *Victorian River Gaugings to 1969,* and the lengths of 230 rivers are tabulated on pages 31–5 of the *Victorian Year Book* 1963.

Drainage areas may be regarded as the hydrologically effective part of a " basin ", or the area from which there is " run-off " to the stream. Thus, the whole of any area may be subdivided into basins, but parts of some basins may be regarded as non-effective, being either too flat or the rainfall too small to contribute to normal stream flows. There is little or no contribution in the north-west of the State where the annual rainfall is less than 457 mm to 508 mm. Above this amount, roughly half the rainfall appears as stream flow.

Total flow

The current estimate of mean annual flow is 20,910 million cubic metres each year, about half of which flows into the Murray, the other half flowing

southward to the Victorian coast. The geographic distribution of flow is heavily weighted towards the eastern half where the total flow is about 17,220 million cubic metres (with about 9,840 million cubic metres in the north-east and 7,380 million cubic metres in the south-east), hence leaving 3,690 million cubic metres in the western half.

VICTORIA—MAIN STREAM FLOWS

Div.	Basin	Stream	Site of gauging station	Drainage area (sq kilometres)	Year gauged from	Annual flows in million cubic metres			
						No. of water years	Mean	Max.	Min.
IV. Murray-Darling	1	Murray	Jingellic, N.S.W.	6,527	1890	80	2,368	6,123	675
	1	Mitta Mitta	Tallandoon	4,716	1935	34	1,269	3,214	273
			Tallangatta	5,058	1886	49	1,411	4,256	250
	2	Kiewa	Kiewa	1,145	1886	84	632	2,071	166
	3	Ovens	Wangaratta	5,827	1941	29	1,572	4,143	221
	4	Broken	Goorambat	1,924	1887	84	247	1,091	19
	5	Goulburn	Murchison	10,772	1882	88	2,139	7,369	145
	6	Campaspe	Elmore	3,212	1886	78	236	820	1
	7	Loddon	Laanecoorie Reservoir	4,178	1891	78	231	740	9
	8	Avoca	Coonooer	2,642	1890	80	76	395	3
	15	Wimmera	Horsham	4,066	1889	77	128	589	..
II. South East Coast	22	Snowy	Jarrahmond	13,421	(*a*)1922	33	1,814	4,002	381
	23	Tambo	Swifts Creek	943	1965	5	58	121	21
	24	Mitchell	Glenaladale	3,903	1938	32	921	2,188	193
	25	Thomson	Cowwarr	1,088	1901	50	400	680	175
	25	Macalister	Lake Glenmaggie	1,891	1919	51	496	1,533	45
	26	La Trobe	Rosedale	4,144	(*b*)1901	55	940	3,240	271
	28	Bunyip	Bunyip	661	(*c*)1908	47	153	304	69
	29	Yarra	Warrandyte	2,328	(*d*)1892	52	804	1,494	176
	30	Maribyrnong	Keilor	1,303	(*e*)1908	39	107	327	4
	31	Werribee	Melton Reservoir	1,155	1917	53	79	314	7
	32	Moorabool	Batesford	1,114	(*f*)1908	24	70	221	1
	33	Barwon	Inverleigh	1,269	1966	4	58	102	7
	35	Carlisle	Carlisle River	78	(*g*)1930	33	38	87	6
	36	Hopkins	Wickliffe	1,347	(*h*)1921	38	32	127	1
	38	Glenelg	Balmoral	1,570	(*i*)1889	60	144	540	3

Source: *Victorian River Gaugings to 1969*, State Rivers and Water Supply Commission.

NOTE. Years excluded in estimating mean :

(*a*)	1949–50 to 1963–64	(*e*)	1933–34 to 1955–56
(*b*)	1919–20 to 1928–29 and 1934–35 to 1936–37	(*f*)	1921–22 to 1958–59
		(*g*)	1943–44 to 1946–47
(*c*)	1951–52	(*h*)	1933–34 to 1943–44
(*d*)	1933–34 to 1958–59	(*i*)	1933–34 to 1938–39

Location of streams

The location of about 2,500 streams in Victoria may be obtained by referring to the *Alphabetical Index of Victorian Streams* compiled by the State Rivers and Water Supply Commission in 1960. Owing to the replication of names for some streams, there are over 2,900 names ; these have been obtained by examining Department of Crown Lands and Survey and Royal Australian Survey Corps maps, so as to include names which have appeared on them. There are, in addition, many unnamed streams, those with locally known names, and those named on other maps or plans. No attempt was made in the *Index* to suggest a preferred name ; this is a function of the committee appointed under the *Survey Co-ordination Place Names Act* 1965.

Stream reserves

In 1881, under the then current Land Act, an Order in Council created permanent reserves along the banks of streams where they passed through

Crown land. These are scheduled in the *Township and Parish Guide* reprinted by the Lands Department in 1955. This schedule indicates the location and width of reservations for 280 streams which (except for the Murray) are 20, 30, or 40 metres wide on *each* bank of the stream. The areas thus reserved were not fully delineated until subsequently surveyed prior to alienation.

Further reference, 1964

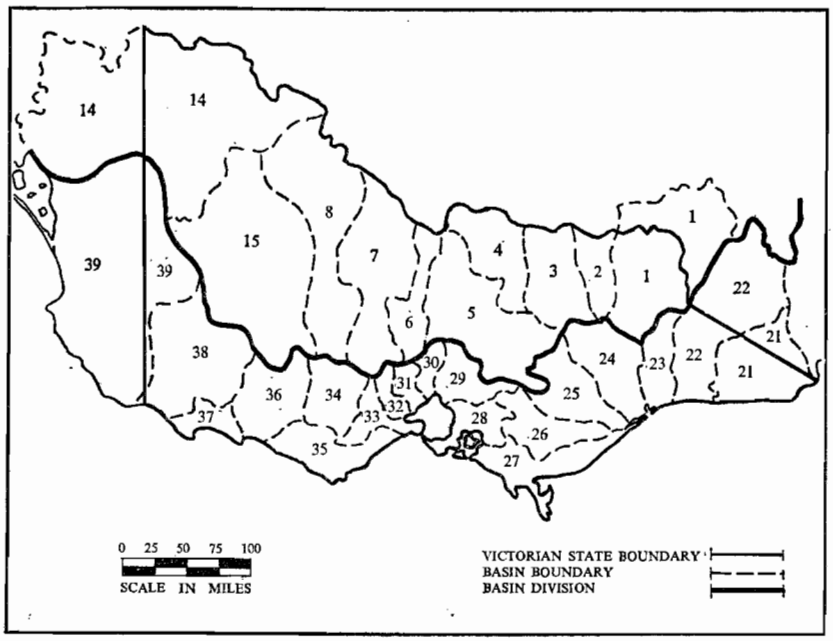


FIGURE 2. Relevant basins of the two Divisions (South East Coast Division and Murray–Darling Division) which include Victoria and some adjacent areas. The basins are numbered as shown on Map 3 (Sheet 2) in *Review of Australia's Water Resources*, published by the Department of National Development, 1965.

SOUTH EAST COAST DIVISION

21. East Gippsland
22. Snowy River
23. Tambo River
24. Mitchell River
25. Thomson River
26. La Trobe River
27. South Gippsland
28. Bunyip River
29. Yarra River
30. Maribyrnong River
31. Werribee River
32. Moorabool River
33. Barwon River
34. Lake Corangamite
35. Otway
36. Hopkins River
37. Portland
38. Glenelg River
39. Millicent Coast

MURRAY–DARLING DIVISION

1. Upper Murray River
2. Kiewa River
3. Ovens River
4. Broken River
5. Goulburn River
6. Campaspe River
7. Loddon River
8. Avoca River
14. Mallee
15. Wimmera–Avon River

Floods

The natural history of unregulated rivers is largely the history of their floods and droughts. Rainfall intensity increases with decrease in latitude and consequently Victoria is less subject to floods than the northern States. The practical importance of floods is, however, largely related to the damage they do in occupied areas.

Flood damage usually occurs because of the occupation of flood plains, and once occupied there is a demand for protection which is commonly provided by levees. Such levees have been constructed along the major streams including the Murray, Snowy, and Goulburn, and also in urban areas occupying the flood plain of the Dandenong Creek. The objection to levees is that by restricting the flood plain, the flood level for a given discharge is increased, and if overtopping does occur, damage is more serious. Other flood mitigation measures used in Victoria, such as straightening the stream to increase the gradient and flow rate, have also been used on such streams as the Bunyip and the Yarra. Provision to prevent excessive scour may be necessary in some cases.

Lake level changes

Another form of flood damage that has occurred in the Western District is due to the increase in level of closed lakes flooding marginal land. This has been caused by a series of wet years since 1950 upsetting the normal balance between evaporation and inflow. In the decade from 1950 the winter rainfalls in the region of Lake Corangamite were 15 per cent above average, and the lake level rose 3.4 metres above its normal level of 116 metres to 119 metres to inundate about 51.8 square kilometres of adjacent land.

To reduce the inflow to this lake and hence the area flooded, a 45 kilometre channel, completed in 1959, diverts water to the Barwon River from the Cundare Pool. This pool, which was formed by building a low barrage across a shallow area at the head of the lake, acts as a temporary storage for the relatively fresh waters of the Woady Yaloak River which normally enter the lake.

The rate of diversion is governed by the level of the Cundare Pool and by the relative salinities of water in the pool and in the Barwon River. If the 73.8 million cubic metres diverted in 1960 had entered Lake Corangamite, the lake level would have been 229 millimetres above the maximum observed level. The level would have been almost as high again in late 1964—another very wet year—but for the diversion in the preceding five years of about 221.4 million cubic metres. These wet years have maintained the relatively high lake level.

Legislation has been passed to permit the Government to pay compensation on a special scale to landowners who may elect to surrender land up to 118 metres above sea level around Lake Corangamite, plus any higher land rendered inaccessible to the landowner by the initial surrender. The legislation also makes similar provision for the neighbouring Lakes Gnarpurt and Murdeduke.

Other floods

Owing to the tendency for major floods to overflow the banks and, in flat country, to pass down other channels which may not rejoin the main stream, it is often difficult to determine even the relative magnitude of major floods. The difficulty is magnified by the necessity for maintaining records of the level of the gauge in relation to a permanent datum, if a true comparison is to be made.

The year 1870 is regarded as the wettest Victoria has experienced for over a century. As there were only thirteen rainfall stations whose records

are available, the estimated average of 950 mm over the State is crude, but is 80 mm more than the next highest figure of 870 mm for 1956. River gauges in 1870 were practically restricted to the Murray, and consequently flood estimates on other streams are crude and can only be inferred from dubious evidence. Furthermore, subsequent to the 1870 floods, levees were constructed along the Goulburn and other streams and consequently heights of subsequent floods were augmented by the restrictions imposed.

In the north-east, floods occurred in the years 1906, 1916, 1917, and 1956. Although records of flood flows at gauging stations on the main streams have been published, such estimates are open to correction in the light of more recent evidence. Owing in part to under-estimation of earlier floods, the protection at the S.E.C. works at Yallourn was inadequate and the 1934 flood overflowed the banks of the La Trobe into the open cut at Yallourn. This flood was caused by a storm which is, on the basis of rainfall over large areas, the most severe to have been recorded within Victoria. An earlier storm of December 1893 which occurred over east Gippsland was heavier, but this also covered part of New South Wales.

Lakes

Lakes may be classified into two major groups : those without natural outlets which are called closed lakes, and those with a natural overflow-channel which may be termed open lakes. For closed lakes to form, annual evaporation must exceed the rainfall : this is the case over most of Victoria.

Closed lakes occur mainly in the flat western part of the State. They fluctuate in capacity much more than open lakes and frequently become dry if the aridity is too high. Lake Tyrrell in the north-west is usually dry throughout the summer and can consequently be used for salt harvesting.

The level of water in an open lake is more stable because as the lake rises the outflow increases, thus governing the upper lake level and partially regulating streams emanating from it. This regulation enhances the economic value of the water resources of open lakes but Victoria does not possess any natural large lake-regulated streams. However, there are small streams of this type in the Western District, such as Darlots Creek partly regulated by Lake Condah and Fiery Creek by Lake Bolac.

Salinity is often a factor which limits the use of lake water ; even the use of freshwater lakes is not extensive in Victoria due to the cost of pumping. The average salinity of closed lakes covers a wide range depending upon the geological conditions of the catchments and the water level.

Lake Corangamite is Victoria's largest lake. It can be regarded as a closed lake although during the wet period in the late 1950s it rose to within 1.2 metres of overflowing. The total salt content is about 16.32 million tonnes, giving the lake a salinity somewhat higher than seawater under average water level conditions.

The Gippsland lakes are a group of shallow coastal lagoons in eastern Victoria, separated from the sea by broad sandy barriers bearing dune topography, and bordered on the ocean shore by the Ninety Mile Beach. A gap through the coastal dune barrier near Red Bluff, which was opened in 1889, provides an artificial entrance to the lakes from the sea. How-

ever, sea water entering this gap has increased the salinity of some lakes, which in turn has killed some of the bordering reed swamp and led to erosion. The Gippsland lakes have been of value for commercial fishing and private angling and also attract many tourists. Coastal lagoons of this type rarely persist for more than a few thousand years and as deposition of sediment proceeds and bordering swamps encroach, the lakes will gradually be transformed into a coastal plain.

A number of Victorian lakes and swamps have been converted to reservoirs. Waranga Reservoir is an example of this, as are Lake Fyans, Batyo Catyo, and Lake Whitton in the Wimmera. A good example of lake utilisation is the Torrumbarry irrigation system on the riverine Murray Plains near Kerang in north-west Victoria.

Further reference, 1965; Natural Resources Conservation League, 1965

SURVEYS AND MAPPING

The Survey and Mapping Division of the Department of Crown Lands and Survey is responsible for the development of the National Geodetic Survey within Victoria; the preparation of topographic maps in the standard map form; the survey of Crown lands under the provisions of the *Land Act* 1958; the co-ordination of surveys throughout the State under the provisions of the *Survey Co-ordination Act* 1958; surveys for the Housing Commission, the Rural Finance and Settlement Commission, and other departments and authorities; and the documentation of these surveys.

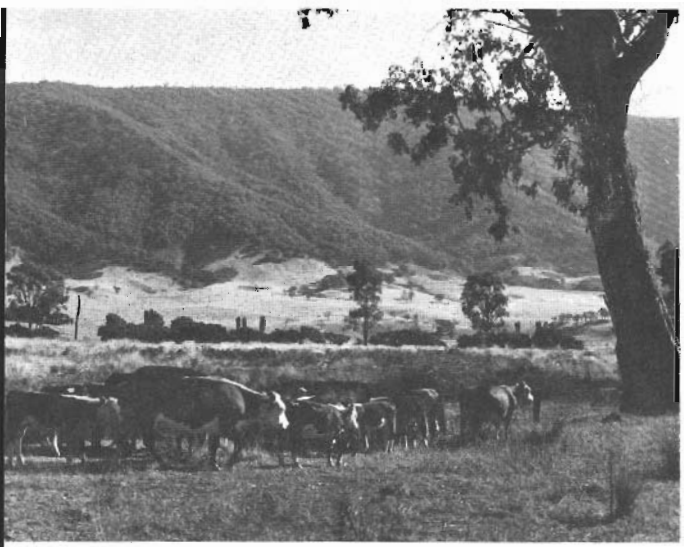
An Australia-wide primary geodetic survey was completed in 1966, and in Victoria this is continuously being intensified to provide a framework of accurately fixed points for the control of other surveys and for mapping. A State-wide network of levels was completed in 1971. The datum, based on mean sea level values around the whole coast of Australia, is known as the Australian Height Datum (AHD), and its adoption obviates the multitude of local datums formerly in use throughout the State. Lists of level values on the AHD in metres are available.

An official map of Victoria showing highways, roads, railways, watercourses, towns, and mountains, together with other natural and physical features, has been published in four sheets at a scale of 1 : 500,000. A less detailed map of Victoria is also available in one sheet at a scale of 1 : 1,000,000. Topographic maps at a scale of 1 : 250,000 providing a complete map coverage of the whole State have been published by the Division of National Mapping of the Department of Minerals and Energy and the Royal Australian Survey Corps. A joint State–Australian Government mapping project, commenced in 1966, is proceeding with the production of topographic maps at a scale of 1 : 100,000 with a 20 metre contour interval. A number of these maps have been published, and a complete map coverage of the State in this series is expected by the end of 1976. The Mines Department and the Forests Commission also contribute to State mapping by publishing maps for geological and forestry purposes.

A series of 22 maps at a scale of 1:25,000 showing streets, rivers, creeks, and municipal boundaries in Melbourne and its suburban area has been produced. A long-term programme for the production of general purpose standard topographic maps, at 1 : 25,000 scale with a 10 metre contour interval, has been planned to extend this map coverage over the greater

SOIL CONSERVATION IN VICTORIA

Victoria's alpine and highland country provides much of Australia's water supplies.



Pastoral land in environmental balance with protective forest ensuring stability of the steep mountain slopes.

Beach dunes restored to stability by planting of marram grass ensure preservation of the beach at Anglesea.

A 1955 demonstration of aerial topdressing techniques used in upgrading pasture growth on steeply sloping, cleared hill country.

Contour banks on sloping land prevent rill and sheet erosion after cultivation.

Drifting sand blocked the Calder Highway in the northern Mallee in 1945. The horses and scoop had been working for a week to open the road to the extent shown in this picture.

A modern earthmover levels a Mallee sand dune in a few hours, preparatory to planting with cereal rye to stabilise the light, sandy soil.

Previously threatened by drifting sand, the railway line is secure because of the stabilising grasses. Adjoining farmlands have been similarly stabilised and have returned to high productivity.

Typical farmland in Western Victoria.

(Top) Thinly grassed pastures have caused accelerated run-off of storm water, and serious gully erosion has resulted. The two concrete structures have been built to prevent the gully head extending.
(Bottom) The pastures have been upgraded to receive and hold more water ; silt traps in the gully have raised the level of the gully bed ; plantings of the gully floor and banks have stabilised them and erosion no longer threatens large areas of now highly productive pasture.

metropolitan area, and to embrace many of the larger provincial centres. Other maps of urban and suburban areas at 1 : 10,000 scale showing full subdivisional information, are being prepared of the Mornington Peninsula area; similar maps of various rural centres are on programme in conjunction with Australian Government maps at the same scale required for census purposes.

Large scale base maps have been prepared for rapidly developing areas throughout the State, including the outer metropolitan area, Mornington Peninsula, Geelong, Ballarat, Bendigo, Phillip Island, and a number of other rural areas. These maps were originally compiled at a scale of 1: 4,800 (400 feet to 1 inch) with a 5 foot contour interval. However, with the introduction of the metric system, all new maps will be prepared at a scale of 1 : 5,000, generally with a 2 metre contour interval. The publication *Official Map and Plan Systems Victoria* has been issued setting out the standard format size and numbering systems which have been adopted for the production of maps and plans at the standard scales of 1 : 10,000, 1 : 5,000, 1 : 2,500, 1 : 1,000, 1 : 500, and 1 : 250. The systems are based on the Australian Map Grid (AMG), which fulfils the basic principles necessary for the complete integration of surveys.

The Division carries out cadastral surveys of Crown lands for the purpose of defining boundaries and for determining dimensions and areas of reservations and of allotments for the subsequent issue of Crown grants. This information forms the basis for the compilation of county, parish, and township plans, which are published at various scales and show details of the original subdivision of Crown lands. Recently further investigations have been made with the object of introducing a fully integrated topographic-cadastral map and plan system. Although cadastral requirements may result in the publication of plans using an additional range of scales, it will be a fundamental principle that the Australian Map Grid will be the basic framework of their compilation.

As part of its mapping activity the Department provides an aerial photography service, and maintains an aerial photography library of approximately 300,000 photographs from which prints and enlargements may be obtained. Maps, plans, and aerial photographs are available for purchase from the Central Plan Office of the Department.

Further references, 1965, 1969; Coastline, Hydrography, 1966; Coastal physiography, 1967; Plant ecology of the coast, 1968; Marine animal ecology, 1969; Marine algae of the Victorian coast, 1970; Erosion and sedimentation on the coastline, 1971; Conservation on the Victorian coast, 1972