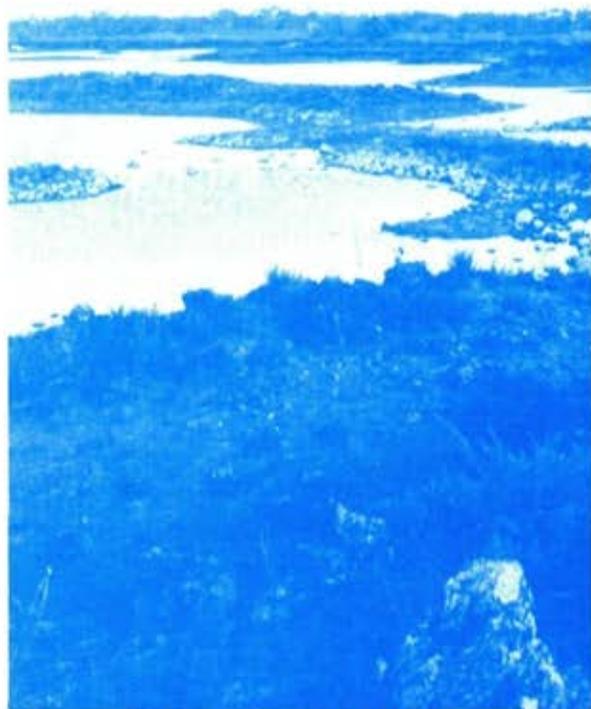


# RIVERS AND STREAMS

SPECIAL INVESTIGATION

## PROPOSED RECOMMENDATIONS



LAND CONSERVATION COUNCIL

# **RIVERS AND STREAMS**

———— SPECIAL INVESTIGATION ————

## **PROPOSED RECOMMENDATIONS**

NOVEMBER 1990

**LAND CONSERVATION COUNCIL**

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## Cover Photographs

### Top left

*Lake Condah — Darlot Creek (Basin 37):*

*Significant Aboriginal Associations — extensive fish traps and 'stone house' complex constructed from abundant scoria produced by the Mount Eccles lava flows. Wetland habitat value is currently being restored.*

### Bottom left

*River Murray — Barmah Forest (Basin 4):*

*Wetland of international significance for migratory birds, at a national level for flora and State level for fauna. A mosaic of river red gum forests, wetlands and associated plant communities provide high-value scenery, nature observation, camping, walking and canoeing, as well as timber. Significant cultural features are common.*

### Top right

*Snowy River (Basin 22):*

*Major white water recreational resource providing for driving, camping, canoeing, and walking. Many reaches have high scenic value with spectacular gorges and waterfalls. Nature conservation values are high with geological features of national significance found along its course and essentially natural tributary catchments.*

### Bottom right

*Victoria River Falls (Basin 1):*

*Across the State waterfalls are important high-value scenic focal points for recreationists. The upstream reach of Victoria River has riparian vegetation values significant at a State level.*

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# Introduction

The Land Conservation Council, Victoria — established by the *Land Conservation Act 1970* — carries out investigations and makes recommendations to the Minister for Planning and Urban Growth on the use of public land in order to provide for the balanced use of land in Victoria. In making its recommendations, Council must have regard to both the present and future needs of the people of Victoria, in relation to criteria emphasising the need to protect significant conservation and recreation values.

Council has also taken the view that it must achieve a balance between these and other community needs of public land seen from local, regional, State, and national perspectives. As part of this, it must provide for legitimate uses such as the harvesting of forest produce and mineral extraction.

## Rivers and Streams Investigation

In June 1987, the government directed the Land Conservation Council to conduct a Special Investigation of Victoria's Rivers and Streams, in accordance with the following Order in Council:

'Under Section 8 of the *Land Conservation Act 1970* the Council is required to carry out an investigation of the scenic, recreational, cultural and ecological values of rivers and streams in Victoria, and to make recommendations on the use of these rivers and how their identified values can best be protected.'

Notices announcing the commencement of the Investigation were published in the *Victoria Government Gazette* and in Victorian newspapers in November 1987.

In September 1989, the Council published the 'Rivers and Streams Special Investigation — Resources Report', which described the natural, cultural heritage, recreational, and scenic values of Victoria's rivers and streams. Its purpose was to ensure that everyone who had an interest in the future use of our waterways and their catchments could obtain and study the basic information that the Council itself studied, and provide a submission on the report and its contents. A list of those who made submissions is provided in Appendix I.

Council's response to those submissions is given below.

These proposed recommendations are published to provide a basis for public comment. A further 90-day submission period now follows and you are encouraged to submit your comments on these proposals, copies of which have been distributed to all who made submissions on the Resources Report. The present recommendations are the next stage of the process followed by the Council in accordance with the *Land Conservation Act 1970*.

After this 90-day submission period, and following consultation with community and user groups, the Council will prepare its final recommendations and present them to the Minister for Planning and Urban Growth for consideration by the government.

## Availability of submissions

Submissions received by the Council are available for inspection at the Council's offices, 1st Floor, 477 Collins Street, Melbourne.

Author confidentiality may be requested; that is, the content of a submission may be made available for public inspection after removal of any information that would identify the author. It is suggested that persons wishing to make a confidential submission contact the Chairman of the Council.

## Reasons for this Investigation

Clean water, along with clean air and food, are fundamental to society. For thousands of years humans have sought to control the flow of rivers to our direct advantage. As a result, our dryland areas have bloomed, floods have been reduced, and we have developed cities and industries that utilise large quantities of water. Hydro-electricity resources have also been developed. Societies are now recognising, however, that these benefits have had costs for the rivers.

This century — with the advance of concrete technology, heavy earth-moving equipment, high-capacity pumps, and the availability of capital — changes to rivers, wetlands, and ground-water tables have taken place at an unprecedented rate.

While Victoria has enjoyed the benefits of

water resource development and the resultant economic growth, this growth has not been without adverse environmental and economic impacts. Construction of numerous weirs and dams has substantially changed the flow of many rivers. Rather than reflecting natural processes, river flows increasingly reflect human requirements, and as a result many natural systems have been put at risk.

Our rivers have also been adversely affected by the discharge of a variety of effluents arising from offstream domestic, industrial, and agricultural uses of water. Land use practices also have an impact. For example, land degradation, the addition of increased amounts of sediment to streams, and dryland salting have resulted from past land use. The salt not only makes an affected area unsuitable for agriculture but also adds to the salt load of the river, decreasing its suitability for irrigation or domestic consumption further downstream.

Collectively, land uses, polluting discharges, and flow regulation have often reduced the scenic, recreational, and other values of rivers. They may also have economic implications where they restrict the downstream use of water, or affect the sustainability of important industries, or the attractiveness of areas with significant recreational or tourism values.

Debates in Australia reflect differences of opinion over the appropriate use of water and surrounding land. The flooding of Lake Pedder and the proposed flooding of the lower Gordon and Franklin Rivers in Tasmania became major issues. In Victoria, controversies over proposals to dam the Murray at Chowilla, to build a storage at Yarra Brae, and to divert the Aberfeldy at Donnelly Creek are reviewed in Dr J. Powell's 1989 book 'Watering the Garden State'. This work also discusses the 1964 proposal to divert Big River water to Melbourne, resulting in Premier Bolte's pronouncement that 'not one drop' of water would cross the Great Dividing Range. More recently, plans to dam the Mitchell River at or below Angusvale and proposals to extract additional water from the Snowy River have aroused concern. The debates have emphasised the need to consider all values, be they economic return, flora, fauna, scenery, recreation, or cultural heritage, when deter-

mining appropriate water and associated land use.

Increases in population and leisure time are likely to place increased demands on public land and resources, as people seek those recreational opportunities provided only by public land. Further, the continued or increased commercial use of both public and private land will make the remaining natural areas even more important for the maintenance of biological diversity.

This Investigation provides a unique opportunity to identify the values present along rivers across Victoria and to plan for the protection of rivers of special significance while the opportunity remains, so that those values can be used and enjoyed by present and future generations.

Public land in this Investigation includes the beds and banks of rivers and streams, their frontage reserves, and public land in their catchments. An integral feature in any consideration of the land is its associated water, and these proposed recommendations embrace water as a public land resource, and as a component of each of the values.

This is consistent with previous Council recommendations for other resources and values associated with land such as timber, flora, fauna, recreation, and landscape.

### **The major government strategies**

The Victorian government has developed three integrated strategies. These relate to social justice, economic development, and conservation. The Social Justice Strategy provides for equity through fairness of access to goods and services, opportunities for people to participate in decisions that affect them, and the protection of people's rights. The Economic Strategy aims at improving Victoria's economic competitiveness through improvement of the State's economic environment, and the identification and development of its competitive strengths.

The government's State Conservation Strategy outlines a philosophy and a program of actions designed to protect and enhance our natural and cultural heritage. Recognising the values of rivers and the impacts of past uses, the Strategy outlines initiatives to protect river values, to provide for environmental flows, and to

improve river frontage management, and also certain other actions.

This Investigation contributes to the implementation of actions identified in that Strategy specifically in relation to the development of a Heritage Rivers Program (described in Chapter 2 of the Resources Report), which will help to:

- protect those rivers and streams that remain in an essentially natural condition
- ensure that rivers and streams of special scenic, recreational, cultural, and environmental value are maintained in at least their present condition
- ensure that representative examples of all stream types in the State are protected

The recommendations proposed for public land, including rivers and streams and river frontage reserves within the Council's jurisdiction, are set out in the following chapters. They apply solely to public land within that jurisdiction — that is, public land outside cities and rural cities.

The Council has made no recommendations for private land.

The Council has drawn together information about river values across the whole State, and has developed a procedure for evaluating this information. It would be appropriate that the same information base and procedures be used for private land along streams. This is not the role of the Council, but if such an investigation were to take place, community representatives — for example, from farming, local government, conservation, recreation, and cultural heritage interests — should be involved in further development of the Heritage River Program.

## Information sources

In formulating its proposed recommendations Council has used information from a range of sources. This includes data collected by consultants on economic resources and on recreational, scenic, ecological, and cultural values as well as from other water-sector studies. The latter include: the 'State of the Environment Report 1988 — Victoria's Inland Waters'; projects carried out for the then Department of Water Resources' South-east and South-west Water Management Strategies; and 'Water Victoria: an Environmental Handbook',

and 'Water Victoria: a Resource Handbook', both recently published by the Office of Water Resources.

Information has come from submissions, from government departments, public authorities, and interested individuals and organisations, and from published reports and other sources.

The methods used to identify and assess the values associated with watercourses across Victoria are described in detail in the Resources Report. The Report has been distributed to regional public libraries and shire offices throughout Victoria. It can also be inspected at the Department of Planning and Urban Growth Library, Ground Floor, 477 Collins Street, Melbourne, and purchased from the bookshop at the same address. (The accompanying pamphlet details other sales and mail order outlets.) The Resources Report briefly describes:

- an outline of past use and administration of water in Victoria
- the geomorphic, hydrologic, and ecological characteristics of catchments and their drainage networks
- special values of rivers and streams for scenery, recreation, and the maintenance of ecological and cultural values
- existing and potential land and water uses

If you require further detail on specific values, you should consult the source documents cited in the Report.

Maps showing the values, in the Report, use as bases the Australian Water Resources Council (AWRC) river basins (see glossary). The proposed recommendations for heritage rivers and essentially natural catchments are listed in river basin order.

## Social and economic assessment

To assist in assessing the implications of its proposed recommendations, Council commissioned a study by consultants: Read Sturges and Associates, in association with Midas Consulting and members of the Resource and Environmental Economics Group, Latrobe University. These consultants conducted an independent appraisal of the social and economic costs and benefits of protecting the values of specified candidate river corridors and essentially natural catchments. Their results were available to Council when it met to

finalise its proposed recommendations. Extracts from the appraisal are provided in this volume for each proposed heritage river, and a summary is given in Appendix II. The full text (Read Sturgess et al. 1990) has not been published, but can be borrowed as an interlibrary loan from the Department of Planning and Urban Growth Library, or can be inspected at the Council's offices.

Government agencies with responsibilities for water, timber and mineral resources, and agricultural and industrial developments provided information to assist the consultants, who also had access to a systematic description of the available timber resources that the draft recommendations might have affected (Sheahan 1990). This report can also be inspected at the Council's offices.

In seeking an independent appraisal, Council requested that the consultants assess any implications of all resource and development issues.

For public land water frontage reserves along the heritage rivers, these recommendations have no implications for resource use beyond the existing approved recommendations applying to frontage reserves. The consultants have collected information that quantifies the areas and boundary lengths of such reserves.

These recommendations specify that the provision of environmental and recreation flows be investigated for certain rivers that are highly regulated. To inform Council, the consultants have calculated the costs, either by purchasing water at irrigation prices or by providing water through new works, of meeting nominal 'environmental' flows in these rivers. The Council has not recommended that these flows be provided, as studies into the technical determination of suitable flows and into the engineering feasibility of providing them, have not yet been completed. Accordingly, the consultants' dollar values are illustrative, and do not represent implications of these recommendations.

With regard to mineral exploration and mining, the recommendations for heritage rivers conform with the existing Council policy. Under this policy (see section F12), unless specifically excluded (reference areas, national parks, etc), public land is generally available for exploration and mining, with the exception

of sensitive or high-value areas, which are identified on a proposal- and site-specific basis. While the consultants have estimated future returns from possible mining operations along the proposed Heritage Rivers, under the Council's policy it cannot be held that these operations would be precluded. Accordingly the resource implications must be qualified.

In assessing implications for industry, for each heritage river the consultants interviewed relevant departmental officers and representatives from companies involved in large proposals. The results indicate no identifiable implications for industry, other than for the following two proposals. A possible wood pulp mill in the Orbost area would require substantial volumes of water. These recommendations, while specifying that no barriers be built on the Snowy River, would not preclude the diversion of water during high flows to an offstream storage. The Gippsland route for the Very Fast Train, if approved, would necessarily cross the Mitchell and Snowy river corridors. Special care would need to be taken at these crossings to minimise any impact on the river values.

## **Council's Response to Submissions Arising from the Resources Report**

Following the publication of the Resources Report, Council received 75 submissions during the public consultation period on the future use of rivers and streams in Victoria, and over 30 subsequent letters providing further information, opinions, and comment (see Appendix I).

Council wishes to acknowledge the significant time and effort put into the preparation of these submissions. Individuals, associations, and local and State bodies, representing a cross-section of the community, made helpful submissions and contributed new information about river values and potential uses and conflicts.

Through submissions and telephone inquiries, a number of people and organisations indicated that they would make a comprehensive response when Council published specific proposals. The recommendations in this book are specific and Council now looks forward to

receiving these detailed responses. The following section broadly mirrors the recommendation structure.

The majority of submissions acknowledged the importance of rivers and streams, as well as the need to protect their values and the resources they provide to the community. Many also recognised that the degradation of rivers and adjacent land had led to economic and environmental losses and that programs to restore the balance were urgently required. Submissions outlined a variety of solutions to resolve land use conflicts, to accommodate the continued resource uses of rivers and their catchments, and to protect and restore a wide range of environmental values.

In these proposals, Council has made specific provision for the protection of outstanding river corridors and essentially natural catchments. It has also made recommendations to improve the quality and values of streams and their frontages across the State. It recognises that the Department of Conservation and Environment, and other government agencies, have established programs to restore and enhance rivers. Community involvement in these programs is of primary importance. Council acknowledges the role of catchment coordinating groups and supports the concept of integrated catchment management, as did a number of the submissions. However, this approach, covering both public and private land, is broader than Council's, and so these proposed recommendations for public land should be viewed as only part of a range of government and community strategies for rivers and catchments.

### **Heritage rivers — values and nominations**

Many of the submissions contained additional information about the values of particular rivers across the State. Some listed one or more streams considered to be of heritage river status. Not surprisingly, these included many streams in the east of the State, but also parts of some in the west, such as the Wimmera, Campaspe, Wannon, and Glenelg. This information has been included with other data held by the Council and used when rivers were evaluated against the criteria described in Chapter A — Heritage Rivers. The detailed descriptions of the proposed heritage rivers also include such information.

While a number of the rivers listed in submissions have not been recommended as heritage rivers, the Council has provided for the protection of their identified values (along with those of other streams) in Chapter D of these proposals. One submission commented that all rivers have heritage values and should therefore be protected. Council agrees that all rivers are of value, but believes that the degree and form of protection should vary according to the significance of the values and their sensitivity to change.

### **Proposed recommendation categories**

Submissions expressed support for or opposition to the number of river categories outlined in the Resources Report. After considering this issue, Council believes that the number should be minimised, as reflected in these proposals. Other views included opposition to and support for heritage rivers legislation and suggestions for other methods of protection. Chapter A outlines alternatives for the protection of heritage rivers and lists Council's preferred option, which is protection under new heritage river legislation.

### **Information base**

Several submissions expressed reservations about the completeness of the data on values provided in the Resources Report, and queried the sufficiency of data to make recommendations to protect these values. Council recognises that its information base is imperfect (and will probably always be so), and the methods used to collect and assess data for the range of values have some inherent problems. However, it considers that it is still possible to identify the outstanding rivers in the State. In forming this view, Council recognises that values may continue to be lost unless steps are taken now to protect them.

Council also acknowledges the specific concerns about the identification of representative rivers and essentially natural catchments, and has modified its approach to these issues in the recommendations.

### **River frontages**

Many submissions outlined the need for greater protection of public land water frontages and their values, and recognised access as a public right. Some raised issues such as the protection of remnant vegetation and the restoration of ecological values (through removal

of grazing from and fencing of all such reserves were raised) along with the need for a program to eradicate weeds along river frontages generally. Others proposed greater access to stream frontages, especially for recreation. Council acknowledges these concerns and has reviewed its existing recommendations with respect to frontages (see Chapter E), but it has also considered them in the light of other interests and concerns. Adjoining landowners have had problems with litter, damage to stock and property, and fire. Furthermore, the government, if it were to assume responsibility for vermin and weed control, fencing, and other management responsibilities, would incur significant additional costs. These concerns were raised during discussions with various individuals and groups.

### **Balancing resource use and value protection**

Some submissions, while not opposing the need to protect river values, considered that the designation of heritage rivers should not impede other important uses such as the provision of irrigation water, domestic water supply, hydro-electricity development, and routes for the disposal of industrial and domestic effluents. Some suggested that the designation should not disadvantage small rural communities and should take into account the government's economic strategy. On the other hand, a number of submissions referred to the ongoing degradation of the State's rivers by the continuing disposal of wastes directly to watercourses. Another view was that all uses, other than water production, should be excluded from water supply catchments.

In response, Council approached all water boards and the major water authorities, including the Rural Water Commission and the Board of Works, that these proposed recommendations might affect, and sought information about proposals for domestic water supply developments or augmentation of existing supplies. Council also collected information on their potential impact on industrial demands for water. This information was taken into account in the formulation of the recommendations.

As it is impossible to predict with any degree of certainty the community's future requirements or priorities, Council has proposed that the

recommendations arising from this Investigation be subject to review — see General Recommendation VII. Council has also addressed concerns about water quality in section F8.

Other submissions considered that heritage river status is incompatible with resource development, and that such rivers should be particularly excluded from future water resource developments. Some noted that the Mitchell is the only major river in Victoria that has not been dammed, and that it should be retained in this condition. Others argued that no new dams should be built in the high country. In the past, dam construction has resulted in the loss of some recreational opportunities, which has not been accounted for in cost/benefit analyses. This is true, but economists have regarded such losses as sunk (or forgone) costs. However, the Council believes that, in future, any analysis of a new proposal should include an assessment of all costs and benefits. It also points out that a loss of recreational benefits may be offset to some extent by the creation of new and different recreational resources and opportunities.

Suggestions included: that all rivers with outstanding values identified in the Resources Report, and all mainstreams with A and B naturalness ratings, should be designated as heritage rivers; that all essentially natural catchments should be protected in their entirety and be used, where appropriate, as links between major conservation reserves; that new hydro-electricity schemes should only be developed in conjunction with existing dams; that the maintenance of aquatic systems should be considered equally with other uses, or receive 'positive discrimination' in decision-making.

Council has adopted the view that, for those rivers that possess outstanding values, uses and future developments that would diminish those values be precluded or controlled (see Chapters A and B of these recommendations). However, for other rivers and streams in the State, provision of water for industry, water resource development, and other activities could be permitted in accordance with the policy recommendations in Chapter F, other government policy, and standard planning procedures.

## **Recreation**

The importance of rivers and streams in Victoria for a wide range of recreational activities was discussed by many people and organisations. There is a need to ensure that a range of activities is accommodated on public land, while at the same time ensuring that these, whether because of their level of use or nature, do not unduly diminish the natural resources upon which they depend. Council considers that the range of recreation conducted along or on rivers is an important aspect of Victorian culture and should continue. Many of the heritage rivers have been proposed because of their outstanding significance for one or more such activities. Other views on recreation were also provided.

## **Management issues**

There was concern that increasing population was placing enormous pressure on our rivers, creating a problem for land and water managers. A need to balance commercial and non-commercial recreational use of our rivers to ensure equity of access was also identified. Other respondents expressed the need to: place restrictions on access for recreation in some areas that are sensitive to disturbance; enhance access to areas with high recreation values; address problems associated with seasonal road closures that can affect access to rivers. These views, and the fact that many rivers are under-utilised for canoeing and other recreational activities because of a lack of public information, should be borne in mind by land managers.

Access to rivers in Victoria, including any proposed heritage rivers, was seen as very important, as was the need to protect aquatic systems to ensure the continuation of recreational fishing for both native and introduced fish. The fishing experience also includes the sense of 'getting away from it all' and experiencing the outdoors.

Council considers that it has, in these recommendations, provided for the wide range of recreational activities associated with rivers and streams, and has taken into account the diversity of views about recreation.

A number of submissions raised issues relating to how land- and water-management activities affect river values. These issues include: flow

regulation, environmental and recreational flows; fish-related matters such as problems associated with movement throughout the river system, possible conflicts between native fish and introduced fish, and the need for more research and information about fish and in-stream biological values in general; more efficient use of water resources, particularly irrigation water; a need to review pricing structures to more accurately reflect the real cost and value of providing water for a range of uses; methods of reducing demand for water; river management issues; and restoration of degraded river environments.

Council acknowledges that these issues are of concern to the community and has discussed these, and other matters not specifically referred to above, in its recommendations in the various sections of Chapter F.

## **Other issues**

Submissions raised some issues that Council considers are not relevant to this Investigation. These included duck-hunting, (primarily a recreational activity associated with wetlands) and the adequacy of logging prescriptions and supervision of timber-harvesting operations. Council has made specific recommendations about these issues in previous studies. Opportunities for community input regarding timber-harvesting were also provided during the development of the Code of Forest Practice.

Council has addressed the need for interstate co-operation regarding river management and flow regulation — highlighted as a particular concern in relation to streams in East Gippsland and the Murray River. Clearly, co-operation on both interstate and inter-governmental levels is required to ensure that the Murray is given appropriate status and management as a river of outstanding significance.

Two particular issues raised in the submissions require special comment as they relate to the scope of this Investigation. These are the decisions by Council to identify values for third-order catchments (see glossary) or larger, and not to assess estuaries in detail. In relation to the first issue, Council adopted the view that the Investigation, if it is to be relevant at the State-wide level, and completed in a reasonable time, should concentrate on the

identification of values associated with third-order streams or greater. This does not mean that values in first- and second-order streams were ignored, but instead, they have been attributed to the associated third-order or larger catchment. Other recommendations and administrative mechanisms are also in place, as a result of earlier Council investigations, which provide protection for many localised areas.

In relation to estuaries, while Council recognises that they are an important component of rivers, in this Investigation more emphasis has been placed on the fresh-water sections. Estuaries are highly complex, many are intensively used, and to collect comprehensive detailed data about them would have doubled the data-collection task. The estuaries of several rivers have been included, however, in recommendations in Chapters A and B where relevant.

## **Water Resources Planning**

Any investigation concerned with the use of land, particularly its rivers and streams and their environmental and resource values, must also consider issues associated with the water resource planning process.

Undeveloped high-quality surface water sources suitable for domestic consumption are becoming scarcer and the economic, social, and environmental costs associated with obtaining new supplies are increasing rapidly. As some undeveloped resources continue to degrade and new resources are developed, the number of options for future development falls. Hence restriction of available options has a potential cost impact.

However, some factors are increasing the range of options; they include not only increased use of high-quality groundwater as its potential is better recognised but new treatment techniques, which allow the use of lower-quality surface and groundwater water sources. Options for increased future water supply can also widen with increased integration of supply systems across the State, provided technical and administrative barriers to the transfer of water between users (for example, one industrial user to another) and uses (for example, irrigation to urban supply) can be overcome. Consumers will also need to become more aware of the limitations on the security of

water supplies and contribute to decisions on the appropriate level of security required for their needs.

Planning for and construction of large storages for irrigation schemes and major urban or industrial requirements has typically been on a 15- to 20-year time scale.

The restructuring of the water resource sector and the formation of the Department of Water Resources in the mid 1980s were specifically designed to broaden the perspective of water resource planning. The Department, now the Office of Water Resources (OWR) in the Department of Conservation and Environment, invested heavily in a range of research- and policy-oriented projects, to back up State-wide and regional planning and co-ordination.

### **Aims of water planning**

The OWR considers that important planning aims are to:

- maintain the integrity and environmental quality of the resource (including protecting high value rivers, wetlands, and catchments)
- maximise net social benefit of water uses to the community (including both in-stream and off-stream uses)
- take a balanced, catchment-based, long-term approach, integrating land and water management and taking account of downstream effects
- harvest water at sustainable levels (to ensure that water is allocated, and releases are timed, to meet environmental requirements)
- retain the ability to meet changing community needs and priorities

Achievement of these aims requires consideration of a wide set of issues in the planning process and in the assessment of water resource use and development options. Prominent among these issues are revised economic and financial assessment and environmental and social considerations.

### **Economic considerations**

For water allocation and use decisions to be economically rational, consumers should pay the full cost of developing the next increment of supply, or the cost of purchasing supplies

from other users. This approach could be characterised by a free market for trading water allocations, using transferable water rights, full cost recovery for new storages, and pay-for-use pricing.

For future demands, there are two basic choices for allocating water. New sources can be developed at increasingly higher economic and environmental costs, or current water allocations supplied from existing storages can be transferred, via the marketplace, from relatively low-value to higher-value uses.

The OWR's view is that development of new resources by building storages should only be undertaken where the cost per unit volume of constructing and operating the new storages and diversions is less than the value of existing water supplies in their lowest-value use, taking into account the cost of water transfer. That is, the cost of new development sets a ceiling price against which the scope for trading of existing allocations between water users can be assessed. Any trading should be voluntary, in line with proposals outlined in the *Water Act 1989*.

### **Environmental considerations**

The following actions are necessary to protect or restore environmental values:

- identify rivers and streams with high environmental values
- provide environmental flows for in-stream habitat
- achieve appropriate water quality
- restore degraded rivers, through the minimisation of erosion and revegetation of river banks
- provide appropriate watering regimes for wetlands and flow regimes for estuaries

Provision of 'environmental flows' has emerged as a critical means of protecting environmental values associated with rivers affected by water resource development. The OWR has been closely involved in projects to develop environmental flow techniques and incorporate them into water planning.

Future water resource developments should incorporate the need for environmental flows in the planning process and the examination of alternative sources, such as groundwater, which may be developed at lower environmental cost.

### **Social considerations**

A fair distribution of costs may be achieved through pricing policy where the capital and maintenance costs of providing water are met by the beneficiary. The 'user-pays' principle reflects such an approach. However, the dollar costs of resource development traditionally only reflect the physical and administrative infrastructure costs. The losses in environmental values, which are in economic terms considered as 'common goods', are carried by the entire community and are rarely translated into a dollar cost to be met by the beneficiary.

Public participation in resource development and allocation decisions is an important social consideration. The OWR strategies for south-west and south-east regions of Victoria are notable examples of the application of this approach. Council considers that this Investigation — involving two formal submission periods, provision for ongoing informal consultation, and consideration of social and economic issues — also provides an important forum for public participation in Statewide planning.

In summary, the framework for considering allocation of water from existing developments or new developments should be based on a systematic economic and environmental evaluation of water allocation options, involving the following steps:

- assess the extent of surface and groundwater resources and their quality
- identify areas of high conservation and recreation value
- determine current use and allocation
- forecast future demands for off-stream and in-stream use, including consideration of innovations in water-treatment technologies that reduce the cost of meeting the quality requirements of different uses
- adopt appropriate security-of-supply criteria, taking into account improved understanding of catchment yield characteristics (as a result of longer periods of data collection) and models of climatic change, including those that may be associated with the greenhouse effect
- formulate economic and technical options to meet future growth in off-stream

demands, by purchase of water or by development of new surface or groundwater resources

- evaluate the options, including an assessment of social and environmental effects considering the whole river basin, and effects on water quality, wetlands, and estuaries

Efficient water use will be increasingly encouraged through pricing, education, publicity, water-saving devices, more efficient use, and recycling. Pricing that reflects the real costs of supply and encourages efficient use may be the main means of influencing demand.

## Structure of the Proposed Recommendations

Having considered submissions arising from the publication of the Resources Report and all other available information, held discussions with numerous individuals and groups, both in Melbourne and country Victoria, and inspected some Victorian streams with a range of values and potential conflicts, Council has formulated these proposed recommendations.

Council proposes three new land-use categories for the protection of outstanding rivers, and has also recognised the importance of other places along rivers with important values. This parallels Council's system of public land use categories, including national parks and State forests. For national parks, for example, the land use category provides for conservation and recreation, while that in State forests provides for timber production, with protection for particular values. The proposed recommendations can be divided into three types: general, particular, and policy.

1. General recommendations qualify the specific recommendations in the body of this report.
2. Particular recommendations relate to specific river reaches, and adjacent corridors, or catchments. These identify the river or catchment, describe the associated values, specify permitted uses, and indicate the proposed method of protection. They can be further categorised as follows.

- **Heritage Rivers**

Recommendations for heritage rivers are described in Chapter A. Council has identified 15 outstanding river reaches and associated corridors across Victoria that it deems worthy of this status. These areas contain a number of outstanding scenic, recreation, cultural, and/or nature conservation values that the Council believes, after having considered the economic and social implications, should be securely protected.

- **Essentially natural catchments**

Following an assessment of information provided in several studies covering various parts of the State, Council identified 49 catchments considered to be in an essentially natural condition. Some 35 occur in existing national parks, wilderness or protected catchment, while the remaining 14 are fully or partly within State forest. Council's recommendations for these catchments and the background to its proposals are detailed in Chapter B.

- **Representative rivers**

Council has identified 16 major river-catchment types in Victoria, based on a range of geomorphic and hydrological characteristics. Each type is represented by a candidate stream with the aim of maintaining, and where possible restoring, its condition. Council's recommendations, which are described in Chapter C, apply only to the public land adjoining these streams.

- **Other river values**

Data collected by Council during this Investigation have identified many reaches of streams that contain significant values. These are shown on Maps 11 to 13 of the Resources Report. Cultural values — Aboriginal archaeological sites, and historical places — are also listed or shown elsewhere in the Resources Report. Additional information on important values has been provided in submissions, or in consultants' reports. Many such values occur on rivers other than those recommended for heritage status.

Council recommends that these reaches and their values be taken into account when decisions that may affect them are being made, and in the development of management plans. These recommendations are described in Chapter D.

- Public land water frontage reserves

In all previous studies Council has made recommendations for the use of public land water-frontage reserves. It is appropriate for this Investigation to review these recommendations. The changes proposed emphasise the need for maintenance and restoration of these very significant linear public land reserves. The recommendations are described in Chapter E.

3. Policy recommendations relate to the use of rivers and streams throughout the State. They are described in Chapter F and cover a range of issues, including flow regulation, environmental and recreational flows, river management, river restoration, utilities, and extractive industries.

## Land status

Several of the following new recommendation categories specify land use activities that, while generally appropriate in many existing public land use categories, are currently excluded from particular areas. The means of exclusion are:

- legislation, including the *Reference Areas Act 1978*, schedules to the *National Parks Act 1975* (as amended), the *National Parks (Amendment) Act 1989*, and exclusions under the *Crown Land (Reserves) Act 1978*
- specific categories in approved land use determinations under the *Soil Conservation and Land Utilization Act 1958*
- certain areas with sensitive values identified explicitly or by description in Council recommendations for larger areas
- government decisions that vary recommendations of Council, or that are unrelated to recommendations
- some zoning provisions in existing management plans

Unless specified, the recommendations of this Investigation will not override these exclusions, and the term 'land status' should be read as a reference to the above.

## General Recommendations

The following recommendations qualify those in Chapters A-F.

Council wishes to stress the need for adequate resourcing for management and protection of public land, as it has made its recommendations on the assumption that sufficient staff and finance will be provided for the appropriate management. Unless these resources are provided, Council's recommendations cannot be effectively implemented. Council emphasises that vermin and noxious weeds (including aquatic species) pose problems in the management of public land associated with rivers and streams. Finance and staff are required to research and implement methods of controlling pest species. As with most public land, fire protection and suppression measures may be necessary from time to time. Council therefore recommends:

- I That the authorities responsible for managing and protecting public land and water resources be allocated the resources necessary for the task.

Council expects that, as a result of further study and investigation, additional areas with special values may be identified and new mineral resources discovered. In addition, new uses of existing resources may also be discovered. Present planning cannot specifically provide for the conservation of these values or the utilisation of these resources. Council therefore recommends:

- II That, when significant new discoveries are made on land within their administration, government agencies enlist the best advice available on the importance of such discoveries and how they should be managed. Advice from relevant organisations other than government authorities and academic institutions should be sought whenever appropriate.

Council also recognises that in some cases existing legislation may have to be amended, or new legislation passed, in order to effectively

implement the recommendations. It is aware that this may result in a delay, perhaps of several years, before some of its recommendations can be implemented. It is concerned that, where implementation of the recommendations would involve a change of land tenure, management efficiency could be reduced during the delay period. Council believes that the government should direct that the intent of the recommendations be followed until they are implemented.

Recommendations III-VI concern the implementation of recommendations.

- III** That the present legal status and management responsibilities for public land continue until the recommendations are implemented or the resources required to manage these areas are available.
- IV** That, as the boundaries of many areas have not been precisely surveyed, they be subject to minor modifications, road excisions, easements, and other adjustments that may be necessary.
- V** That in cases where occupation does not agree with title, the Department of Conservation and Environment may at its

discretion make adjustments to boundaries of public land when implementing these recommendations.

- VI** That the recommendations in this report do not change the status of roads passing through or abutting public land that are at present declared roads under the Transport Act 1983.

In view of the difficulty of long-term planning — with respect to the provision of water for a range of human uses, or the development of newly discovered mineral resources or alternative industrial uses of known resources — Council believes that it would be appropriate to review its recommendations in order to take account of changed circumstances and community demands.

- VII** That, to accommodate changes in information, community demands to facilitate orderly water resource planning, the development of newly discovered mineral resources or alternative industrial uses of known resources in the State, the recommendations for heritage rivers in this report be reviewed by the Land Conservation Council in 7 years from the date of their acceptance.

## A. Heritage Rivers

In such a dry continent, Victoria's rivers and streams are a most valuable asset. Although clean water is a basic need of our society and provides many benefits, it is now recognised that in obtaining these benefits we have had serious impacts on many of our rivers and streams.

Fortunately, some watercourses and their catchments retain important values, from those that remain in an essentially natural condition to those that are modified but can still be used for recreation and enjoyed by the community. Such streams have many benefits for society, by providing a range of recreational, scenic, nature conservation, and cultural heritage values. These values — and benefits — are becoming increasingly scarce as standards of living increase, and the demands of a growing population place greater stress on our natural resources. Until recently, the importance of such values was ignored or inadequately considered in the planning of water resource developments. These issues have been recognised elsewhere, and the United States of America, Canada, and New Zealand have introduced or amended existing legislation to:

- protect scenic, recreation, and cultural heritage values of rivers
- maintain riparian, aquatic, and wetland habitats

Legislation and policy vary from country to country, but the central aim — to protect rivers and their environs — is the same.

### International approaches

The United States *Wild and Scenic Rivers Act* 1968 seeks to 'protect for future generations, rivers and their immediate environments that possess outstanding scenic, recreational, geological, ecological, and cultural features'. The Act created a procedure by which river segments across the country could be evaluated and then designated as part of a national wild and scenic river system. This ensures that the values of the designated segment are protected and not flooded, and that the segment remains free-flowing.

Segments are classified as 'wild', 'scenic', or 'recreational'. 'Wild rivers' are 'vestiges of primitive America'; 'scenic rivers' have 'shores or watersheds still largely primitive and shorelines largely undeveloped but accessible in places by roads'; and 'recreational rivers' are 'readily accessible by roads' and 'may have some development along their shorelines'. By 1985, more than 120 segments were designated under that Act. They range in length from 2 to 360 km and total more than 11500 km. The protected segments are corridors, not whole catchments. Many individual States also enact their own legislation. By 1983, 30 had done so, affording various levels of protection to about 22000 km of waterways.

The Canadian Heritage Rivers System, instituted in 1984, gives national recognition to important Canadian rivers and ensures long-term management that will conserve their natural, historical, and recreational values for the benefit and enjoyment of Canadians now and in the future. It is a one-category system, 'Canadian Heritage River', with no distinct classifications or categories. Selection is based on the values that reflect the aims:

- natural heritage of outstanding Canadian value
- human heritage of outstanding Canadian value
- recreational opportunities of outstanding Canadian value

Public involvement in the nomination process is encouraged, and the system is administered by a board with representatives from relevant government agencies. By May 1990, nine river segments had been designated and another nine had been nominated as heritage rivers, with a total length of 4057 km. Conservation of values is through the application of a management plan. The river segment must be of sufficient length, and contain most of the key resources and ecosystem components necessary to demonstrate its heritage value. Also, the quality of water must sustain the processes, features, or activities that make it unique.

## Towards a Victorian heritage river system

The Council believes that it is timely that rivers in Victoria with outstanding values be identified and protected for current and future generations.

To this end, in accordance with the Order in Council for this Investigation, the Council proposes that the most outstanding streams or reaches in Victoria be designated as heritage rivers and their values securely protected. The term 'heritage river' best describes the range and variety of values recommended for protection. It is an established term, which would provide these corridors with appropriate status. Other terms, such as 'wild and scenic river', may not convey the intention to protect ecological and cultural values. Of course, many other streams possess a range of values that warrant protection also, and need to be taken into account in future planning. But just as areas with outstanding values are set aside as national and State parks, it is appropriate that outstanding river values be similarly identified for permanent protection.

A heritage river is defined here as a part of a river corridor — that is, a linear reserve — set aside to protect natural heritage, cultural heritage, recreational, and/or scenic values of outstanding significance. Recommendations for each heritage river outline the main reasons for protection and appropriate uses, and will guide planners, managers, and users.

Heritage river protection encompasses a range of values: in highly natural areas the protection of a stream's condition and the conservation of native flora, fauna, and other features are essential parts of management; in modified areas cultural heritage values for example, may be associated with rivers in a condition substantially changed from the natural. Accordingly, the land uses recommended must be appropriate to the particular circumstances.

In corridors recommended for protection because of their essentially natural mainstream condition, activities such as land-clearing, timber-harvesting, mining and extractive industries would generally conflict with the protection of this value. Some forms of recreation, road or track construction, utility sites or easements, and certain mineral exploration activities may conflict, depending on the type

of activity and its location.

On other river corridors, the construction of water storages or barriers to fish passage along streams, or any appreciable diversion of flow out of the watercourse, may conflict with a component of the heritage river concept. That is, some rivers should be set aside to protect natural values, including their naturally occurring flow regime, which responds to daily, seasonal, and longer-term climatic conditions, and to which the natural stream biota are adapted.

A recommended heritage river selected partly for its outstanding scenic landscape values in a farm-forest setting may not, however, be adversely affected by land use or in-stream activities if these are carefully planned to avoid scenic impacts.

### Heritage river values

When considering a river or stream for heritage river status, the Council took into account whether the watercourse, or its immediate environment, contained one or more of the following values:

#### Natural values

- sites supporting plant or animal communities that have particular significance because of their rarity, very restricted distribution or unusually high diversity; these include 'sites of zoological or botanical significance' identified in published reports
- sites with individual species of plants or animals that are rare or endangered, or otherwise have particular conservation significance; these also include 'sites of zoological or botanical significance'
- streams — identified as 'essentially natural' mainstreams — that are in very good condition because their catchments have undergone little modification by modern technological society
- features which are outstanding examples of geological history or geomorphological processes, or other natural phenomena; these include 'sites of geological/geomorphological significance' identified in published reports

The natural heritage values are all closely associated with the riparian or aquatic environments, or within the river corridor.

### Cultural heritage values

- important cultural features that by virtue of their rarity, antiquity, concentration or representativeness, illustrate human interactions with riverine environments
- areas or features within the corridor that are strongly associated with significant persons, events, movements, achievements, ideas, or beliefs

### Scenic landscape values

- combinations of landforms, waterforms and vegetation types, and (in appropriate settings) cultural features that provide outstanding opportunities for the enjoyment of scenic vistas
- vistas of high scenic quality that reflect particular landscape character types and river settings, and outstanding examples of particular landscapes

### Recreation values

- river corridors whose biological and physical characteristics provide outstanding recreational opportunities along their length or at numerous points along their courses
- significant recreational opportunities, found on river corridors that are rare in terms of their resource requirements or setting
- an outstanding diversity of recreational opportunities along a river corridor

## Identification of heritage rivers

The development of proposed recommendations, identifying heritage rivers, has involved the five steps detailed below.

### Step 1. Collect data

The Resources Report outlined the range of information that was available at publication. New information, from submissions and other sources, includes: results of unpublished work; recent survey data; newly identified high-value areas; and new approaches. As a result, changes have occurred in the number of fish species used to gauge diversity, the evaluation of fish conservation status, and the approach used to assess rivers for canoeing against the opportunities they provide at a national, State, regional, or local level.

### Step 2. Rank rivers according to values and establish threshold levels

Several of the value types have been assessed, and rated on a scale from local to international significance. For scenic landscape, those outstanding rivers with the highest number of positive scenic elements for each river/landscape setting were identified. The assessment took into account whether each river or stream reach had particular significance for these values:

- botanical qualities
- faunal qualities
- essentially natural mainstream condition
- geological/geomorphological features
- diverse native fish populations (7 or more freshwater species recorded)
- presence of 'endangered' or 'vulnerable' native fish species
- scenic landscape
- cultural heritage
- native fish angling
- introduced fish angling
- car-based camping
- canoe-touring or white-water canoeing

Given the diversity of the values and their expression, the Council does not believe that a numerical weighting system is appropriate or desirable. Rather it used the following points (each of equal importance) to judge and rank the total values of rivers, and determine the upper and lower boundaries.

- the extent of each corridor/site with high values, in terms of its size, and relation to the river
- the significance of each value, where assessed
- the significance, distribution, and extent of overlap of values
- the combination of particular values that enhances the significance rating
- the diversity of values present
- start and finish points of significant river values
- exclusion of modified/degraded sections

This ranking process allowed rivers to be ordered into groups. Outstanding rivers were then identified based on the range, distribution, and significance levels of their values, and accordingly as having heritage river status.

A heritage river has:

- one or more values of national or international significance, where those values are strongly associated with a substantial section of the watercourse (a single localised value is insufficient), or
- an aggregation of at least four values, generally of State or greater significance, which together create a corridor of heritage river status

The corridor includes the stream-bed and banks, and also adjoining land of sufficient width to contain attributes necessary to sustain the nature conservation, cultural heritage, scenic, and/or recreation values of the river.

In general, Council proposes that this corridor include the stream and a 200-m-wide strip beside each stream-bank. In many areas this would be sufficient to protect the values, and to provide a clear identity for the heritage river. In some cases, the width of the corridor increases to reflect the topography of narrow valleys or gorges or the distribution of adjacent areas with significant values: then it follows the valley or gorge rim, or a larger unit of public land, where practical for management. Where the heritage river corridor comprises a public land water frontage reserve, its width narrows, usually to about 30 m.

### **Step 3. Identify conflicting uses or activities**

Protection of a heritage river begins with the identification of land uses or activities that may place its values at risk. The extent of risk depends on the characteristics of the value, the nature of the activity, how this is undertaken, and its frequency and duration.

In developing recommendations for heritage rivers the Council has been conscious of the need to ensure that its decisions represent a balanced approach to the use of land in Victoria.

### **Step 4. Develop recommendations**

Developing recommendations that balance the protection of values with utilisation of commercial resources, and also separate conflicting uses, involves four components. These are: identification of known or potential resources and use constraints along the rivers; resolution of the land use issues identified in Step 3;

consideration of the resource use implications; and development of proposed recommendations by the Council for public comment.

Potential resources found along heritage rivers include:

- water — for off-stream uses, and hydro-electricity generation through the construction of in-stream barriers or diversions
- timber — extraction for sawmilling and further processing, subject to existing land status and other constraints
- minerals — exploration for and mining of surface alluvial deposits of gold, other metals, gravel, sand, soil, or subsurface mineral deposits
- areas used for grazing or honey production
- industry — many activities use water or are located near rivers

Submissions following the Resources Report identified some resource uses and issues arising. Some also provided ideas that contributed to the resolution of conflicting uses.

The Council considered draft proposed recommendations in the light of known resources, alternative resources (where they are known), and modifications to the way the resource may be used, in comparison with partial or total loss of corridor values. It also sought details of known resources, uses, and likely development proposals on various 'candidate' rivers from relevant government agencies, and had access to an independent appraisal of the social and economic costs and benefits of protecting the identified values of specified candidate rivers. Extracts from this appraisal are included in each heritage river description.

The Council then developed and discussed proposed recommendations, to ensure a balanced approach to the use of Victoria's land, accommodate conflicting uses, and maintain the values of heritage rivers.

### **Step 5. Propose administrative mechanisms to protect heritage rivers**

An administrative mechanism is required to ensure that heritage river values identified by the Council can be adequately protected. The following could be used either as alternatives or jointly, to protect the values along the heritage rivers.

### Heritage rivers legislation

The Council's preference is for specific legislation that could achieve State-wide, uniform protection of identified values. This would be debated and resolved in Parliament, ensuring that the resulting Act had followed full discussion of the issues. Among its benefits, a 'Heritage Rivers Act' would give a firm and long-term commitment to protecting the values that led to heritage river status. It would also provide a focal point for protecting rivers so declared, and could specify appropriate land use and broad management requirements.

A 'Heritage Rivers Act' styled on the *Reference Areas Act 1978* would have a number of advantages. Proclamation under such an Act would apply an 'overlay' without altering existing land tenure, avoiding the complex procedures involved in revocation and subsequent reservation under other Acts.

While the tenure of the land would remain unchanged, a heritage river proclamation would require changed management goals, for maximum protection of the special values. However, it would not reduce the protection provided for values by the existing land status.

Advantages of this option are the level of protection provided, the relative ease of application, and the opportunities not only to develop wording for the specific requirements of rivers but for public debate about the protection of river values. Disadvantages are that this is not an existing mechanism, and it would take some time to consult with community groups, develop a Bill, and pass legislation in Parliament.

### Crown Land (Reserves) Act

The *Crown Land (Reserves) Act 1978* has been commonly used in the past to reserve public land following Council's recommendations. It involves a conventional reservation process or in the case of existing reserves, re-reservation. Under Section 4 of the Act, any Crown land can be temporarily or permanently reserved for various purposes, including the following:

- protection of the beds or channels and the banks of rivers and watercourses
- preservation of areas of ecological significance
- conservation of areas of natural interest or

beauty or of scientific, historical or archaeological interest

- preservation of species of native plants
- preservation or management of wildlife or preservation of wildlife habitat
- provision of public recreation including areas for camping

Advantages are that reservation is by an established Order in Council process, and revocation of permanent reserves requires an Act of Parliament. Given that many areas of public land across the State are now reserved under this Act and others, reservation for a new purpose would require a complex process of revocation of existing reservations and re-reservation, a substantial disadvantage of this alternative.

### Planning and Environment Act

Some protection of the identified values could be achieved through the existing provisions of the *Planning and Environment Act 1987*. Under this Act, policies relevant to river protection may be included in the State section of planning schemes, where the policies are so general that they apply to all or most rivers and streams across Victoria. However, specific controls as to how particular parcels of land within corridors could be used or developed would need to be included in the local section of planning schemes.

Planning controls could:

- include land requiring protection in specific zones
- introduce relevant 'special control' provisions
- specify protection of identified river values as a 'mandatory' requirement in schemes
- provide for appropriate agencies to become referral authorities for permit applications

The procedure would involve identifying the area affected, specifying requirements additional to existing scheme provisions, then advertising amendments to the scheme. If the amendment is adopted, the scheme would be administered by the local planning authority — usually the municipality. Any subsequent amendments proposing to alter the additional requirements would require the approval of the Minister for Planning and Urban Growth.

Protection for the river values is therefore at the ministerial level.

The *Planning and Environment Act* has the advantage that it exists and procedures are well established. Council considers, however, that it has substantial disadvantages: the number of local section amendments that could be required; the avenue to reverse protection by a subsequent amendment; the current exemption of Crown land from its provisions; and it cannot be used to alter existing land uses.

### **Codes of practice**

A code of practice document stipulates detailed requirements concerning the practices relating to a particular activity. Codes are in general more detailed than is possible in either legislation or regulations. Compliance with codes may be voluntary, or be supported by sanctions.

Under the *Conservation, Forests and Lands Act* 1987, for example, approved codes can be made compulsory by incorporation in or adoption by certain laws or regulations or conditions under a law, and after being ratified by both Houses of Parliament. The laws referred to are those administered by the Minister for Conservation and Environment relating to land and resource management.

Under these Acts, codes may relate, among other things, to conservation, land protection and forest practices.

Other codes have been developed. In the attainment program for control of ozone-depleting substances, for example, the Environment Protection Authority specifies seven separate codes of practice for different industrial uses of chlorofluorocarbons, halons, and related solvents. Once such codes are adopted by the Authority, compliance is compulsory.

While codes provide for day-to-day activities to be carried out responsibly, they are not an effective equivalent to reservation. They can serve to reduce impacts of particular activities, but in general would not address aggregate or incremental effects.

For the purpose of implementing the recommendations of this Investigation, a disadvantage is that a wide-ranging set of codes may be required to include measures relating to proper management of land in river

corridors and catchments. They would need to address many forest-management, water-harvesting and agricultural activities, road-works, recreation, mining, sand and gravel extraction, and industrial activities. Codes of practice could, however, be a useful supplement for other forms of firm protection.

### ***Land Conservation Act***

Government-approved recommendations from Council's investigations specify, within broad categories, land use and guidelines for management. The recommendations commonly include general policies for the protection of values.

Section 10(3) of the *Land Conservation Act* 1970 provides that, for recommendations approved by the government, an Order-in-Council requires departments or public authorities to use 'all diligence and dispatch to give effect to' any recommendation 'so far as it affects any land vested in or controlled by' such departments and authorities.

Government approved recommendations are the first stage in the process of implementation leading to protection, however they are no substitute for firm reservation or some equivalent.

## **Proposed heritage rivers**

The following recommendations identify 15 proposed heritage river corridors. Several other river corridors were included as candidates during the development of these proposed recommendations, and information about the costs and benefits of protecting them is included in the social and economic appraisal. However, the King, Loddon, and Tyers Rivers were not considered further, as recent information and field inspections led to re-assessment of their values. The Council resolved against recommending the Bunyip River for heritage river status after comparison with other candidates, considering the values and resources present, and recognising that the proposed corridor would not protect the full extent of the cool temperate rainforest present.

The Council also considered whether certain of these outstanding rivers should be designated as heritage rivers of national significance. Currently, there is neither an

established set of national criteria for this purpose, nor a national heritage river system. However the Council would support the development of appropriate Australia-wide criteria.

If such a study were to take place, the Council believes that the Snowy River and Mitchell River should be included for consideration, because of the significance, diversity, and extent of their values. The Murray River would also be an obvious candidate, with the extraordinary array of cultural, recreational, scenic, and nature conservation values present along its Victorian frontage.

The recommendations below apply to all

proposed heritage rivers. These are followed by a description, discussion of resource implications, and specific recommendations for each corridor. Map 1 shows the 15 heritage river corridors diagrammatically. Maps 2 to 28 at the end of this volume illustrate their location more precisely, and show the existing public land tenure. The descriptions list the area of each public land category within the corridor, and the length of each category along the river. Note that, as river reaches often have different categories on their left and right banks, the sum of lengths shown may exceed the total corridor length.

### Proposed Heritage Rivers — Map Numbers

Recommendation number	River corridor name	Map no.
A1	Mitta Mitta River	2,3
A2	Ovens River	4
A3	Howqua River	5
A4	Big River	6
A5	Goulburn River	7,8
A6	Wimmera River	9,10
A7	Bemm River and its tributaries, Goolengook, Arte, and Errinundra Rivers	11,12,13
A8	Snowy River	14,15,16
A9	Suggan Buggan and Berrima Rivers	17
A10	Upper Buchan River	18
A11	Mitchell and Wonnangatta Rivers	19,20,21,22
A12	Thomson River	23
A13	Yarra River	24,25
A14	Lerderderg River	26
A15	Glenelg River	27,28

## Heritage Rivers

### Recommendations

#### A1-A15

That the river corridors shown on Maps 1 to 28 and described below be designated heritage rivers, and be used:

- (a) to protect natural, scenic, cultural heritage, and recreational values, according to the recommendations for specific river corridors listed below
- (b) to provide opportunities for landscape

appreciation and education, except where this conflicts with (a) above

- (c) to provide a range of recreation opportunities as specified in the following recommendations for each heritage river corridor, and in accordance with the policies in Chapter F

that

- (d) where indicated below, the river corridors be retained free from impoundments, artificial barriers, or structures that impede stream flow or passage of in-stream fauna

- (e) (i) any new water diversions from the mainstream or tributaries upstream of the lowest point on each heritage river not significantly diminish the existing values identified in the river descriptions below
- (ii) where detailed environmental and recreational flows have been established, they should be retained
- (iii) where detailed investigations to establish the environmental water requirements of heritage rivers have not been undertaken, these investigations should be completed in any review of water allocations in existing regulated systems
- (f) heritage rivers be given priority in investigations undertaken to establish appropriate environmental water requirements in existing regulated systems
- (g) timber-harvesting not be permitted in heritage river corridors, except where specified for particular rivers below
- (h) (i) where currently permitted, public land within the heritage river corridors continue to be available for grazing, except where this would prevent revegetation of the banks and frontage reserves or cause bank erosion
- (ii) priorities for revegetation be developed in accordance with a process similar to that proposed for public land water frontage reserves (See Recommendation E1)
- (iii) grazing be strictly controlled or excluded either temporarily or permanently by the land managers from areas found to have significant vegetation that would be eliminated by continued grazing, or where there are bank erosion problems
- (i) (i) in carrying out road reconstruction and maintenance, relevant authorities take particular care with drainage, spoil disposal, and batter stabilisation, so that as far as possible sediment does not reach streams, causing siltation and turbidity
- (ii) in siting new roads and tracks, locations parallel and close to stream-courses be avoided and crossings minimised
- (j) (i) where currently permitted, use of public land along streams for bee-keeping continue
- (ii) where investigations show that the presence of commercial honey-bees is causing land management problems or adversely affecting river values at specific sites, hives be relocated temporarily or permanently
- (k) exploration and mining be permitted in heritage river corridors, except where land status excludes these activities, and subject to:
  - (i) existing Council policy (section F12) that areas of particular value and sensitive to disturbance be identified and excluded from mining and from forms of exploration inappropriate to the protection of values
  - (ii) conditions ensuring that operations, discharges, treatment, and tailings have no adverse impact on the identified values or water quality

and that they be protected under a Heritage Rivers Act, and managed by the Department of Conservation and Environment.

Notes:

1. The Council is aware that new legislation will need to be developed and enacted in order to give effect to this recommendation, but it believes that this will provide the most appropriate form of protection for the State's outstanding rivers. The new legislation should be styled on the existing *Reference Areas Act 1978*.
2. The Gippsland Water Strategy is being developed by the Department of Conservation and Environment. Its aims are to protect high value areas, promote sustainable catchment and waterway management, and provide a balanced allocation of water to off-stream users and the environment. The Bemm, Snowy, Suggan Buggan, Buchan, Mitchell, and Thomson Rivers, their tributaries and other rivers in Gippsland, are included in the Strategy.

## Mitta Mitta River

The Mitta Mitta River — its main headwater tributary being the Big River — originates on the north-western slopes of Mt Nelse North. It divides Mount Bogong and the Bogong High Plains, flows south for some 30 km, joins with the Bundara and Cobungra Rivers, then flows east, emerging suddenly from mountainous country onto the gently undulating Livingstone Creek valley. It then flows northwards for another 30 km to Dartmouth Reservoir.

The river-course has responded strongly to the underlying geology, with changes in direction strongly influenced by rock-type changes and fault lines. The upper catchment, including the Morass and Livingstone Creek basins, was originally part of the Tambo River system, but due to differing erosion rates is now part of the Mitta Mitta system. As evidence, the main course of the Upper Mitta Mitta River, tributaries Bundara and Cobungra Rivers, and the Morass Creek all drain initially towards the south. The proposed heritage river corridor is from Big River Bridge at Glen Valley, below the junction of the Big River and Glen Wills Creek, to the Dartmouth Reservoir.

This reach has a range of values. First, it is of State significance for canoeing, along the 30 km from Glen Valley to the Hinnomunjie Bridge. This comprises three sections, all suitable for canoe touring, with the section from Bundara River to Hinnomunjie Bridge requiring advanced and proficient skills in some sections, as well as having flat-water stretches. From Glen Valley downstream, there are opportunities for both day trips and overnight tours. The significance reflects the variety of skills and activities, the accessibility of the river adjacent to the Omeo Highway north of the Bundara, and the magnificent setting, largely in the Alpine National Park and Mount Wills Historic Area. The reach between the Bundara junction and the Livingstone Creek valley has a spectacular remote setting and frequent rapids. It is used annually for a major competition involving canoeing, cycling, running and skiing, and for organised tours.

Below the junction with Livingstone Creek, the Mitta Mitta flows for a short distance through a low-gradient section in an agricultural setting, then enters a steeper section leading to Dartmouth Reservoir. From this point

— where Kellys Road enters public land — the river corridor is of State botanical significance, for its riparian closed scrub of *Leptospermum brevipes* and *L. phyllicoides* beneath an overstorey of narrow-leaf peppermint and manna gum.

The corridor includes sections of high scenic landscape value, from Bundara River confluence to Eight Mile Creek. The landscape character type is Eastern Highlands, here in a farm-forest river setting category. The vulnerable Macquarie perch spawns in the long, narrow inlets at the southern end of the Dartmouth Reservoir.

The Mitta Mitta River and its tributary the Big River are crossed by the nationally important Alpine Walking Track, including a recently constructed suspension footbridge at Taylors Crossing. Many car-based camp sites have become established beside the Omeo Highway — especially near Anglers Rest — and on Kelly Road, and these are very popular over summer, particularly in association with trout angling. The Highway carries a substantial number of pleasure drivers, who enjoy the impressive views over the Big River valley.

Cultural features include the Mount Alfred Mine battery site in the Historic Area, and the timber truss Hinnomunjie Bridge.

### Tenure

Public land tenure	Area (ha)	Length (km)
Alpine National Park	1760	40
Mount Wills Historic Area	115	4
State forest	130	7
Public land water frontage reserve	330	21
	2335	60

The corridor is generally 200 m wide on each side of the river, except for a wider section for some 4 kilometres below the Bundara River where the southern boundary follows the Omeo Highway, and narrower areas of public land water frontage reserve.

### Resources

Code of Forest Practices constraints, combined with a generally unmerchantable timber resource, mean that effectively the proposed heritage river corridor contains no harvestable timber resource. A possible future hydro-electric generation scheme for the Upper

Mitta Mitta River has been outlined by the State Electricity Commission, although the consultants considered that it was not likely to proceed. Past mining and more recent exploration suggest that alluvial and vein gold, tin, lead, copper, silver, and antimony occurrences may be present along the Mitta Mitta River.

The consultants concluded that the environmental values are likely to exceed the resource values.

## Recommendation

### A1 Mitta Mitta River

That the river corridor of 2335 ha shown on Maps 2 and 3 be used in accordance with general recommendations A1–A15 (a) to (k) above that

- (l) (i) the corridor be retained free from impoundments, artificial barriers, or structures that impede stream flow or passage of in-stream fauna
- (ii) any new diversions of water only be permitted if their volumes, timing, and offtake do not impair canoeing quality or native fish habitat conditions, or reduce scenic landscape value

that

- (m) the following values be protected
  - (i) scenic landscapes from the Bundara River confluence to Taylors Crossing
  - (ii) riparian closed scrub of narrow-leaf peppermint with *Leptospermum brevipes* and *L. phylloides* — Livingstone Creek to Lake Dartmouth
  - (iii) canoeing — Glen Valley to Hinnomunjie Bridge
  - (iv) Macquarie perch spawning site — tailwaters of Dartmouth Dam

and that

- (n) fishing, car-based camping, canoeing (below Hinnomunjie Bridge), picnicking, bushwalking, and seasonal deer-hunting by stalking continue where land status permits, and the management of the river corridor recognise the importance of these uses.

## Ovens River

The proposed heritage river corridor along the Ovens River extends from Killawarra to the Murray River. Lake Mulwala inundates the lower section of this reach.

The alluvial floodplains along the River Murray and tributaries are dominated by river red gum (*Eucalyptus camaldulensis*) open forests and woodlands. This majestic tree characterises the landscape in such areas, but its distribution is now greatly reduced due to past clearing for agriculture. Extensive open forests and woodlands still occur, however, along the Ovens River floodplain, from Spring Creek to Lake Mulwala. These are considered to be of State botanical significance, for the following reasons:

- river red gum communities were formerly widespread but are now uncommon because of habitat depletion
- they are excellent examples because of their relative lack of disturbance, diversity, and botanical 'intactness'
- they are considered to be inadequately represented in reserves

The proposed heritage river corridor includes riparian communities of river red gum with a shrub layer of silver wattle and grassy understorey, which are similarly of State significance. River bottlebrush is also present in the shrub layer. A regionally significant localised shrubland of *Melaleuca parvistiminea* is located in the area near Peechelba, previously recommended as a flora reserve.

The forests below Spring Creek have State faunal importance as habitat for the large-footed myotis, a bat with 'indeterminate' conservation status. Normally cave-dwelling, it has been recorded in the Ovens River forests roosting in mature river red gums. Wetlands, particularly at the lower portion of the river corridor, also provide valuable habitat for many species of water-birds.

From Killawarra to Lake Mulwala, the Ovens River forests have high scenic value, in the Murray Basin Plains landscape character type, and farm-forest setting.

Murray cod are found in the reach and, while their conservation status is 'vulnerable', it is considered that angling does not significantly

affect cod numbers. The reach is judged of high value for this much-sought-after sport fish. The Ovens has high value for conservation of the freshwater hardyhead and crimson-spotted rainbow fish, and has a diverse native fish fauna, with golden perch, flat-headed galaxias, big-headed gudgeon, western carp gudgeon, and Australian smelt as well as the cod.

The lower Ovens is also the destination for other recreational users. Near the confluence of the Ovens and Murray Rivers, the Lower Ovens Regional Park consists of numerous anabranches, billabongs, and islands created by Lake Mulwala. The ready access provided by the Murray Valley Highway makes the area popular with campers and anglers, and provides opportunities for boating, canoeing, picnicking, nature study, camping, and swimming.

#### Tenure

Public land tenure	Area (ha)	Length (km)
Lower Ovens Regional Park	790	7
Flora reserve	230	2
Public land water frontage reserve	70	5
State forest	2660	38
	<u>3750</u>	<u>52</u>

The corridor comprises the lower Ovens riverine forest between Killawarra and the Murray River and is generally less than 2 km wide. In this section the river flows across a broad floodplain. Here, the river red gum communities form a unit, and Council considers that this unit of public land should be managed as a single parcel.

#### Resources

No specific water resources that these proposals may affect have been identified. The lower Ovens forest is an important source of river red gum timber. Council believes that timber production should continue in accordance with the principles and guidelines outlined in Chapter F2. Application of the visual management system will allow for the protection of the special scenic values. A management plan is being developed for the Mid-Murray Forest Area which includes this riverine forest. No mineral prospects that are currently seen as likely to be mined occur in

the corridor, although the area is considered to be prospective for coal and alluvial gold. It is unlikely that alluvial gold mining — by dredging — would recommence in the area.

The consultants concluded that environmental values are likely to exceed the resource values.

### Recommendation

#### A2 Ovens River

That the river corridor of 3750 ha shown on Map 4 be used in accordance with general recommendations A1-A15 (a) to (k) above

that

- (l) (i) the corridor be retained free from further impoundments, artificial barriers, or structures that impede streamflow or passage of in-stream fauna
- (ii) any new diversions of water only be permitted if their volumes, timing, and offtake do not impair native fish habitat conditions or the riverine forest-flooding regime, or reduce scenic landscape value
- (iii) timber-harvesting be permitted in the lower Ovens forest, subject to the principles and guidelines for river red gum harvesting operations (see section F2)
- (iv) grazing continue where it is currently permitted, but that in areas where future surveys identify a risk of degradation through the loss of biological values or bank instability, licences be reviewed

that

- (m) the following values be protected
  - (i) areas with river red gum open forests-woodlands with an intact understorey, occurrences of river red gum with a shrub understorey of river bottlebrush, silver wattle, and *Melaleuca parvistiminea*, and native grasslands
  - (ii) areas providing habitat for the large-footed myotis and a surrounding buffer
  - (iii) scenic landscapes along the Ovens River from Killawarra to Lake Mulwala

- (iv) fishing opportunities, especially for Murray cod
- (v) Murray cod habitat, by avoiding cold-water releases during spawning, maintaining rising water levels and temperatures for spawning (during spawning season) and better water quality for larval and juvenile stages, and retaining in-stream logs and a variety of bed conditions for adult resting and shelter
- (vi) native fish diversity, by implementing the principles and guidelines for fish habitat protection (see section F2)

and that

- (n) canoeing, boating, nature observation, car-based camping, picnicking, bushwalking, and recreational fishing continue where land status permits, and the management of the river corridor recognise the importance of these uses.

## Howqua River

The proposed heritage river corridor rises on the north fall of the Great Dividing Range at Mount Howitt and flows westward, draining eventually into Lake Eildon.

For much of its length the valley is deep and narrow. However, in a few areas it widens slightly and a narrow floodplain develops, such as at Sheeppark Flat, Frys Hut, and in the lower section as the river approaches Lake Eildon. The river valley is essentially forested. Along its mid section, the south side of the corridor is flanked by spectacular rocky scarps, including The Bluff. The mountains flanking the valley are usually snow-covered in winter.

Some of the Devonian rocks through which the river has cut contain fish fossils. These are important markers for comparison, and give the localities national geological significance.

'Greenstone' also outcrops along the valley. This material is extremely tough and was highly prized for axe heads by Aborigines, who quarried and subsequently traded it throughout the surrounding region. Other archaeological evidence of Aboriginal use of the river flats also remains around Sheeppark Flat.

More recently other mineral resources have been developed along the river, and by the 1860s alluvial gold was being worked. Following its exhaustion, reef gold was located and crushing batteries and furnaces were established. The tunnel and races still evident at Tunnel Bend brought water to drive the crushing plant. The tall brick chimney of the smelting furnace remains on the narrow flat beside the river. The Sheeppark Flat and Frys Hut areas were also the focus for the Howqua grazing run, taken up in 1845. Around Frys Hut the clearing, homestead, and flying fox used to cross the river are tangible reminders of the grazing history. Today, the evidence of the transformation of the Howqua Valley is contained within the Howqua Hills Historic Area.

Along with the Historic Area, the river and its flats provide an important focus and venue for a variety of recreational activities. Thousands of people enjoy the scenic splendour of the Howqua Valley and its history through car-based camping and picnicking. The Howqua corridor is a popular destination for four-wheel-driving and for horse-riding. Numerous camping sites are scattered along the entire length of the river, with those below Eight Mile Creek being generally accessible to two-wheel-drive vehicles.



*Ovens River*

The cool clear water and deep shaded pools provide good trout habitat and anglers rate the river highly. The rapids formed by the many rocks and gravel bars in the river provide opportunities for white-water canoeing activities of State significance. The half-day trip from Eight Mile Creek to Sheeppond Flat is very popular. Sheeppond Flat has good vehicle access and an extensive and picturesque camping area, and is a venue for national slalom championships. It is a popular starting point for four-wheel-drive tours and horse-rides along the tracks following the river valley. The river is also the focus for the Alpine Feeder Track, which links with the Alpine Walking Track.

The recreation value of the Howqua River depends in many ways on the maintenance of its in-stream values, including its water quality. In confirmation, a survey of macro-invertebrates revealed that the river supports a rich and diverse fauna. The 'vulnerable' frog *Litoria spenceri* has been recorded here, contributing to the river's faunal significance.

#### Tenure

Public land tenure	Area (ha)	Length (km)
Alpine National Park	660	32
Howqua Hills Historic Area	160	10
Public land water frontage reserve	160	10
State forest	540	34
Other	-	1
	<hr/> 1520	<hr/> 60

The heritage river corridor comprises a strip 200 m wide on each side of the river, except where the narrower public land water frontage reserve occurs in the lower section.

#### Resources

Only one water resource development possibility has been identified. It would involve providing water for 200 residential lots at Howqua, but alternative water sources are believed to be available.

Some 4050 cu.m of mature class C+ and 810 cu.m of class D sawlogs are present in the corridor, and is estimated to represent the direct employment of 1.5 persons for 5 years. Council considers that the values in this corridor would not be adversely affected if these resources were available for timber production, and recommends that harvesting continue to be permitted subject to existing codes, local

prescriptions, and land status, in particular those that protect recreation routes and destinations.

No implications for mineral and stone resources were identified. The corridor includes some areas in which mineral production occurred last century.

The consultants concluded that the environmental values are likely to exceed the resource values.

### Recommendation

#### A3 Howqua River

That the river corridor of 1520 ha shown on Map 5 be used in accordance with general recommendations A1-A15 (a) to (k) above

that

- (l) (i) the corridor be retained free from impoundments, artificial barriers, or structures that impede stream flow or passage of in-stream fauna
- (ii) any new diversions of water only be permitted if their volumes, timing, and offtake do not impair fish habitat conditions or canoeing quality, or reduce scenic landscape value
- (iii) timber-harvesting continue, where land status permits, subject to the Code of Forest Practices and local prescriptions providing for a buffer around recreation routes and destinations

that

- (m) the following values be protected
  - (i) canoeing — Nine Mile Creek to Frys Hut, and the Sheeppond Flat slalom site
  - (ii) fishing opportunities — especially for trout
  - (iii) cultural heritage sites — Frys Bridge, and early settlement and mining features
  - (iv) Devonian fish fossil beds
  - (v) habitat for the frog *Litoria spenceri*

and that

- (n) vehicle-based camping, bushwalking, and horse-riding continue where land status permits, and the management of the river corridor recognise the importance of these uses.



*Big River*

## **Big River**

The proposed heritage river corridor extends from the junction of Spring and Oaks Creeks (about 8 km north of the Warburton–Woods Point road) downstream to the Big River and Fryer Creek junction, near the Eildon–Jamieson road. High water levels in Lake Eildon periodically inundate the lower 2 km of this reach.

The river flows through scenically attractive native forest and is free of urban, agricultural, or industrial discharges. The aquatic habitat is of great interest. Above the confluence with the Torbreck River and near Lake Eildon, the vulnerable frog *Litoria spenceri* has been recorded, contributing to the faunal significance of this section.

Surveys for macro-invertebrates along the river indicate a rich and diverse population. This reflects the condition of the catchment, which, although not completely undisturbed, has allowed macro-invertebrates to recolonise downstream sections from the smaller headwater tributaries, following disturbance of the main-stream by past mining, roading, and other activities. The existence of such conditions is of scientific interest as it allows studies of the longitudinal changes in the benthic fauna.

The character of the river valley changes markedly along its course. In its upper section, above Big Bend, it tends to be open, and small alluvial flats adjoin the river. Similar conditions occur below Enochs Point, but the middle reaches flow through a magnificent V-shaped valley. This section of the river can be viewed from the Big River four-wheel-drive track that runs south from Enochs Point, following a probable access route developed during the gold-mining era last century. In places this track is only one vehicle wide, as it clings to the very steep eastern side of the valley.

Many popular camping and picnicking areas are located in the more open sections. Extensive bush-camping areas with good two-wheel-drive vehicle access occur in the upper section from Snowy Road above Stockmans Reward down river to Horse Camp. They are all named, and most have information boards. On a State basis this area is important for its remoteness from urban centres and rural areas, it is the closest such area to Melbourne, and is one of the few such areas that can be reached by two-wheel-drive vehicle. The lower sections around Enochs Point and Chaffe Creek are other popular bush-camping areas.

The Big River is highly rated for trout-fishing. Good road access and the river's proximity to Lake Eildon provide a variety of trout-fishing opportunities. During high river flows, white-water canoeing or rafting conditions are excellent and are regarded as being of State significance. The section from Frenchmans Creek confluence to Lake Eildon is navigable. The deep valley and good forest cover also make the Big River Valley one of the most popular areas in the State for deer hunting, particularly for Sambar deer, which are relatively common here.

Recreational activities are enhanced by scenic qualities. The river winds between gravel shoals and falls over rock outcrops, separated by long quiet pools. The area from Twenty Five Mile Creek to Enoch Falls is particularly highly rated.

The corridor also contains reminders of the gold-mining era, when the gravels along much of the river were worked for gold. The now largely abandoned town of Enoch Point on the river's east bank owes its existence to this era, probably serving as a community centre for the surrounding hard rock mines and the alluvial mines immediately downstream. Today, gold-seekers can still pan the river and with luck get a show of colour.

### Tenure

Public land tenure	Area (ha)	Length (km)
State forest	1315	46
Eildon State Park	150	6
	1465	51

The heritage river corridor comprises a strip 200 m wide along each side of the river.

### Resources

There is no substantial current use of Big River water within the corridor, although it contributes to storage in Lake Eildon. The Board of Works considers the Big River is an important prospective water source for the future. The consultants estimate that a Big River diversion to augment Melbourne's water supply would be \$2-4M per year cheaper to construct and operate than the next-cheapest option, which is a diversion located at the Goulburn and Black Rivers junction.

The corridor contains some 2280 cu.m of mature class C+ and 460 cu.m of class D sawlogs. Withdrawal of this resource will reduce regional sustainable yield by about 0.2% in the Central Forest Management Area over the next 11 years. Vein gold and antimony have been mined in the past within the corridor, and economic reserves may still be present.

The consultants concluded that different in the cost between the Big and the Black/Goulburn as the 'next best' option for augmenting Melbourne's water supply is likely to exceed the Big River's environmental values.

## Recommendation

### A4 Big River

That the river corridor area of 1465 ha shown on Map 6 be used in accordance with general recommendations A1-A15 (a) to (k) above

that

- (l) (i) any new diversion of water only be permitted if its volume, timing, and offtake do not impair canoeing quality or in-stream habitat conditions, or reduce scenic landscape value
- (ii) should it be decided that the Big River is needed as a source of water supply for Melbourne, any barriers or structures be designed and constructed so as to not impede the passage of in-stream fauna (see note)
- (iii) timber-harvesting not be permitted in the corridor, but be permitted in the remainder of the valley, subject to application of the visual management system to minimise impacts on the scenic landscape viewed from the river and strategic vantage points
- (iv) the Big River four-wheel-drive track be maintained in its current condition in order to maintain the current range of recreational opportunities
- (v) if possible, the shallow quarries along the Jamieson Road be relocated and the sites reclaimed

that

- (m) the following values be protected
  - (i) habitat for the frog *Litoria spenceri*
  - (ii) scenic landscapes along the Big River from Oaks Creek to Lake Eildon
  - (iii) fishing opportunities — especially for trout
  - (iv) the canoe resource in a semi-remote setting from Frenchman Creek to Jamieson Road Bridge

and that

- (n) car-based camping, picnicking, bush-walking, and deer-hunting be permitted to continue, and the management of the river corridor recognise the importance of these uses.

Note:

When a review of these recommendations is carried out, the future use of the Big River for water supply should be considered.



*Goulburn Weir near Nagambie, Goulburn River*

## **Goulburn River**

The proposed heritage river corridor stretches 430 km downstream from Lake Eildon to the Murray River near Echuca. Along much of its length the river flows through open farmland, and only in the section below Toolamba does it flow through a wider area of native vegetation on public land. Above Nagambie sections of the river meander across a wide floodplain, while in some places — such as at Trawool — the valley narrows.

River flows are highly regulated. Water is stored in Lake Eildon and released for irrigation use in summer, flowing downstream to Goulburn Weir below Nagambie where much is diverted. Regulation has created its own set of values, but significant natural in-stream and riparian values remain. The cold and often clear waters released from Lake Eildon provide ideal conditions for trout, and anglers often gather along the many bends and gravel shoals in the section from Eildon to Yea River. With the summer releases, these bends, pools, and gravel rapids also provide excellent canoe-

touring opportunities, of State significance. Care is needed, however, to avoid the many overhanging willows. The rapid at Blue Gum is a popular venue for canoe slalom events.

Opportunities for a wide range of other recreational activities abound. Scenic picnic spots are common along the entire length and at Nagambie major camping grounds are located along the river. The impounded waters at Nagambie are also a focus for water sports and it is possible to visit some of the local wineries by boat.

Further downstream, the area between Toolamba and Kanyapella, where remnant native vegetation is up to 3 km wide, is popular with bush campers, anglers seeking native fish such as Murray cod, and nature observers, the river here being navigable by small boats.

Through much of its length the river has high scenic value, particularly where the remaining river red gums provide a pleasing visual contrast to the surrounding cleared land. Of particular scenic interest is the Trawool Valley area. Today, pleasure drivers can take in these views from the Goulburn Valley Highway, and the informal lookouts dotted along the valley.

Numerous cultural features along the Goulburn reflect major themes in human interaction with rivers. Structures to overcome rivers as barriers to transport and development — the timber Chinamans Bridge built in 1865, and the steel-girder rail bridge at Seymour built around 1872 — are of State significance. Days Flour Mill at Murchison used a water-driven wheel as the power source for grinding wheat. As a source of raw material — water — the Goulburn Weir downstream of Nagambie and associated infrastructure is of national significance. It marks the development of the first major irrigation scheme in Australia. These achievements are recorded in the interpretation centre at Nagambie Weir.

Despite the modifications in stream flow and in-stream and riparian habitat changes, many biological values remain.

The native vegetation below Murchison comprises river red gum open forests and woodlands that are significant examples of these communities, particularly those with an intact understorey. The Goulburn River marks a boundary where drier river red gum

associations found to the west meet the wetter ones more usual to the east. These areas are also particularly important habitat for a number of species, including the squirrel glider, brush-tailed phascogale, and barking owl — all rare species in Victoria. Squirrel gliders live in holes in mature trees, and require a relatively intact understorey to provide their food sources. Also of significance are the large-footed myotis and the frog *Limnodynastes fletcheri*. Although its distribution and habitat requirements are poorly known, this frog is suspected to be 'rare' if not 'endangered'.

In-stream values are also of note. The river contains Macquarie perch above Nagambie and Murray cod below Goulburn Weir — both species with a 'vulnerable' conservation status in Victoria. Below Nagambie it has a significant diversity of native fish species.

### Tenure

Public land tenure	Area (ha)	Length (km)
Flora and fauna reserve	80	2
Wildlife reserve	1 390	19
Echuca Regional Park	250	8
Streamside reserve	1 150	28
Murchison historic reserve	140	5
Public land water frontage reserve	5 740	187
State forest	10 560	169
Other	-	44
	<hr/>	<hr/>
	19 310	430

From Lake Eildon to Toolamba the corridor comprises the public land water frontage reserve, and is generally less than 200 m wide. Below Toolamba the river flows through the lower Goulburn riverine forest, which is up to 2 km wide, flowing across a broad floodplain. However, the riverine forest river red gum communities form a unit, and Council considers that this unit of public land should be managed as a single parcel. Accordingly in this section the width of the corridor has been increased to include the riverine forests and their associated values.

### Resources

The existing major use of water from this river is mentioned above. No current proposals exist for augmenting water storage, although a site at Trawool has been considered in the past.

Low intensity timber-harvesting in the river red gum forests downstream of Toolamba has a current annual sustained yield of 490 cu.m of sawlogs and 1170 sleeper units. It is recommended that these operations continue, in accordance with the principles and guidelines outlined in section F2. A management plan is being developed for the Mid-Murray Forest Area which includes this riverine forest.

The corridor may contain alluvial gold and lies within an area that is prospective for vein gold. It contains sand and gravel as well and these resources would also be present on the adjacent floodplain.

The consultants concluded that the environmental values are likely to exceed the resource values.

### Recommendation

#### A5 Goulburn River

That the river corridor of 19310 ha shown on Maps 7 and 8 be used in accordance with general recommendations A1-A15 (a) to (k) above that

- (l) (i) the corridor be retained free from further impoundments, artificial barriers, or structures that impede stream flow or passage of in-stream fauna (see Note 1)
- (ii) any new diversions of water only be permitted if their volumes, timing, and offtake do not impair wetland, riverine forest, or native fish habitat conditions, or reduce scenic landscape value
- (iii) timber-harvesting be permitted in the lower Goulburn forests below Murchison, subject to the principles and guidelines for river red gum harvesting operations (see section F2)
- (iv) grazing continue where it is currently permitted, but that in areas where future surveys identify a risk of degradation through loss of biological values or bank instability, licences be reviewed (see Note 2)

that

- (m) the following values be protected

- (i) areas with river red gum open forests/woodlands with an intact

understorey, and occurrences of river red gum, yellow box, and grey box woodlands/open forests

- (ii) areas of habitat significance for squirrel gliders, large-footed myotis, the frog *Limnodynastes fletcheri*, barking owls, brush-tailed phascogales, and water rats
- (iii) Murray cod habitat below Goulburn Weir, by avoiding cold-water releases during spawning, maintaining high water levels and better water quality for larval and juvenile stages, and retaining in-stream logs and a variety of bed conditions for adult resting and shelter
- (iv) Macquarie perch habitat above Goulburn Weir, by allowing seasonal water temperature changes and free passage, particularly from spring to early summer
- (v) native fish diversity, by implementing the principles and guidelines for fish habitat protection in section F2
- (vi) fishing opportunities — especially for trout from Eildon to Yea River, and native species below Goulburn Weir
- (vii) canoeing — Eildon to Goulburn Weir
- (viii) cultural heritage sites listed above
- (ix) scenic landscape — from below Seymour to Echuca, and from Molesworth to above Seymour

and that

- (n) car-based camping, picnicking, bushwalking, and boating continue where land status permits, and the management of the river corridor recognise the importance of these uses.

Notes:

1. The Goulburn River has required bed and bank stabilisation measures in the past, and Council is aware of the existence of various works and of continuing needs.
2. The Council has been informed that some limited areas of the public land water frontage are cultivated or used for

horticulture. While in the long term these are considered inappropriate uses of frontages, the recommendations do not propose that they be removed.



*Big Bend, Wimmera River, in the Little Desert National Park*

## **Wimmera River**

The proposed heritage river corridor extends along the Wimmera River from Polkemmet Bridge, past Lake Hindmarsh, and on to the Outlet Creek system and its terminal lakes — Albacutya and ultimately Wirrengren Plain. This section of river flows north across an extensive plain that on average receives less than 300 mm of rain each year and has an annual potential evaporation rate of more than 1000 mm. It regularly contains water from Polkemmet Bridge to Lake Hindmarsh, but only intermittently fills downstream of the Lake. The frequency with which this section contains water has been reduced as a result of substantial diversion from the Wimmera River headwaters for the Wimmera-Mallee stock and domestic supply system.

As a result, the flow regime through the river corridor has been considerably modified by water diversion, and the maintenance of some downriver in-stream, riparian, and floodplain values is at risk. The importance of environmental flows along the Wimmera River to its terminal lakes has already been recognised by government (see Note 1). Above Jeparit, it is slow-flowing, its water is warm, the river-bed

sandy, and long deep pools separated by sandy bars are a common feature.

Some sections of the river — such as immediately south of Dimboola and north of Lake Hindmarsh — are surrounded by extensive native vegetation. Elsewhere a narrow riparian strip of remnant vegetation is all that exists in an area that has been substantially cleared for agriculture.

Flowing through such dry country the river is a corridor of life. It has created a distinct pattern of vegetation and animal habitats across its floodplain and associated lake system. In sections where the adjacent land has been cleared the riparian river red gum-box association is of particular significance, and forms a vital corridor for wildlife habitat and migration.

Dorrington Point at Lake Albacutya also has floristic significance. The river red gums here have a higher than usual salt tolerance and their seed is in international demand. The riparian communities also contain many species of conservation significance, particularly where the understorey is intact. The section south of Dimboola contains six species that are considered to be extremely rare, and another four that are either endangered or have very localised occurrences. An area with intact understorey occurs between Antwerp and Dimboola, including populations of the vulnerable bottle bluebush (*Maireana excavata*).

Lake Hindmarsh is ringed by woodlands of large old river red gums with shrubby understoreys, merging into black box woodlands, occasionally with open shrublands of tangled lignum. To the south-west of the lake, impressive woodlands of yellow gum and slender cypress pine occur. An excellent stand of the depleted salt paperbark (*Melaleuca halmaturorum*) grows to the immediate north-east of the Wimmera River mouth. The extremely rare plant species jerry-jerry (*Ammannia multiflora*), water-fire (*Bergia ammonioides*), *Cyperus rigidellus*, and six-point arrowgrass (*Triglochin hexagona*) have been recorded at Lake Hindmarsh, as have large populations of other significant plants, including three-nerve wattle (*Acacia trineura*), short rat-tail grass (*Sporobolus mitchellii*), and *Atriplex australasica*.

In-stream habitat makes the perennial sections also significant — providing refuge for the

Murray cod, which is considered vulnerable as a result of habitat changes.

Its lake system is a key feature of the river. When full, Lake Hindmarsh is the largest fresh-water body in Victoria. One of only three Victorian breeding colonies of Australian pelicans has been located here, as is one of the few breeding colonies of pied cormorants in the State. The river red gum woodlands at its northern end are frequented by a variety of significant birds, including the regent parrot, Mallee ringneck, splendid fairy wren, bush thick knee, and Gilberts whistler. When full, Lake Albacutya too attracts many different birds and in large numbers, including the rare freckled duck. The inclusion of Lake Albacutya under the international Ramsar convention on wetlands underlines its outstanding significance.

The Wimmera River terminal lake system has geomorphic significance. The sediments around the lake margins and surrounding dunes form an important record of past water levels, reflecting climatic changes in the region over the last million years.

Both river and lake margins record changes in the cultural landscape that date back thousands of years. The river was a focus for traditional Aboriginal society, a source of fresh water, plant foods, mussels, fish, and bird life. The numerous middens and scarred trees from which bark has been removed attest to this cultural association with the river. For the Wergaia the Wimmera was also a feature of the mythological landscape, and they recount the creation of the river and its lakes.

Social dislocation of Aboriginal culture occurred in the nineteenth century — a period of great injustice. Today the remains of the Ebenezer Mission, established in 1858 to attempt to redress the injustices, symbolises this aspect of Australia's recent history. Current place names — for example, Lake Albacutya, Jeparit and the river itself are also reminders of the period. The river continues to influence the cultural landscape. Today it is a key area for many recreational activities in the region.

In such a dry area the river course and lake margins, with their eucalypts, are an important visual feature in what Eyre in 1838 described as a dreary, sandy, barren, scrubby, flat-looking country. The section of river adjacent to Little

Desert National Park, from Polkemmet to Dimboola, is particularly scenic, with popular camping and picnic spots. These often have good swimming holes, and provide the chance to catch fish, especially golden perch, and to observe wildlife.

The river is a recreational focus for the towns of Dimboola and Jeparit, with a number of developed sporting facilities. Lake Hindmarsh, with its expanse of water and high redfin numbers, is also a popular recreation spot.

The often-dry channel of Outlet Creek is popular with walkers who follow it into Wyperfeld National Park. This creek and its associated lakes provide attractive spots for bush camping, and a number of car-based camping sites have been developed in the park. The periodic filling of the creek was also a cause for celebration by the people of Pella, who used to walk along with the rising waters and celebrate its arrival at Pella with a picnic.

**Tenure**

Public land tenure	Area (ha)	Length (km)
Little Desert National Park	580	12
Wyperfeld National Park	25 490	59
Lake Albacutya Regional Park	8 740	28
Lake Hindmarsh Lake Reserve	15 820	21
Public land water frontage reserve	4 420	104
Outlet Creek Education Area	350	5
Wail State Forest	620	11
Other	-	2
	<u>56 020</u>	<u>229</u>

Corridor width is irregular. Upstream of Lake Hindmarsh and between it and Lake Albacutya, the corridor comprises the public land water frontage reserve. At these Lakes, the corridor widens to 10 km to include the lake-beds and their margins. Downstream of Lake Albacutya it broadens to include the river red gum — black box association, which reflects the location of the distributory channel and lake system and their associated values.

**Resources**

Within Wail State Forest, areas adjacent to the river are not utilised for hardwood production.

In order to protect the botanical values of the Lake Hindmarsh surrounds it is recommended that commercial firewood-harvesting continue to be prohibited here. Lake Hindmarsh is used for commercial fishing for redfin and yabbies.

The corridor is within a major mineral sand province covering much of north-western Victoria. To date five areas with significant deposits have been identified or inferred from exploration, but are located well away from the corridor. If current extraction and metallurgical problems associated with their development are resolved, these areas are considered to contain many years of reserves.

It is concluded that the environmental values are likely to exceed the resource values.

**Recommendation**

**A6 Wimmera River**

That the river corridor of 56 020 ha shown on Maps 9 and 10 be used in accordance with general recommendations A1–A15 (a) to (k) above

that

- (l) (i) the corridor be retained free from further impoundments, artificial barriers, or structures that impede stream flow or passage of in-stream fauna
- (ii) any new diversions of water only be permitted if their volumes, timing, and offtake do not impair native fish habitat conditions or riverine vegetation flooding regimes, or reduce scenic landscape value (see Note 1)
- (iii) the land managers review the location of river roads away from sensitive river banks and Aboriginal sites (see Note 2)
- (iv) areas currently available for firewood collection, with the land manager's approval, continue to be available (see Note 3)

that

- (m) the following values be protected
  - (i) cultural heritage associations of the entire reach, including many archaeological sites, and the Ebenezer Mission

- (ii) sites of botanical significance from Antwerp to Outlet Creek, Lake Hindmarsh surrounds, and areas with river red gum open forests-woodlands with an intact understorey
- (iii) significant water-bird habitat
- (iv) the significant geomorphological features of lake surrounds.
- (v) scenic landscapes along the Wimmera River from Polkemmet to near Dimboola
- (vi) Murray cod habitat, by avoiding cold-water releases during spawning, maintaining rising water levels and temperatures for spawning (during spawning season) and better water quality for larval and juvenile stages, and retaining in-stream logs and a variety of bed conditions for adult resting and shelter
- (vii) fishing opportunities, especially for golden perch, yabbies, and redfin (see Note 4)

and that

- (n) boating, car-based camping, picnicking, fishing and walking continue, where land status permits, and management recognise the importance of these uses.

Notes:

1. The government has approved recommendations O230 and O231 (as varied) of the Council's Mallee Area Review. These require: the urgent study of the means of providing environmental flows along the Wimmera River to its terminal lakes in Wyperfeld National Park; that this study be reported on by 1991; and that recommendations arising from it be considered as a matter of urgency.
2. Council is aware of the development of a management plan for the Wimmera River and its catchment by the Department of Conservation and Environment, Horsham region.
3. Lake Hindmarsh surrounds should not be available for licensed firewood-harvesting, because of the particularly high botanical values there.
4. Council is aware of the professional fishing operations on Lake Hindmarsh.

## **Bemm River & its Tributaries, Goolengook, Arte, and Errinundra Rivers**

The proposed heritage river corridor extends along the Bemm River including its estuary and its tributaries — the Arte River from the upper Glen Arte Road crossing to its confluence with the Goolengook River, the Goolengook River from its headwaters to the Bemm River, and the Errinundra River and its East Branch.

The Bemm River lies approximately halfway between the towns of Orbost and Cann River.

The headwaters of the Errinundra and Goolengook Rivers drain south from the Errinundra Plateau, which varies in elevation from 1000 to 1200 m.

Originating on the plateau, the East Errinundra River displays a range of undisturbed aquatic environments — from subalpine springs and swamps on the plateau proper, through a stream with very steep gradients and spectacular waterfalls on the escarpment, to a substantial foothill river. The headwaters of the Goolengook River differ from those of the East Errinundra, being developed on granitic parent material. Furthermore, the Goolengook River, with its steep headwaters but relatively broad flat valley tract, provides a valuable undisturbed example of a stream type that has been cleared for agriculture elsewhere in East Gippsland.

Streamside vegetation — indeed the entire catchment — is essentially native forest, and for much of their length these rivers have a *high mainstream naturalness*. Their corridors contain the best rainforest continuum in the State, with a near-continuous occurrence of cool temperate and warm temperate rainforest from 1200 m to close to sea level.

Cool temperate rainforest occurs in the highland areas and down to elevations of 600 m. Southern sassafras is dominant, with black olive berry frequently *co-dominating the canopy*. Other common associated trees or shrubs associated include forest wattle, Gippsland waratah, mountain pepper, privet mock olive, and banyalla. Ferns dominate the understorey. This community only develops to maturity on

suitable sites in the absence of severe fire for a century or more.

Warm temperate rainforest communities occur on the alluvial flats along these rivers and at elevations from sea level to 700 m. Depending on the susceptibility to flooding, kanooka or lillypilly may dominate. Where lillypilly dominates it may reach a height of 30 m, commonly forming a closed canopy usually with a variety of woody vines or lianes. These communities are particularly well developed along the lower reaches of the Bemm River with the section around the Princes Highway being in excellent condition. The flora includes species that are uncommon or rare in the State — for example, the white supplejack, a tall robust cane-like vine that is known in only a handful of lowland rainforest sites in East Gippsland. In recognition of the importance of these stands, the section of the Bemm near the highway is rated as nationally significant, and the section below the highway to Bemm River township as of State significance, for rainforest conservation.

Between 400 and 800 m elevation, elements of cool temperate and warm temperate rainforest intergrade, and occurrences are found on the Goolengook, Errinundra, and the Arte Rivers. In such areas southern sassafras, black olive berry, and lillypilly are co-dominant overstorey trees. Such intergrades are rare in Victoria. Normally, although these two communities may be close together, substantial differences in elevation separate them. The occurrences of intergrades or overlap rainforest on the Arte River has been well documented and is of State significance.

Rainforest also provides habitat for a number of rare animals. For the site studied in detail at Bellbird Creek it is a key component of the habitat requirements for the long-footed potoroo, providing shelter and the fungi that are its main dietary requirement. The species has endangered status and is of international significance. It was first confirmed as a separate species in 1980, since when scientists have identified only 20 sites and these tend to be clustered rather than evenly distributed. Two predator scat records containing potoroo remains were located in the Bemm River corridor.

The aquatic habitat too is significant. The 'vulnerable' Australian grayling occurs in the

Bemm River. The lower reaches of that river and its estuary, Sydenham Inlet, are also important for conserving the diverse range of fish species present.

The estuary contains a number of geomorphic features that reflect changes in the location of the mouth of the Bemm, formation of the outer barrier dune, and the hydrological balance within the estuary and the adjoining wetlands. These features are of State significance.

Sydenham Inlet is a popular car-based camping spot and is often crowded during holidays over the summer. It is also regarded as an anglers' Mecca for species such as bream, perch, and bass. Fishing from shore and from boats are both popular, although the open nature of the estuary means that strong winds can be a problem. Scenic drives adjacent to sections of the Bemm River and its tributaries, provide opportunities for rainforest interpretation and appreciation. A self-guided tour through the rainforest at the Princes Highway is currently being developed, allowing people to experience, and have interpreted at first hand, the atmosphere and beauty of such places, and to appreciate the complex ecology of these ecosystems.

#### Tenure

Public land tenure	Area (ha)	Length (km)
Errinundra National Park	630	16
Croajingolong National Park	340	7
Arte River Flora Reserve	70	2
Sydenham Inlet/Cape Conran Coastal Park	1410	16
Bemm River Scenic Reserve	410	9
Public land water frontage reserve	330	36
State forest	*3330	106
	*6520	148

\* provisional

The corridor comprises the rainforest protection zone and a small flora reserve on the Arte River, the natural features zones along the Bemm, Goolengook, and Errinundra Rivers, and a strip 200-m wide along each side of the Errinundra and East Errinundra Rivers in the Errinundra National Park. Small lengths of public land water frontage reserve occur adjacent to private land.

## Resources

In the State forest section of the proposed heritage river corridor, the land managers currently apply protective measures for rainforest, and in the recommended natural features zone. The aims of this protection are described in Council's East Gippsland Area Review Final Recommendations. The natural features zone has not been defined in a forest management area plan to date, so the corridor through State forest shown on Maps 11, 12 and 13 is diagrammatic and the area figures are provisional.

A protective buffer of 40 m around rainforest in State forest is included in the area shown on the maps, where relevant.

No mineral prospects that are currently seen as likely to be mined have been identified. However, the river corridor is prospective for alluvial gold and the area in which it lies is prospective for vein gold, lead, zinc, and silver deposits.

The consultants concluded that the environmental values are likely to exceed the resource values.

## Recommendation

### A7 Bemm River and its tributaries, Goolenook, Arte, and Errinundra Rivers

That the river corridor of 6520 ha (provisional area) shown on Maps 11, 12, and 13 be used in accordance with general recommendations A1-A15 (a) to (k) above

that

- (l) (i) the corridor be retained free from impoundments, artificial barriers or structures that impede stream flow or passage of in-stream fauna
- (ii) any new diversions of water only be permitted if their volumes, timing, and offtake do not impair native fish habitat conditions, adversely affect rainforest and its continuity, or reduce scenic landscape value
- (iii) stocking with fish species that are not indigenous to these streams not be permitted

that

- (m) the following values be protected

- (i) rainforest occurrence
- (ii) long-footed potoroo habitat (see Note)
- (iii) Australian grayling habitat, by retaining free passage to the sea for migration, and maintaining water quality, flow, and in-stream habitat conditions
- (iv) native fish diversity in the lower reaches and Sydenham Inlet, by implementing the principles and guidelines for fish habitat protection (see section F2)
- (v) Sydenham Inlet, an estuary of geomorphological significance

and that

- (n) boating, recreational fishing, car-based camping, picnicking, and bushwalking continue where land status permits, and the management of the river corridor recognise the importance of these uses.

Note:

A recent report (Scotts and Seebeck, 1989) highlights the need for extra work to clarify the requirements of this species.

## Snowy River

The proposed heritage river corridor along the Snowy, one of Australia's best-known rivers, extends from the New South Wales-Victorian border south to its ocean outfall at Marlo. Its tributary the Little River, from the Deddick road to the Snowy River, is also included.

The character of the river and its valley changes markedly along its course. From the border to Tulloch Ard Gorge, below McKillop Bridge, its river flows through an open steep-sided valley. Below the gorge its valley widens again before it finally crosses a broad floodplain south of Bete Bolong. This extends to Marlo, where it enters Bass Strait.

A series of sites of national and State geological or geomorphological significance occur here. The Boundary Creek/Little River Gorge area is among the most precipitous terrain in Victoria and contains extensive exposure of the Snowy River volcanics; the Campbells Knob/Tulloch Ard area displays an excellent example of bedrock geology control of valley morphology; and the New Guinea area has

exposures of Snowy River volcanics, Buchan Caves Limestone, and associated karst features. The caves here also contain evidence of Aboriginal use of the region dating back 18 000 years. Other sites with evidence of Aboriginal use are found along the Snowy River upstream of Little River.

Among the many nature conservation values, a variety of vegetation communities reflect broad-scale changes in rainfall and relief. They include rain-shadow woodland, dry sclerophyll, lowland sclerophyll, riparian forests, and warm temperate rainforest. Containing 18 rare plants, the section between Deddick River and Betts Creek is of outstanding botanical significance. The Snowy River gorge section in particular has drawn the attention of biologists following botanical discoveries in the 1950s. In this section a number of species are endemic or disjunct in their occurrence. Those endemic to the river tract and nearby areas include *Leucopogon riparius*, *Hibbertia spathulata* and Snowy River wattle. Snowy River daisy and *Dodonaea rhombifolia* were described here and are rarely encountered outside the Victorian section of the river. Disjunct western species that occur in the gorge include *Micromyrtus ciliata*, *Kunzea parvifolia*, and *Phebalium glandulosum*.

The lower Snowy is also of floristic significance, particularly between Long Point and Pipeclay Creek, where remnant stands of warm temperate rainforest occur. Some stands are floristically distinct from similar rainforest to the east. Rare species include the only Victorian record of hazelwood and the yellow milk-vine.

Further north, from the border to Currie Creek, the riparian woodland and forest provide habitat for many birds. The caves along the river are important maternity sites for the common bent-wing bat, with less than 10 such sites having been identified in Victoria. In the steep and rocky Little River gorge, several active colonies of brush-tailed rock-wallabies have been recently recorded. This species is considered to be 'endangered' in Victoria.

The cool clear waters, coarse substrate, and numerous rapids and pools in the section above the floodplain provide excellent habitat for the vulnerable Australian grayling, and the estuary is significant for the diversity of its fish fauna.

Rugged valleys and gorges, rapids, pools, sandy beaches, and the pattern of vegetation communities, including the rain-shadow woodlands dominated by native pine, create a river of high scenic beauty. Notable vantage points occur along the Deddick River road and the Alpine Way. At one lookout, Wulgulmerang Creek and Little River can be seen as they plunge 300 m into Little River Gorge. Pleasure drivers can also take in the spectacular valley views from the Turnback to McKillop Bridge section of the Deddick River road as it winds its way into the valley.

McKillop Bridge and Willis (at the State border) are important starting points for canoeists and rafters. The thrill of negotiating numerous rapids, and the pleasure of paddling the long still pools, camping on sandy beaches, and enjoying the spectacular scenery give the Snowy River a national reputation for white-water touring in a remote setting.

Many car-based bush camp sites occur adjacent to the Snowy River road, above Gattamurh Ford, and at McKillop Bridge. The river valley provides opportunities for other recreational activities including rock-climbing and abseiling, especially around Little River Gorge, and overnight walking in a remote setting.

The Snowy River also illustrates a theme significant in Victorian history — rivers and communication. In the mid nineteenth century shallow-draft boats transported goods, brought to Marlo by sea, up the Snowy to Orbost. To assist navigation, river red gums and their snags were systematically removed. What was then considered beneficial is now recognised to have resulted in environmental problems. As effective land transport networks were established, river transport came to an end. By 1916 the railway had reached Orbost, but to establish a link across the Snowy floodplain required extensive bridging to allow floodwater to pass beneath. This now-disused wooden trestle bridge still crosses the floodplain, and is the longest trestle-supported rail or road bridge in the State.

Crossings in the valley sections required a different approach, and it must be remembered that, prior to diversion of water by the Snowy Mountains Scheme, the Snowy had the highest discharge of any Victorian river. By 1840 the section around the present McKillop Bridge

was an established crossing, with a ferry in operation by the 1890s. The first bridge built at this location was destroyed by floods in the 1930s. It has now been replaced by a steel deck, which sits on four reinforced concrete pylons.

Such a substantial bridge, on the narrow and winding Deddick River road (one of only two bridges to cross the Snowy River in Victoria), is a permanent reminder of the power of rivers in shaping human settlements.

The flow regime of the Snowy River has been considerably modified by headwater diversions through the Snowy Mountains Hydro-electricity Scheme located in New South Wales. These diversions and consequent increase in the duration of low flows have had an adverse impact on a number of in-stream values. Consequently, Council has endorsed current initiatives to investigate the provision of environmental flows.

### Tenure

Public land tenure	Area (ha)	Length (km)
Alpine National Park	11 460	32
Snowy River National Park	29 530	79
Wood Point Flora Reserve	75	1
First and Second Island Flora Reserve	35	2
Wildlife reserve	30	1
Coastal reserve	325	4
Public land water frontage reserve	820	34
State forest	4 415	28
	<u>46 690</u>	<u>175</u>

The corridor width varies substantially. In the Alpine and Snowy River National Parks, the corridor takes in the catchments to steep, first-order streams draining to the Snowy. To include the gorge sections, the boundary on the west side extends to the edge of the national park in places. Downstream in the State forest, the corridor again takes in the catchment of short adjoining streams. It narrows to comprise the public land water frontage reserve in places, adjacent to private land.

### Resources

The possible siting of a pulp mill at Orbost may have implications for flows and values in the proposed heritage river corridor. The water requirements of such a mill could be met by an offstream storage. These recommendations do

not preclude diversion from the Snowy River to such a storage, provided it neither impairs fish passage, and canoe value nor increases the incidence of low flows.

Timber-harvesting is recommended to continue in the lower Snowy State forest part of the proposed corridor, outside the existing natural features zone. The timber resource there consists of coastal and foothill mixed species and is currently utilised using low-intensity operations to extract mainly durable species. The Council has previously recommended that most of this area be available for forestry education and research.

Where land status permits mining, there are no known mineral resources.

In regard to industrial activities, the proposed East Gippsland route of the Very Fast Train would cross the corridor on the floodplain section upstream of Orbost. The recommendations do not preclude such a proposal.

The consultants concluded that the environmental values are likely to exceed the resource values.

### Recommendation

#### A8 Snowy River

that the river corridor of 46690 ha, shown on Maps 14, 15, and 16 be used in accordance with general recommendations A1-A15 (a) to (k) above

that

- (l) (i) the corridor be retained free from further impoundments, artificial barriers, or structures that impede stream flow or passage of in-stream fauna
- (ii) any new diversions of water only be permitted if their volumes, timing, and offtake do not significantly impair canoeing quality or native fish habitat conditions, particularly during low-flow periods, or reduce scenic landscape value
- (iii) timber-harvesting be permitted in the lower Snowy State forest part of the corridor, by selection felling at a low intensity, except within the natural features zone, and subject to application of the visual management system to minimise the impact

on scenic landscapes viewed from the river and strategic vantage points, and in accordance with previous Council recommendations

that

(m) the following values be protected

- (i) canoeing and rafting — border to Buchan confluence
- (ii) scenic landscapes along the Snowy River from the border to Bete Bolong and the Little River Gorge
- (iii) Australian grayling habitat, by retaining free passage to the sea for migration, and maintaining water quality, flow, and in-stream habitat conditions
- (iv) native fish diversity in the estuary, by implementing the principles and guidelines for fish habitat protection (see section F2)
- (v) geological and geomorphological sites of significance listed above
- (vi) cultural heritage sites of Pleistocene occupation, at New Guinea, Aboriginal archaeological sites upstream of Little River, river crossings and other features on the Orbost floodplain
- (vii) outstanding botanical values outlined above
- (viii) fauna habitat values of the Snowy River valley, especially those associated with riparian vegetation and caves

that

(n) vehicle-based camping, picnicking, bushwalking, and recreational fishing continue where land status permits, and the management of the river corridor recognise the importance of these uses

and that

(o) discussions take place between the relevant Victorian, New South Wales and Commonwealth authorities with a view to investigating the provision of increased flows in low-flow periods (usually during the summer months).

Notes:

1. The upper reach of this river is in an area of high wilderness quality being considered in the Council's current Wilderness Special Investigation.
2. Provision for commercial development beside the Snowy River at McKillop Bridge has been made by Council (Alpine Area Special Investigation — Recommendations T5). Council is seeking comment in submissions on this use and its relationship to the heritage river proposal.

### **Suggan Buggan and Berrima Rivers**

The proposed heritage river corridor extends from the New South Wales border to the Snowy River confluence. The Suggan Buggan and Berrima Rivers are part of the one drainage system. The Berrima River rises in the Great Dividing Range around Mt Pilot, and drains to the south-east before becoming the Suggan Buggan River, a tributary of the Snowy. Over the corridor section the river falls 800 m, to 200 m above sea level. Except for a cleared area of private land around the township of Suggan Buggan, the areas in native forest have high mainstream naturalness.

As a result of changes in elevation and rainfall pattern — a major rain-shadow area occurs around Suggan Buggan — the river corridor intersects a number of vegetation communities. These include riparian forest, montane sclerophyll woodland, dry sclerophyll forest, rocky outcrop open scrubland, and rain-shadow woodland.

A site of State botanical significance surrounds the corridor. The dry rain-shadow woodland and rocky outcrop open-scrubland communities are of outstanding botanical value, but of particular interest is their striking contrast with the riparian forest. Two sample quadrats on the Berrima and Suggan Buggan Rivers in the riparian forest community were rated as having high botanical significance for their undisturbed condition, and the rare and endangered leafless shrub *Discaria pubescens* occurs at the Berrima River site. The corridor along the Suggan Buggan is also an important water and food source for animals and birds — yellow-tufted honeyeaters nest here.

The in-stream habitat is also of note: it includes an important spawning site for the

Australian grayling, which has a 'vulnerable' conservation status.

The visual character of the corridor has been assessed as having high scenic value. Some see the rain-shadow rainshadow country, with its cypress pine and sparse understorey, as dry and stark. For others it is a source of variety and relief, differing greatly from corridor vegetation along many other river valleys in East Gippsland. The Snowy River road crosses it at Suggan Buggan, but, except around this township, tracks along the river are few, giving the river a high capability for those recreational activities requiring a remote setting.

#### Tenure

Public land tenure	Area (ha)	Length (km)
Alpine (Cobberas-Tingaringy) National Park	1725	48
Public land water frontage reserve	115	8
	1840	56

The corridor is uniformly 200 m wide along each stream-bank, except at Suggan Buggan where the frontage reserve is narrower.

#### Resources

Owing to the existing national park status of the corridor, there are no resource implications of these recommendations.

#### Recommendation

##### A9 Suggan Buggan and Berrima Rivers

That the river corridor of 1840 ha shown on Map 17 be used in accordance with general recommendations A1-A15 (a) to (k) above that

- (l) (i) the corridor be retained free from impoundments, artificial barriers, or structures that impede stream flow or passage of in-stream fauna
- (ii) no new diversions of water from the rivers be permitted
- (iii) no new roading be constructed in the corridor

that

- (m) the following values be protected
  - (i) sites of botanical significance outlined above

- (ii) scenic landscapes along the Suggan Buggan and Berrima Rivers from the border to the Snowy River (except around Suggan Buggan)
- (iii) Australian grayling habitat, by retaining free passage to the sea (via Snowy River) for migration, and maintaining water quality, flow, and in-stream habitat conditions
- (iv) the essentially natural condition of the Suggan Buggan and Berrima mainstreams

and that

- (n) walking and other activities requiring a remote setting continue, where access and current land status permit, and that management recognise the importance of these uses.

Note:

Except around Suggan Buggan township, this corridor is in an area of high wilderness quality being considered in the Council's current Wilderness Special Investigation.

#### Buchan River

The proposed heritage river corridor extends from 'The Playgrounds' near Mount Cobberas downstream to the Campbells Creek confluence. Over this reach it falls some 500 m and, after a gently sloping and broad valley in the upper section, has a deep and V-shaped valley. The river corridor forms parts of a larger area within a site of outstanding botanical significance. Important riparian forests range from Native Dog Flat, where the Victorian endemic *Leucopogon pilifer* is found, to specific sample quadrats with high botanical significance for their undisturbed condition. The thick-leaf star-hair (rare in Victoria) and bristle-fern (rare in Australia and Victoria) have been recorded on the upper Buchan River.

The lack of diversions, timber-harvesting, mining, waste discharges, and other resource developments that may adversely affect the in-stream condition makes the mainstream corridor highly natural. These conditions provide habitat for the Australian grayling, which has a 'vulnerable' conservation significance.

The corridor area of the Buchan River is a major geographic feature within a site of State faunal significance. The vulnerable alpine water skink has been recorded in sphagnum

bogs along the upper Buchan River, and the rare broad-toothed rat, which occurs in wet closed heaths and sedgeland, has been found alongside the upper Buchan in this corridor.

Also of importance is the section between Lake Hill and Never Never Creeks — of State significance for its geological and geomorphological features. Erosion by the river has exposed a sequence of Ordovician and Silurian sediments and associated volcanics. These beds contain bands of marine fossils which are the 'type' locality allowing the rocks to be dated and correlated with sediments outside the region. The complex entrenched meander near Honeysuckle Creek has geomorphic significance. In this section the river is 300 m below the adjacent ridges and spurs and, over a distance of 400 m as the crow flies, it changes direction nearly 360°.

The combination of a deep V-shaped valley, numerous rock outcrops, sinuous river form, and the tall open eucalypt forest gives this section of river a high scenic value. The natural visual setting and general absence of an extensive riparian track network gives the river a high capability for those recreational activities requiring a remote setting.

**Tenure**

Public land tenure	Area (ha)	Length (km)
Alpine (Cobberas-Tingaringy) National Park	1780	55

Along its entire length, the corridor is uniformly 200 m wide along each stream-bank.

**Resources**

Owing to the existing national park status of the corridor, there are no resource implications of these recommendations.

**Recommendation**

**A10 Upper Buchan River**

That the river corridor of 1700 ha shown on Map 18 be used in accordance with general recommendations A1–A15 (a) to (k) above

that

- (l) (i) the corridor be retained free from impoundments, artificial barriers, or structures that impede stream flow or passage of in-stream fauna
- (ii) any new diversions of water only be permitted if their volumes, timing,

and offtake do not impair native fish habitat conditions, or reduce scenic landscape value

that

- (m) the following values be protected
  - (i) botanical values outlined above
  - (ii) faunal values outlined above
  - (iii) scenic landscapes along the Buchan River
  - (iv) Australian grayling habitat, by retaining free passage for migration, and maintaining water quality, flow, and in-stream habitat conditions
  - (v) the essentially natural condition of the Buchan mainstream
  - (vi) geologically significant exposures of Ordovician and Silurian sediments

and that

- (n) bushwalking and fishing continue where access and land status permit and management of the corridor recognise the importance of these uses.

Note:

This river is in an area of high wilderness quality being considered in the Council's current Wilderness Special Investigation.



*Mitchell River silt jetties*

## Mitchell and Wonnangatta Rivers

The proposed heritage river corridor includes the Wonnangatta River, which becomes the Mitchell below its confluence with the Dargo River. Together these form a river 260 km long, which falls over 1400 m from the Great Dividing Range to its estuary in Gippsland Lakes. It is the largest free-flowing river in Victoria, free of barriers that affect the movement of native fish, or water diversions or additions that affect the timing of natural flows. Such rivers are important examples of the large-scale biological systems that were once widespread in south-eastern Australia.

The character of the river corridor changes markedly. The upper section has a wide steep-sided valley, but with small intermontane basins filled with alluvium, caused by constriction of the valley downstream. Between the junctions with the Wongungarra and the Wentworth is an extensive area of alluvial deposits. Below this point the river enters the Mitchell River Gorge, downstream from which it crosses a broad floodplain along the Lindenow flats. It has developed a long digitate delta (the silt jetties) below Bairnsdale. Along its course, numerous sites of significance reflect its physical, ecological, and cultural evolution.

Of State geological significance are exposures of the Avon River and Wentworth Groups of rocks, and the intrusive and structural features exposed in both the gorge and at Tabberabbera. The cliff-lined gorge has State geomorphological significance. It contains entrenched and spurred meanders and highly undercut cliffs. The particular form of the Mitchell River silt jetties — two parallel fingers of sediment reaching almost 8 km into Lake King — is one of the best examples of a digitate delta in the world.

The shelter provided by the deep gorge and its steep, deeply incised tributary streams provide the particular requirements of a number of plants. One of the western most Australian occurrences of warm temperature rainforest occurs here. Consequently a number of individual species are also at the limit of their distribution. These features are of national botanical significance. Among other individual plant species of significance, an undescribed species of daisy bush at Billygoat

Bend is of State significance, having a restricted occurrence.

Sections of river corridor within the gorge have been identified as having high naturalness. The river itself has special ecological significance. Both the Wonnangatta and the Mitchell have populations of the vulnerable Australian grayling. The gorge area and sections of the river on the Lindenow flats are of conservation significance because of the apparent absence of exotic fish species and the abundance and diversity of native species recorded during fish surveys. The estuary too has a highly diverse fish population. In addition, the presence of species such as bream and estuary perch make the lower reaches a popular recreational fishery, and its depth and width ensure it is a popular boating venue. Upstream, the clear cold waters of the Wonnangatta are well regarded by anglers for brown trout.

Opportunities for other recreational activities — gold-panning, horse-riding and deer-hunting — abound. The remote Wonnangatta Station homestead site is a popular destination and camp site for four-wheel-drive enthusiasts and bushwalkers. Other popular car-based camping and picnic locations include Bullock Flat, Jacobs Ladder, and Monkey Flat, and the extensive clearing that surrounds the river at what was once the Angusvale Hotel, which also interests walkers and river travellers. Nearby is a major rapid, consisting of a series of chutes that link to create a 200-m-long canoe slalom course. It is a venue for State championships and is one of many highlights of a canoe or raft trip from Waterford to Glenaladale. The upper section of this trip is rated as among the best white-water tours in Victoria, while the section below the slalom rapid is rated among the best in Australia. The first recorded canoe trip through the gorge was undertaken in 1875 by two local Aborigines who guided Howitt, the explorer and naturalist. A popular walking track also winds along the river downstream from Angusvale, eventually finishing at Woolshed Creek.

The recreational activities along much of the river are enhanced by its scenic beauty. The Wonnangatta road gives pleasure drivers excellent views of the forested valley walls and the mosaic of farms along the open sections of

valley bottoms. 'The Amphitheatre' and also the Woolshed Creek Lookout are popular destinations for pleasure drivers seeking vistas of the river, its rugged rock-strewn valley walls, surrounding mountainous terrain, and the distant roar of rapids.

The Mitchell and Wonnangatta Valleys have numerous cultural heritage associations, and Aboriginal archaeological sites occur along their length. Angus Macmillan's Track — a major access and stock route — followed the Wonnangatta above Eaglevale. Wonnangatta Station was an early pastoral station, and the site has its own mystique. On the lower Mitchell, Bairnsdale was a major port for river-boats.

### Tenure

Public land tenure	Area (ha)	Length (km)
Alpine (Wonnangatta-Moroka) National Park	4 330	76
Mitchell River National Park	4 890	34
Public land water frontage reserve	2 110	125
Gippsland Lakes reserve	400	15
State forest	1 770	69
Other	-	4
	13 500	256

The corridor is generally 200 m wide along each stream-bank but increases where values require. Within the gorge section of the Mitchell River, it extends to the first drainage divide along the river and is up to 2 km wide. This ensures that it incorporates the scenic, recreational, and key natural features. Similarly, to incorporate areas important for recreation, the width of the corridor within the Wonnangatta Valley has been increased to about 1 km where a wide valley floor is present.

### Resources

Proposals to build a dam on the Mitchell River in (or above) the gorge have been considered on several occasions. The major users of water from such a storage would be irrigators on the Lindenow Flats and Bairnsdale water supply. The Council is concerned that such a structure and the associated changes to flow regime would seriously damage certain river values — the natural condition of the flow regime and

the mainstream, free passage and habitat requirements for native fish, canoeing, and significant botanical and geological sites (depending on the location of the flooded area). The consultants assessed the economic values of a dam on the Mitchell and concluded that it is 'not an economic proposition'. Many of the perceived benefits of a dam had occurred in its absence, while both irrigation and town supply needs are currently being met and future needs can be met by other measures. Accordingly, the Council's recommendation is that the Mitchell River remain free-flowing.

Small areas of State forest occur along the Wonnangatta River, but these either lie within an existing natural features zone (making any timber resources already unavailable) or carry unmerchantable stands.

Minor alluvial deposits of gold may be present along the Mitchell River, and extensive gravel and sand resources occur both inside and outside the river corridor.

The consultants concluded that the environmental values are likely to exceed the resource values.

## Recommendation

### A11 Mitchell and Wonnangatta Rivers

That the river corridor of 13 500 ha shown on Maps 19 to 22 be used in accordance with general recommendations A1-A15 (a) to (k) above that

- (l) (i) the corridor be retained free from impoundments, artificial barriers, or structures that impede stream flow or passage of in-stream fauna
- (ii) any new diversions of water only be permitted if their volumes, timing, and offtake do not impair native fish habitat conditions, riparian vegetation, angling opportunities, or canoeing quality, or reduce scenic landscape value

that

- (m) the following values be protected
  - (i) botanical values in the Mitchell River Gorge as outlined above
  - (ii) Australian grayling habitat, by retaining free passage to Lake King

for migration, and maintaining water quality, flow, and in-stream habitat condition

- (iii) native fish diversity, by implementing the principles and guidelines for fish habitat protection in section F2.
- (iv) the essentially natural condition of the Mitchell River in the gorge, and its recreational setting
- (v) geological and geomorphological sites of significance, particularly the silt jetties, and others described above
- (vi) scenic landscapes from Eaglevale to the lower end of the Mitchell Gorge
- (vii) fishing opportunities, particularly for trout in the Wonnangatta River, and for estuary species in the lower Mitchell
- (viii) canoeing — Wonnangatta River, and Mitchell River particularly in the gorge

and that

- (n) car-based camping, pleasure driving, bushwalking, fossicking, horse-riding, and seasonal deer-hunting by stalking continue where land status permits, and management recognise the importance of these uses.

Note:

The upper reach of the Wonnangatta River is in an area of high wilderness quality being considered in the Council's current Wilderness Special Investigation.

## Thomson River

The proposed heritage river corridor begins just below the Thomson Dam and extends downstream to Cowwarr Weir. The river initially flows south along the foot of the eastern fall of the Baw Baw Plateau, and then swings to the east downstream of Coopers Creek. Through most of the corridor the valley is V-shaped and steep-sided. In the section above Cowwarr the river flows through a 1.2-km gorge. Here it narrows to 5 m from its previous 20 to 30 m and is bounded by vertical walls 5 to 10 m high. Along most of its length it is surrounded by native forest.

With its deep valley, the Thomson formed an obstacle to early attempts to establish transport routes to the rich goldfields of Walhalla. Today a number of significant bridges still span it. Bruntons Bridge, built in 1888 of steel and timber, and the prefabricated steel bridge at Poverty Point are considered to be of State significance, and their designs reflect the technical innovations used to cross this river.

The river valley was also rich in minerals, with alluvial gold being found in the river-bed. In one section, just below Stringer Creek, a tunnel was dug through the neck of a meander to assist the recovery of gold by diverting the flow of the river from its natural course. Known as the Chinese tunnel, it forms one of the features of the Walhalla Historic Area and today still diverts much of the river flow. By 1864 copper ore had been found beside the river at Coopers Creek, and mining and smelting operations commenced. Today the landscape of the area reflects over a century of copper-mining, the development of an associated limestone quarry and lime kilns high on the valley walls, and the Coopers Creek settlement. The settlement occupies one of the few flat areas along this section of the Thomson River, opposite the copper-mine. The Coopers Creek area is considered of State significance, being the first of the few copper-mines in Victoria.

Today the cleared area at Coopers Creek is popular as a camping, picnicking, and fishing spot and stopping-off point on the Thomson River canoe trail, which runs from just below the Thomson Dam to Cowwarr Weir. The river provides opportunities for white-water touring of State significance.

The river corridor is rated as having high to very high scenic quality. Semi-natural and natural landscape settings dominate it. The outstanding scenic features are the sharply defined 'V'-shaped valleys, the sinuous river course, calm pools, boulders and gravel bars and rock outcrops that produce white-water rapids, and diverse vegetation patterns. The historic bridges that cross the river also add to the range of visual features. This scenic beauty can be appreciated in a variety of ways: travelling by canoe or raft down the river itself; walking along the Alpine Walking Track, which winds along the river near Rawson; or driving to one of the road or track crossings. These crossings, such as at Bruntons Bridge and on

the Erica-Walhalla road, are good places to picnic and relax with the sights and sounds of the river.

The Thomson also has a high value for recreational angling, and its freshwater blackfish interest fish biologists. With its deep, slow-flowing pools alternating with faster-flowing water over the many gravel and cobble bars, it provides ideal habitat for another significant fresh-water native fish, the 'vulnerable' Australian grayling. Although Cowwarr Weir on the Rainbow Creek break-away is a barrier to fish movement, Australian grayling migration between this corridor and the ocean is still possible along the old course of the Thomson River.

Construction of the Thomson Dam has considerably modified the flow regime through the corridor, potentially affecting a number of nature conservation and recreation values. Council notes that the provision for environmental flows has not yet been formalised. However, the small tributary streams to the river in much of this corridor are considered to be in a relatively natural condition, which assists in the maintenance of some of the in-stream values.

### Tenure

Public land tenure	Area (ha)	Length (km)
Baw Baw National Park	500	15
Walhalla Historic Area	100	5
State forest	1680	49
	2280	64

The corridor is 200 m wide along each side of the river, extending from the Thomson Dam down to Coopers Creek, then along the gorge section it follows the natural features zone boundaries — the upper edge of steep slopes leading to the river — with an average width of about 250 m along each side.

### Resources

A potential dam site has been identified towards the lower end of this corridor, a short distance upstream of Cowwarr. It is one of several possible future sites in the LaTrobe and Thomson River Basins and current cost estimates suggest that there are comparable alternatives.

The corridor contains no harvestable timber, as a result of existing constraints, including the

Code of Forest Practices, the natural features zone, and the interim regional prescriptions for the Central Gippsland Forest Management Area, which exclude steep slopes and areas adjacent to the Alpine Walking Track from harvesting.

The old mining area around Coopers Creek is prospective for gold, copper, and platinum minerals, however no mineral prospects that are currently seen as likely to be mined occur in the corridor.

The consultants concluded that the environmental values are likely to exceed the resource values.

## Recommendation

### A12 Thomson River

That the river corridor of 2280 ha shown on Map 23 be used in accordance with general recommendations A1–A15 (a) to (k) above

that

- (l) (i) the corridor be retained free from further impoundments, artificial barriers, or structures that impede stream flow or passage of in-stream fauna
- (ii) no new diversions of water from the Thomson River corridor be permitted
- (iii) any new diversions from tributary streams upstream from Cowwarr Weir only be permitted if their volumes, timing, and off-take do not impair canoeing quality or native fish habitat, or reduce scenic landscape value
- (iv) the Committee established to review releases from the Thomson Dam assess the level of adequate environmental flows, and ensure these are provided
- (v) the maximum number of canoe days possible (consistent with the protection of in-stream biological values) be provided
- (vi) the release regime so determined be implemented as soon as possible
- (vii) timber-harvesting in the Thomson Valley outside the corridor be subject to application of the visual

management system, to minimise impacts on the scenic views from the river and strategic vantage points

that

- (m) the following values be protected
- (i) canoeing — Thomson Dam to Cowwarr Weir
  - (ii) the relatively natural mainstream condition
  - (iii) scenic landscapes along the Thomson River for the whole reach
  - (iv) fishing opportunities, especially for freshwater blackfish
  - (v) Australian grayling habitat, by not creating further barriers to migration below the designated corridor, and by maintaining water quality, flow, and in-stream habitat conditions

and that

- (n) picnicking, bushwalking, recreational trout-fishing, car-based camping, and seasonal deer-hunting by stalking continue where land status permits, and management recognise the importance of these uses.

Note:

The Committee established to review releases from the Thomson Dam is convened by the Office of Water Resources. A draft report is expected in late 1990.

## Yarra River

The proposed heritage river corridor extends from Warburton downstream to the City of Doncaster and Templestowe boundary, at Blue Tongue Bend. Throughout this reach the Yarra winds through a series of floodplains and gorges. Its valley provides a text-book example for people interested in studying river processes associated with incision and floodplain deposition. An abandoned high-level meander at Watsons Creek has State significance, as does the gravel terrace at Crooked Creek. Along this reach a further 10 sites are considered to be of regional significance for their geological/geomorphological properties.

The patterns of clearing and remnant vegetation make the valley a scenic resource of

high value. The vegetation, and the habitat it provides, is significant as described below and also important, being all that remains in an extensively cleared area. Programs to maintain remnant vegetation and restore degraded frontages are currently being implemented.

The riverside stand of Buxton gum (*Eucalyptus crenulata*) south of Yarra Glen is of national significance. Although the species is endemic to south-central Victoria, this is one of only two known indigenous stands. It also contains a relatively intact tussock grassland and two other rare plant species — *Pomaderris vacciniifolia* and *Pimelea pauciflora*.

At Everard Park a disjunct stand of mountain swamp gum is its most western occurrence. Together with a significant (although small) remnant of floodplain vegetation, river red gum woodland with a relatively intact understorey, this site is of State significance. So too are the box-stringybark woodlands associated with riparian forest communities in the Yering gorge to Warrandyte gorge section.

Although fragmented, the remnant vegetation along the Yarra provides a most important wildlife corridor, linking the forested hills around Warburton to remnants in central Melbourne such as at Studley Park. This corridor with its diverse habitats provides critical breeding sites for numerous birds, mammals, reptiles, and amphibians, supporting a highly varied native fauna. The reach is considered to be of State zoological significance. Its in-stream biological values are also of note. As well as containing a diverse fish fauna, it affords suitable habitat for the 'vulnerable' Macquarie perch. Anglers value it for its freshwater blackfish, Macquarie perch, and trout.

Canoeists also enjoy the river — the entire corridor is of regional canoeing significance, with the 20-km section from Homestead Road to Jumping Creek Reserve of State significance for white-water touring, particularly for novice canoeists.

Many picnic facilities have been developed here. When considered with those riverside picnic facilities established by the Board of Works on the outskirts of Melbourne, they form a system of recreation reserves along the Yarra from its mouth to the mountains. These are popular places for an outing, given their proximity to Melbourne. The Warrandyte State Park, managed by the Department of

Conservation and Environment and focused on the Yarra, has very high visitor numbers and a range of recreational uses.

Some of the access roads, such as the aptly named Skyline Road south of Sugarloaf Reservoir, provide pleasant and extensive views across the Yarra valley. The section from Warrandyte to Yarra Glen is considered to be particularly picturesque.

### Tenure

Public land tenure	Area (ha)	Length (km)
Warrandyte State Park	285	11
Public land water frontage reserve	780	56
Other	-	36
	1065	103

For much of its length the corridor consists of the frontage reserve, however this is fragmented between the Maroondah Highway and Coldstream West. Despite this limitation, the Council considers that, because of its numerous values it should receive heritage river status. In the State park the corridor is 200 m wide along the river-bank to Blue Tongue Bend. Downstream from this point the park and frontage reserves are not 'public land' under the *Land Conservation Act 1970*.

### Resources

The Board of Works diverts an appreciable part of the Yarra's flow to supply Melbourne, from the Upper Yarra, Maroondah, O'Shannassy and smaller weirs outside the proposed heritage river corridor. Within the corridor, a series of pumps — with a capacity of 1000 ML per day — lift water at Yering Gorge to the Winneke treatment plant. A possible augmentation of this system may be required by the year 2006, in associated with construction of a reservoir at Little Watsons Creek. Alternatives include sources such as the Big River.

With regard to other economic resources, none is affected by the proposed heritage river corridor.

The consultants concluded that the environmental values exceed resource values.

### Recommendation

#### A13 Yarra River

That the river corridor area of 1065 ha shown on Maps 24 and 25 be used in accordance with

general recommendations A1–A15 (a) to (k) above

that

- (l) (i) any new impoundments, artificial barriers, or structures that impede stream flow or passage of in-stream fauna, or diversions of water from the river, only be permitted if their volumes, timing, and offtake do not impair fish habitat conditions, canoeing quality, or scenic landscape value
- (ii) programs to revegetate and restore frontages be continued, or developed according to priorities that take account of the identified values

that

- (m) the following values be protected
  - (i) scenic landscapes from Yarra Glen to Warrandyte
  - (ii) botanical values as described above
  - (iii) canoeing — Warburton to Warrandyte
  - (iv) freshwater blackfish habitat, by avoiding sustained very high fast flows, maintaining high oxygen levels in water, allowing rising water temperatures in late spring–early summer, and retaining abundant in-stream logs and other cover
  - (v) Macquarie perch habitat, by allowing seasonal water temperature changes and free passage, particularly from spring to early summer
  - (vi) fishing opportunities, especially for trout
  - (vii) geological/geomorphological sites of significance, as described above

and that

- (n) recreation in the Warrandyte State Park, and fishing, picnicking, and bushwalking continue where land status permits, and management of the river corridor recognise the importance of these uses.

### Lerderderg River

The proposed heritage river rises in the Wombat Forest. It flows south-east past the township of Blackwood, through the Lerderderg Gorge

to the Werribee Valley above Bacchus Marsh. The landscape throughout the upper reaches is dissected. This area is almost entirely forested, with narrow riparian strips on the deeper footslope soils quickly changing to dry sclerophyll forests on the steep slopes.

As the river winds its way along this corridor, it runs through a progressively deeper valley with steeper and more rocky sides before flowing through a spectacular gorge. In some sections, it is at least 300 m below the surrounding ridge tops. The gorge was formed when the river was rejuvenated by uplift along major faults in the region. It is regarded as an outstanding illustration of this process and has therefore been assessed as being of State geological and geomorphological significance.

At its downstream end, the gorge contains exposed rocks that were laid down when much of 'Australia' was covered with glaciers during the Permian. These exposures are of international significance and are among the few areas in south-eastern Australia that record this period of Earth's history. The river-bed consists of cobbles and rock bars. During normal flows it is often shallow and can be easily walked across, being only 3 m wide at the upstream end, but up to 10 m at its downstream end.

Vegetation along this corridor varies substantially. Within the gorge, the open forest II of red stringybark, blue gum (*Eucalyptus pseudoglobulus*), and red box occurring on the lower slopes changes clearly to the dry open forest I associations of red stringybark, long-leaf box, and red box higher on the rocky gorge slopes. The whole corridor, however, from the dry forests near the gorge mouth to the wet forests at the upstream end, displays a striking transition along a rainfall gradient.

In the upstream reach, the dry forests are replaced by wetter forests of messmate, broad-leaf peppermint, manna gum, and brown stringybark. Manna gum becomes dominant on alluvial soils close to the river, while associated species include mountain grey gum, blue gum, and candlebark. Associations in the gorge with blue gum and manna gum have been assessed as being of State botanical significance for their development and intact condition, and the riparian forest transition from the mouth of the gorge to the upstream end of the corridor is also significant at a State level, as the prime example of progressive change in

vegetation associations in western Victoria.

The gorge area in particular contains many plant species that are considered rare or localised in the western part of the State. In the riparian zone these include cane spear-grass, tortuous rapier-sedge, slender saw-sedge, swamp bush-pea, hairy beard-heath, and violet westringia.

Lerderderg River catchment includes gold-bearing rocks and in the 1850s was the site of one of the many Victorian gold rushes. The area boomed and people from many parts of the world flocked to the field. The town of Blackwood, adjacent to the river, housed over 10 000 people at the height of the rush. The layout of the town, from Golden Point to Simmons Reef, the small allotments, and the remaining log miner's cottages reflect this background.

Evidence of diggings, tunnelling, and the construction of water-races can still be seen. Many of the walking tracks, popular with day or over-night walkers, now follow the old water-races and provide excellent opportunities to see the remains of the gold-mining era. Visitors may also relax at picnic spots, sample the mineral spring waters around Blackwood, or take in the river scenery.

The whole river corridor has been assessed as having high scenic landscape value, from the forested slopes, the sight and sound of the river flowing over the many rock bars and minor rapids along the steep upper river course, to the more spectacular scenery in the Lerderderg Gorge.

Its rugged terrain makes the Lerderderg Gorge very popular with day and over-night walkers, with a track following the river from the gorge entrance upstream to O'Briens Crossing.

#### Tenure

Public land tenure	Area (ha)	Length (km)
Lerderderg State Park	5090	45
Public land water frontage reserve	60	5
Wombat State forest	340	13
	5490	63

In State forest the corridor is 200 m wide along each side of the river, except upstream of Simmons Reef where the boundary on the south side generally follows the Lerderderg

River road, which runs along the south side of the river. The comparatively wide, gravel, and well-formed road, is between 50 and 100 m from the river. It provides access to many informal bush camping spots on the river. Council proposes that it form a geographically well-defined southern boundary to the corridor. Where it is closer to the river, though, such as near Loam Ridge Track and immediately downstream, the southern corridor boundary is approximately 100 m from the river. At Blackwood the corridor consists of the public land water frontage reserve. It widens in the Lerderderg State Park; the boundaries follow the rim of the gorge and spurs and ridgelines link gorge sections.

### Resources

Flows, through the proposed heritage river corridor are diverted by a weir near the downstream end, within the Lerderderg Gorge, to the Merrimu Reservoir. There are no plans to augment this diversion or for any new water resource developments within the corridor.

The timber resources affected by these recommendations are 13 000 cu.m class C+ sawlogs and 3200 cu.m class D sawlogs.

The upper section is prospective for both alluvial gold and vein gold deposits, for which the Blackwood area was extensively worked last century. However, there are no current or immediately foreseeable plans to develop possible deposits within the corridor.

The consultants concluded that the environmental values are likely to exceed the resource values.

### Recommendation

#### A14 Lerderderg River

That the river corridor of 5490 ha shown on Map 26 be used in accordance with general recommendations A1–A15 (a) to (k) above

that

- (l) (i) new impoundments, artificial barriers, or structures that impede stream flow or passage of in-stream fauna, or any new diversions of water from the river only be permitted if their volumes, timing, construction, and release regime do not impair riparian vegetation quality or scenic landscape value

- (ii) timber-harvesting in State forest adjoining the corridor be subject to application of the visual management system to minimise impacts on scenic landscapes viewed from the river and strategic vantage points

that

- (m) the following values be protected
  - (i) geological and geomorphological area of State significance — the Lerderderg Gorge
  - (ii) geological features of international significance — Permian glacial exposures near the gorge mouth
  - (iii) scenic landscapes along the Lerderderg River from Crowley Creek to the gorge mouth
  - (iv) blue gum and manna gum open forests, riparian forest transition
  - (v) cultural heritage sites as described above

and that

- (n) appreciation of the gorge rock exposures and vegetation sequence, camping, fishing, picnicking, and bushwalking continue where land status permits, and management recognise the importance of these uses.

### Glenelg River

The proposed heritage river corridor is the lower Glenelg from Dartmoor downstream to the sea at Nelson. The section of the Glenelg River in South Australia is not included.

For much of its length the river is bounded by limestone cliffs. The lower section is a drowned river valley, being formed when the sea level rose to its present height about 6000 years ago, filling and drowning the valley that the river had previously cut through the surrounding Millicent Plains. Much of the reach is 50 m or more wide and on average 5 m deep, while the section above Jones Lookout is narrower and shallower, and the mouth at Nelson sandy and shallow. Much of the reach has estuarine characteristics and salt water may reach 75–85 km upstream.

The limestone from Keegans Bend to Nelson forms the lower Glenelg karst area — one of the largest in Victoria, with significance at a

State level. It contains good examples of caves and other solution features. These caves provide habitat for bats, the large-footed myotis, and the bent-winged bat, which has restricted Victorian distribution. They also contain the fossil remains of now-extinct animals. Other features of nature conservation significance include the formerly widespread river red gum communities found just below Dartmoor. These provide regional representation of the community, and include some excellent examples for their lack of disturbance. The in-stream faunal values are also important, with diverse fish fauna being recorded in both fresh and estuarine sections.

The towering cliffs, vegetation pattern, and river vistas that unfold around each bend make this corridor of the Glenelg of high scenic value. In 1836 these qualities inspired the explorer Major Mitchell to write:

'The scenery on the banks was pleasing and various: at some points picturesque limestone cliffs overhung the river, and cascades flowed out of caverns hung with stalactites; at others, the shores were festooned with green dripping shrubs and creepers, or terminated in a smooth grassy bank sloping to the water's edge.'

While Aborigines would have known the reach, Mitchell's journey along its length by row-boat in 1836 illustrates a significant historical theme — rivers and communication. Today canoeists can repeat Mitchell's journey from Dartmoor to Nelson — rated as among the best flat-water touring trips in Australia.

Mooring facilities and bush camps have been specially constructed at a number of sites along the river such as Moleside Landing. These are also popular for picnicking. Many have facilities for launching small boats, allowing people to cruise the river at their leisure, take in the views, and try their luck at fishing. The estuarine section has a good reputation for its catches of bream, estuary perch, and mulloway and is reputed to be the fourth-best Victorian coastal fishing river.

Other popular recreation features along the river include the Princess Margaret Rose Caves and the Great South West Walk. The Caves, located on the river upstream of Nelson, can be

reached by land or river. This popular tourist attraction has provision for people to experience at first hand, and have interpreted, underground caverns and the process of cave formation. The Great South West Walk, a 250-km walking track, meets the Glenelg River near Moleside Landing. The Walk has a gentle grade and winds along the river edge for over 50 km leaving the river at Nelson. The Glenelg River section of the Walk is popular with both day and overnight walkers.

### Tenure

Public land tenure	Area (ha)	Length (km)
Lower Glenelg National Park	2360	59
Public land water frontage reserve	370	21
Discovery Bay Coastal Park	170	2
Streamside reserve	120	4
	3020	83

The corridor boundaries follow the public land water frontage reserve downstream of Dartmoor and around Nelson, and within the Lower Glenelg National Park either lie 200 m from each side of the river or follow the park boundary or the river-side road, as shown on Maps 27 and 28. Below Nelson the corridor continues through the Discovery Bay Coastal Park.

### Resources

The natural flow conditions of this proposed corridor are modified by the substantial storage and diversion of headwater flows at Rocklands Reservoir. The impact of this diversion on the salt wedge in the estuary and the potential implications for fish and other in-stream values along the corridor are not known. No proposed water resource developments were identified.

There are no timber resource implications, as the corridor had no available timber resources prior to these proposals.

Limestone is present, but there are no current or immediately foreseeable plans to mine this deposit, and considerable limestone reserves occur elsewhere in the region.

The consultants concluded that the environmental values are likely to exceed resource values.

## Recommendation

### A15 Glenelg River

That the river corridor of 3020 ha shown on Maps 27 and 28 be used in accordance with general recommendations A1-A15 (a) to (k) above

that

- (l) (i) the corridor be retained free from further impoundments, artificial barriers, or structures that impede stream flow or passage of in-stream fauna
- (ii) any new diversions of water only be permitted if their volumes, timing, and offtake do not impair riverine forest or fish habitat conditions, or reduce scenic landscape value

that

- (m) the following values be protected
  - (i) areas with river red gum open woodlands and riparian communities
  - (ii) areas of habitat significance for roosting bats
  - (iii) Glenelg karst area — State geological/ geomorphological significance
  - (iv) canoe touring — the reach from Dartmoor to Nelson is of national significance
  - (v) scenic landscapes along the whole reach with special attention in the national park to the removal of invasive exotic trees, especially those incompatible with 'natural' and

'semi-natural' river setting categories

- (vi) native fish diversity, by implementing the principles and guidelines for fish habitat protection (see section F2)
- (vii) fishing opportunities — especially for bream, estuary perch, and mulloway

that

- (n) (i) boating, car-based camping, picnicking, bushwalking, and recreational fishing continue where land status permits, and the management of the river corridor recognise the importance of these uses
- (ii) the use of speedboats only be allowed if it can be demonstrated that other values are not adversely affected, and the use of houseboats not be permitted

and that

- (o) (i) an interdepartmental team be established by the Department of Conservation and Environment to investigate management strategies for environmental flow releases from Rocklands Reservoir
- (ii) consideration be given to allocating such releases should savings in water be made as a result of piping the northern part of the Wimmera-Mallee stock and domestic channel system.

## B. Essentially Natural Catchments

Across Victoria, land-clearing, logging, mining, and water-harvesting have been widely carried out. An extensive road and track network has been constructed, and cattle graze some otherwise essentially natural country. While many small areas have none of these activities, in only a few cases has an entire catchment remained free of them. The physical and biological processes are therefore essentially unimpaired in these substantially unmodified catchments, which gives them high ecological value and importance for nature conservation and scientific study. In accordance with the Order in Council, this Investigation has identified such catchments and their streams.

Recognising the importance of these remaining essentially natural streams, the State Conservation Strategy stated: 'As these waterways are scarce and irreplaceable, the government will ensure special protection is extended over their entire catchments'.

In order to rank stream catchments according to their level of naturalness, Macmillan (1987) developed a method that applied a series of land use filters. Catchments to third-order streams (see Glossary) were used as the basic land unit for the assessment and commonly range in size from 1000 to 10000 ha. An 'essentially natural' catchment is one with no urbanisation, clearing, intensive agriculture (including grazing), timber-harvesting, plantations, mining, extractive industries, water storages, water diversions, river engineering works, or roads parallel and immediately adjacent to streams. State-wide studies to identify and rank the catchments have used various departmental records of these activities.

Subsequent studies (cited in Chapter 15 of the Resources Report) initially identified 147 catchments to third-order streams as being essentially natural. These occur widely in the Eastern Highlands, with few in the west of the State, and very largely on public land. Some 85 of the catchments are within existing national or State parks or reserves, and another five are partly within such parks. The remaining 57 are in State forest, hardwood production, or uncommitted land categories of public land. More detailed analysis of these catchments,

however, has shown that many support one or more uses that diminish their naturalness, such as water diversion, some timber-harvesting, stock-grazing, and roading. Council's analysis established 49 catchments to third-order streams as being essentially natural. These are listed in Appendix III.

Most of the essentially natural catchments tend to be isolated from each other. However, some adjoining ones can be grouped:

- Red and Benedore Rivers, and Shipwreck, Easby, and Seal Creeks catchment area
- Rodger River and Mountain Creek catchment area
- Avon, Turton, and Dolodrook Rivers and Ben Cruachan Creek catchment area
- O'Shannassy River catchment area

Consideration of these areas showed that they often contain other important catchment- or stream-related values. These include:

- significant flora, fauna, or geomorphological/geological values
- smaller essentially natural catchments between the third-order catchments
- mainstream segments highly rated for their natural condition

Consequently it was possible to define broad hydrologically coherent areas incorporating these additional catchment values, which are described in the recommendations below.

### Resource implications

Many of the essentially natural catchments are within conservation reserves (Appendix III), and no resource implications result, because the recommendations proposed for these catchments are broadly consistent with the existing land status.

None of the catchments within State forests contained known mineral resources, nor would their recommended use affect any current water resource development or planned augmentation. In fact, the proposed use would benefit existing downstream water withdrawals, such as that from O'Shannassy Reservoir and from below the Mt Tabor catchment, by providing conditions that also protect high-quality water.

The timber resources in those catchments where timber-harvesting has previously been permitted vary according to forest type. Table 1 summarises this information. It also lists the percentage reduction to the sustainable yield for forest management areas affected, and estimates of direct job losses if the resources were withdrawn. Five catchments contain timber resources in excess of 10 000 cu.m: Front, South Buller, Swamp, Cavender, and Decimal Creeks. On balance Council considered that the value to the community of maintaining these catchments in at least their present condition warranted their protection, with one exception — Decimal Creek, a tributary of the Humffray River. In considering Decimal Creek, Council was mindful that:

- It contains three land systems — 1.1/Ss8<sub>1</sub>, 1.1/Ss8<sub>3</sub>, and 1.1/Ss9<sub>1</sub>, each of which is represented in three or more essentially natural catchments that Council proposes be protected.

- It contains 1932 regrowth alpine ash, containing, at maturity, 67 000 cu.m of timber. The labour involved in the direct processing of this timber resource would be equivalent to just over 13 people per year for 10 consecutive years.

Consequently Council considered that a change in the land use for Decimal Creek was not appropriate.

The Council believes that the catchments described below should be protected in their entirety from future disturbance. The total area of essentially natural catchments is 165160 ha, with 35 (total 134300 ha) wholly in existing parks and reserves and 14 (total 30 860 ha) fully or partly in State forest. Detailed plans of the catchments are not included in this report; however, they are available from the Council on request.

**Table 1**  
**TIMBER RESOURCE DATA**  
**Essentially Natural Catchments in State Forest**

Rec. no.	Catchment name	Timber volume (cu.m)	Percent of sustained yield for forest management area <sup>2</sup>	Jobs <sup>3</sup> affected if resource is withdrawn (person/year)	Forest management area
B5	Log Bridge Creek — East Branch	1280	0.1	negligible	Wodonga
B6	Front Creek	16200	1.5	3.2 for 9 years	Wodonga
B7	Mt Tabor Creek	1800	0.1	negligible	Wodonga
B8	Banimboola Creek	2400	0.2	negligible	Wodonga
B9	Devils Creek — Middle Branch	No economic stands of merchantable timber			
B10	Yarrarabula Creek	1620	0.1	negligible	Wangaratta
B11	Long Jack Creek	940	<0.1	negligible	Wangaratta
B12	South Buller Creek	14920 <sup>1</sup>	2.5	3.9-5.6 for 6 years	Benalla/Mansfield
B13	Williams Creek	240	0.2	negligible	Benalla/Mansfield
B19	Swamp Creek	67950	0.8	0.8 long term	East Gippsland
B22	Cavender Creek	25900 <sup>1</sup>	0.3	0.7 long term	East Gippsland
B25	Stony Creek	800	<0.1	negligible	Tambo
B26	Wongungarra River headwaters	No economic stands of merchantable timber			
B29	Swamp/Punchen Creek	300	<0.1	negligible	Tambo
-	Decimal Creek	67000 <sup>1</sup>	0.1	13.2 for 10 years	Benalla/Mansfield

Notes:

1. Includes estimated volume of regrowth forest at maturity
2. Forecast up to the year 2000/1
3. Estimated number of persons employed in direct processing

# Essentially Natural Catchments

## Recommendations

### B1-B30

That the catchments shown on Map 1 and described below be maintained in at least their present essentially natural condition

that

(a) to protect their essentially natural condition, the following land uses be excluded:

- clearing of indigenous vegetation
- timber-harvesting
- plantation establishment
- mining
- mineral exploration involving activities inappropriate to land status or protection of the highly natural condition
- extractive industries
- water storages
- water diversions
- river engineering works
- new roads or the upgrading of existing roads
- domestic stock grazing
- activities involving the addition of fertilisers or chemicals other than in accordance with an approved management plan
- stocking of non-indigenous fish species

(b) they be available for water production, education, non-manipulative scientific study, nature study, bushwalking, fishing, deer-hunting by stalking (where land status permits), trail-riding on existing tracks, and four-wheel-driving on existing roads and formed tracks, where these uses do not conflict with the primary value of the catchment

and that they be protected under a Heritage Rivers Act, as described in Chapter A, and managed by the Department of Conservation and Environment, except for B4 — managed by the Board of Works.

Notes:

1. Implementation of these recommendations may require the closure of some existing tracks

2. In regard to water production, it is intended that water not be diverted from or stored within these catchments, with the exception of the O'Shannassy catchment.
3. Measures necessary to control wildfires must be taken in these catchments as in other areas of public land, except for those parts in reference areas to which specific management plans apply.
4. Several of these catchments contain weeds that will need appropriate forms of control.
5. Some of the catchments are within areas of high wilderness quality being considered in the Council's current Wilderness Special Investigation

## Areas of adjoining catchments

### Red and Benedore Rivers, and Shipwreck, Easby, and Seal Creeks catchment

This area consists of five adjoining catchments — from east to west, Shipwreck Creek, Seal Creek, Benedore River, Red River, and Easby Creek — that drain directly to the Tasman Sea. It lies approximately 15 km south-west of Mallacoota, and covers 14 470 ha. The catchments are defined from the estuary mouth, with small infill areas between them, which drain directly to the ocean, included. The distance from the headwaters to their mouths is at most 10 km, and the maximum elevation on the catchment margins is about 200 m above sea level. Nowhere else in Victoria can such an array of contiguous entire catchments be found from headwaters to ocean, with such a level of naturalness. This area within the Croajingolong National Park is also the core of a Biosphere Reserve declared under the UNESCO program, along with adjacent parts of the national park and the Nadgee Nature Reserve. It is one of 12 such reserves in Australia and 262 world-wide.

The streams have intact in-stream habitats. Exotic fish are absent, one of few parts of Victoria where this is the case. The fish fauna is diverse in the fresh and estuarine sections of the Red River and the estuarine section of the Benedore River. The 'endangered' freshwater herring has been recorded in Easby Creek.

These streams are important benchmark systems for the study of hydrology and

hydrochemistry, fish, invertebrates, aquatic plants, land vegetation, and other fauna, against which land use impacts may be compared. The Benedore River, Red River, and Easby Creek are considered of geomorphological significance. These, along with Shipwreck Creek, are third-order streams. The upper Benedore River and Seal Creek catchments are existing reference areas, where land use activities are strictly controlled in accordance with the recommendations of a scientific advisory committee.

Plant species present make the vegetation communities in the catchments of outstanding botanical significance. The coastal heathlands at Seal Creek are among the richest plant communities in the world. Near the mouth of Shipwreck Creek, rare species include the tiny spyridium, rush fringe-lily, and sheath rush. In addition, undisturbed lowland sclerophyll forest, dominated by a red bloodwood-silvertop overstorey, occurs in the Benedore River and Seal Creek catchments.

The plant communities also provide animal habitat for a number of significant species, including the rare ground parrot, one of only three ground-dwelling species of parrot in the world.

A number of wilderness attributes include high biophysical naturalness, remoteness from settlement, and low-density track network. Road access is available to the popular camping and picnic spots immediately to the east (Shipwreck Creek and Mallacoota) and west (Wingan Inlet). Both places provide excellent starting points for day or overnight walks into this stream and catchment system. The area is particularly photogenic, especially in spring when the diversity of plants is reflected in a brilliant floral display.

### **Recommendation**

#### **B1 Red and Benedore Rivers, and Shipwreck, Easby, and Seal Creeks catchment**

That the area of 14 470 ha shown on Map 1 be used in accordance with the general recommendations B1-B30 (a) and (b) above

that

- (c) no alteration occur to the natural hydrological properties of these catchments

- (d) no stocking of these catchments with either native or introduced fish species be carried out

and that

- (e) sites of botanical, zoological, and geological/geomorphological significance be protected.

#### **Rodger River and Mountain Creek catchment**

This area comprises two adjoining drainage systems — those of Rodger River (upstream of Yalmy River) and Mountain Creek — which drain to the Snowy River. It is 42 090 ha in size. The catchments and mainstreams are essentially natural in condition making them of high nature conservation significance, particularly as this is the largest contiguous area in this condition in the State. The third-order catchments are: Rodger River headwaters; Cattle Creek, Wrong Creek, and two unnamed creeks, all tributaries of the Rodger River; Mountain Creek headwaters; and New Country Creek — a tributary of Mountain Creek.

Rodger River and Mountain Creek vary in features such as bedrock geology and morphology. The former is an upland basin, comparatively open with gentle slopes, whereas Mountain Creek has an incised V-shaped valley with steeper side slopes.

The area is considered to be of national botanical significance, containing one of the few remaining extensive stands of old-growth wet sclerophyll forest in the State. The vegetation and fauna values are described in detail in the Council's final recommendations for the East Gippsland Area Review.

Continuous tree cover, age structure, and species composition contribute to the visual qualities of the catchments, making them a resource of high scenic value. These visual qualities and the virtually unmodified nature of the catchment give the area a high capability for recreational activities requiring a remote setting.

### **Recommendation**

#### **B2 Rodger River and Mountain Creek catchment**

That the area of 42 040 ha shown on Map 1 be used in accordance with general recommendations B1-B30 (a) and (b) above

that

- (c) no stocking of these catchments with either native or introduced fish be carried out

and that

- (d) sites of botanical/ and zoological significance be protected.

### **Avon, Turton, and Dolodrook Rivers and Ben Cruachan Creek catchment**

Three adjoining, south-flowing streams dominate this area, which covers 39840 ha. From east to west, they are Turton and Avon Rivers and Ben Cruachan Creek. Headwater streams of the Dolodrook River, which flows to the Macalister River, are also included. The area is largely within the Avon Wilderness Park. In general the catchments are highly dissected, with deeply incised valleys and prominent ridgetops. The relief between the watercourse and valley sides is often 200 m or more, although in the headwaters of the Avon it reaches 800 m. Snowfalls are common in the upper parts.

The catchments and mainstream corridors are still highly natural, mainly because the area was of little interest for mining and timber-getting activities over the last century. The track network is sparse, being largely restricted to catchment divides.

Together these catchments form the second-largest aggregation of essentially natural catchments in the State: the Avon River headwaters; the Turton River above its confluence with the Avon; Mount Hump Creek; a unnamed tributary of the Avon; McColl Creek headwaters; Little River headwaters (a tributary of Ben Cruachan Creek); Ben Cruachan Creek headwaters; Dolodrook River headwaters; and Thiele Creek, a tributary of Dolodrook River.

This aggregation contains a complex mosaic of vegetation, related to altitude (ranging from 400 to 1200 m), aspect, rainfall, and exposure. A diverse fish fauna is present in the major streams, and the 'vulnerable' Australian grayling has been recorded in the Avon River.

Its dissected topography and substantially natural condition give the area a high capability for recreation activities requiring a remote setting. Experienced walkers, and overnight campers, often use the stream divides (such as the Purgatory-Razorback)

as through-routes, and also the major water-courses such as the Avon and Turton.

### **Recommendation**

#### **B3 Avon, Turton, and Dolodrook Rivers and Ben Cruachan Creek catchment**

That the area of 39 840 ha shown on Map 1 be used in accordance with the general recommendations B1-B30(a) and (b) above

and that

- (c) Australian grayling habitat be protected by retaining free passage to the sea (via the Thomson River) for migration, and maintaining water quality, flow, and in-stream habitat conditions.

#### **O'Shannassy River catchment**

The O'Shannassy River catchment, covering 12 230 ha, is of special interest. This tributary of the upper Yarra — flowing directly off the Great Dividing Range — lies south of the popular Lake Mountain ski-field. The catchment divide has an elevation between 900 and 1200 m. The lowest point is the O'Shannassy Reservoir at an elevation of approximately 400 m, an important component of the Board of Works' water supply system. The northern and upper sections of the catchment have a gentle relief compared with the steep valley sides in the lower section.

It is essentially free from the impacts of mining, agriculture, and urban and timber-harvesting activities. Third-order essentially natural catchments are Smiths Creek and O'Shannassy River headwaters. The catchment escaped being burnt by the 1939 fires, and retains some of the State's most impressive stands of mature mountain ash wet sclerophyll forest. As such, it reflects a long history of natural processes largely unaffected by modern society. Such areas are comparatively rare, particularly because of the wildfire frequency in this region.

Floristically the catchment is of national significance. The vegetation is old, rich, undisturbed, and in many places breathtakingly beautiful. The communities are of extremely high quality, generally with low or non-existent weed problems. Mountain ash wet sclerophyll forest dominates, but excellent examples of montane forest, myrtle beech cool-temperate rainforest, subalpine forest, and other communities also occur here.

hydrochemistry, fish, invertebrates, aquatic plants, land vegetation, and other fauna, against which land use impacts may be compared. The Benedore River, Red River, and Easby Creek are considered of geomorphological significance. These, along with Shipwreck Creek, are third-order streams. The upper Benedore River and Seal Creek catchments are existing reference areas, where land use activities are strictly controlled in accordance with the recommendations of a scientific advisory committee.

Plant species present make the vegetation communities in the catchments of outstanding botanical significance. The coastal heathlands at Seal Creek are among the richest plant communities in the world. Near the mouth of Shipwreck Creek, rare species include the tiny spyradium, rush fringe-lily, and sheath rush. In addition, undisturbed lowland sclerophyll forest, dominated by a red bloodwood-silvertop overstorey, occurs in the Benedore River and Seal Creek catchments.

The plant communities also provide animal habitat for a number of significant species, including the rare ground parrot, one of only three ground-dwelling species of parrot in the world.

A number of wilderness attributes include high biophysical naturalness, remoteness from settlement, and low-density track network. Road access is available to the popular camping and picnic spots immediately to the east (Shipwreck Creek and Mallacoota) and west (Wingan Inlet). Both places provide excellent starting points for day or overnight walks into this stream and catchment system. The area is particularly photogenic, especially in spring when the diversity of plants is reflected in a brilliant floral display.

## **Recommendation**

### **B1 Red and Benedore Rivers, and Shipwreck, Easby, and Seal Creeks catchment**

That the area of 14 470 ha shown on Map 1 be used in accordance with the general recommendations B1-B30 (a) and (b) above

that

- (c) no alteration occur to the natural hydrological properties of these catchments

- (d) no stocking of these catchments with either native or introduced fish species be carried out

and that

- (e) sites of botanical, zoological, and geological/geomorphological significance be protected.

### **Rodger River and Mountain Creek catchment**

This area comprises two adjoining drainage systems — those of Rodger River (upstream of Yalmy River) and Mountain Creek — which drain to the Snowy River. It is 42 090 ha in size. The catchments and mainstreams are essentially natural in condition making them of high nature conservation significance, particularly as this is the largest contiguous area in this condition in the State. The third-order catchments are: Rodger River headwaters; Cattle Creek, Wrong Creek, and two unnamed creeks, all tributaries of the Rodger River; Mountain Creek headwaters; and New Country Creek — a tributary of Mountain Creek.

Rodger River and Mountain Creek vary in features such as bedrock geology and morphology. The former is an upland basin, comparatively open with gentle slopes, whereas Mountain Creek has an incised V-shaped valley with steeper side slopes.

The area is considered to be of national botanical significance, containing one of the few remaining extensive stands of old-growth wet sclerophyll forest in the State. The vegetation and fauna values are described in detail in the Council's final recommendations for the East Gippsland Area Review.

Continuous tree cover, age structure, and species composition contribute to the visual qualities of the catchments, making them a resource of high scenic value. These visual qualities and the virtually unmodified nature of the catchment give the area a high capability for recreational activities requiring a remote setting.

## **Recommendation**

### **B2 Rodger River and Mountain Creek catchment**

That the area of 42 040 ha shown on Map 1 be used in accordance with general recommendations B1-B30 (a) and (b) above

that

- (c) no stocking of these catchments with either native or introduced fish be carried out

and that

- (d) sites of botanical/ and zoological significance be protected.

### **Avon, Turton, and Dolodrook Rivers and Ben Cruachan Creek catchment**

Three adjoining, south-flowing streams dominate this area, which covers 39840 ha. From east to west, they are Turton and Avon Rivers and Ben Cruachan Creek. Headwater streams of the Dolodrook River, which flows to the Macalister River, are also included. The area is largely within the Avon Wilderness Park. In general the catchments are highly dissected, with deeply incised valleys and prominent ridgetops. The relief between the watercourse and valley sides is often 200 m or more, although in the headwaters of the Avon it reaches 800 m. Snowfalls are common in the upper parts.

The catchments and mainstream corridors are still highly natural, mainly because the area was of little interest for mining and timber-getting activities over the last century. The track network is sparse, being largely restricted to catchment divides.

Together these catchments form the second-largest aggregation of essentially natural catchments in the State: the Avon River headwaters; the Turton River above its confluence with the Avon; Mount Hump Creek; a unnamed tributary of the Avon; McColl Creek headwaters; Little River headwaters (a tributary of Ben Cruachan Creek); Ben Cruachan Creek headwaters; Dolodrook River headwaters; and Thiele Creek, a tributary of Dolodrook River.

This aggregation contains a complex mosaic of vegetation, related to altitude (ranging from 400 to 1200 m), aspect, rainfall, and exposure. A diverse fish fauna is present in the major streams, and the 'vulnerable' Australian grayling has been recorded in the Avon River.

Its dissected topography and substantially natural condition give the area a high capability for recreation activities requiring a remote setting. Experienced walkers, and overnight campers, often use the stream divides (such as the Purgatory-Razorback)

as through-routes, and also the major water-courses such as the Avon and Turton.

### **Recommendation**

#### **B3 Avon, Turton, and Dolodrook Rivers and Ben Cruachan Creek catchment**

That the area of 39 840 ha shown on Map 1 be used in accordance with the general recommendations B1-B30(a) and (b) above

and that

- (c) Australian grayling habitat be protected by retaining free passage to the sea (via the Thomson River) for migration, and maintaining water quality, flow, and in-stream habitat conditions.

#### **O'Shannassy River catchment**

The O'Shannassy River catchment, covering 12 230 ha, is of special interest. This tributary of the upper Yarra — flowing directly off the Great Dividing Range — lies south of the popular Lake Mountain ski-field. The catchment divide has an elevation between 900 and 1200 m. The lowest point is the O'Shannassy Reservoir at an elevation of approximately 400 m, an important component of the Board of Works' water supply system. The northern and upper sections of the catchment have a gentle relief compared with the steep valley sides in the lower section.

It is essentially free from the impacts of mining, agriculture, and urban and timber-harvesting activities. Third-order essentially natural catchments are Smiths Creek and O'Shannassy River headwaters. The catchment escaped being burnt by the 1939 fires, and retains some of the State's most impressive stands of mature mountain ash wet sclerophyll forest. As such, it reflects a long history of natural processes largely unaffected by modern society. Such areas are comparatively rare, particularly because of the wildfire frequency in this region.

Floristically the catchment is of national significance. The vegetation is old, rich, undisturbed, and in many places breathtakingly beautiful. The communities are of extremely high quality, generally with low or non-existent weed problems. Mountain ash wet sclerophyll forest dominates, but excellent examples of montane forest, myrtle beech cool-temperate rainforest, subalpine forest, and other communities also occur here.

The old-growth mountain ash forest provides habitat for a wide range of significant species, resulting in national faunal significance. The large-footed myotis has been found along the O'Shannassy River. Other significant species dependant on tree hollows occur here, including the sooty owl, a species classified as rare in Victoria, and the endangered Leadbeaters possum. With the passage of time, old-growth forest areas such as the O'Shannassy catchment will become increasingly important habitat as 1939-wildfire stags in surrounding forests rot and fall over.

Its complexity of colour, form, and texture gives the vegetation scenic beauty. The damp and decaying debris on the forest floor, rough brown-barked tree ferns with their drooping fronds, the dappled light beneath the canopy, and the towering ash trees with their long strands of light-coloured peeling bark are important elements. While most of the catchment is inaccessible, the popular drive along the Cumberland Road from Marysville to Warburton crosses it and, particularly in winter, when the ground and trees may be dusted with snow, allows visitors to be touched by its beauty. However, many people just want to know that such nationally important floristic and faunal areas exist, and that they will be protected.

## Recommendation

### B4 O'Shannassy River catchment

That the area of 12 230 ha shown on Map 1 be used in accordance with general recommendations B1-B30 (a) and (b) above

that

- (c) sites of botanical and zoological significance be protected

and that it continue to be managed by the Board of Works.

Note:

This area includes the O'Shannassy Reservoir. From time to time it will be necessary for the Board of Works to carry out reservoir maintenance and catchment management activities.

## Isolated essentially natural catchments

### Recommendations

#### B5-B30

That these areas shown on Map 1 be used in accordance with general recommendations on B1-B30 (a) and (b)

**B5** Log Bridge Creek — East Branch

**B6** Front Creek

**B7** Mount Tabor Creek

Note: The reservoir on Mt Tabor Creek lies downstream of the catchment and the diversion of water from this reservoir is not affected by this recommendation.

**B8** Banimboola Creek

**B9** Devils Creek — Middle Branch

**B10** Yarrarabula Creek

**B11** Long Jack Creek

**B12** South Buller Creek

**B13** Williams Creek

**B14** Double Creek

**B15** Unnamed tributary to Genoa River

**B16** Winnot Creek

**B17** Errinundra River — East Branch

**B18** Gattamurh Creek

Note: The area recommended for protection forms part of the headwaters of the Gattamurh Creek catchment. While the entire catchment is essentially natural in condition, half of it lies in the Byadbo Wilderness Area of Kosciusko National Park. This New South Wales section is covered by an approved management plan, whose aims will maintain its essentially natural character. Council therefore proposes that the Victorian section also be managed to maintain its current condition.

**B19** Swamp Creek

**B20** Wallaby Creek

**B21** Mount Gelantipy Creek

**B22** Cavender Creek

**B23** Musk Creek

**B24** Brodribb River headwaters

**B25** Stony Creek

**B26** Wongungarra River headwaters

**B27** Blue Rag Creek

**B28** Pinnacle Creek — East Branch

**B29** Swamp/Punchen Creek

**B30** Mount Vereker Creek

## C. Representative Rivers

The recommendations in this chapter serve to identify, and provide some protection for, streams that are representative of distinct river-catchment types found across Victoria. A classification system to determine types is thus needed. A system was proposed and discussed in the Resources Report, and a revised version of it forms the basis for the recommendations below.

Victoria's rivers vary greatly in their geomorphological and hydrological properties and in the plant and animal communities they support along their various tracts. For example, the West Kiewa River lies in a deep V-shaped valley, is cold and fast-flowing, and has a gravel and rock bed. By comparison the lower Wimmera flows across a plain and consists of relatively warm tranquil pools with a sandy bed. Some of our river systems are important on an international scale. The basalt plains in western Victoria are among the largest in the world. The rivers that drain these plains, their water chemistry, gradient, substrate, particular flow characteristics, and the plant and animal communities that have adapted to these conditions are in consequence likely to be of major importance.

While the heritage rivers recommendations focus on outstanding values, a balanced conservation system aimed at protecting Victorian river and stream values, in accordance with the Order in Council for this Investigation, requires recognition of both the outstanding and the representative.

The State Conservation Strategy specifies a commitment to the selection of such representative examples and their maintenance in at least their present condition — similar to the Council's standard policy of ensuring that, as far as practicable, examples of the major land types are represented within conservation reserves. Clearly, however, streams in western Victoria are far from natural, and representative rivers in such areas cannot protect unmodified systems.

In past investigations the Council has based its recommendations on data describing the characteristics of the land. It has also adopted an ecological approach, integrating

environmental attributes such as rainfall, geology, topography, soils, and native vegetation into repeating patterns, classifying them into units, and thematically mapping them.

River characteristics and stream flow patterns depend on climate, topography, geology, vegetation, and soil. Further, rivers are active agents in landscape development and in the formation of other environmental features such as habitat. They are integral to both the erosion-deposition cycle and the water cycle.

For the purpose of this Investigation, geomorphic units and hydrological regions have been used as the basis for identifying river-catchment types in Victoria. The method used to identify the various types is briefly described below.

### River Classification Systems

Various approaches to classification have used geomorphic and/or hydrological criteria. The flora and fauna, landscape settings, and features important for recreation, found on particular rivers, reflect geomorphic and hydrological characteristics. A stream-type classification can therefore, in a broad sense, provide a framework with which to compare and assess various values and uses of rivers. Another purpose of such a classification is to enable selection of representative examples.

The Council believes that the identification of representative rivers as outlined below represents an acceptable approach. It is based on the best available data and it can be developed by further division to accommodate other features for more specialised purposes. It is based on 'desk top' criteria, and is intended for application and comparison of information mapped at scales of 1:250000 or smaller. Further, it is a 'general-purpose' classification, combining many physical factors that various authors have used to identify ecological units. It is not designed to separate differences that are only evident at large scales (such as river-bed form and substrate), to distinguish between characteristics that are used in special-purpose classifications (like localised habitat requirements), or to reflect the individual geomorphic history of each river.

## Geomorphology

The first factor in the river classification is geomorphology. Rivers have played an important role in the evolution of the Victorian landscape, so geomorphology is a necessary and important component.

Gordon *et al.* (in press) review approaches to stream and catchment classification. One paper reviewed outlines landform effects on ecosystem processes and patterns, including:

- topographic influences on ground and air temperature (e.g., aspect), moisture, nutrients, and other materials
- landform effects on how organisms, seeds, spores, etc., energy, water, nutrients, and other matter flow through a landscape
- landform influences on the spatial pattern and frequency of disturbance from exterior factors such as fire, snow, and wind
- effects of landslides, geomorphic processes, etc. on biotic processes and features

Units with similar broad characteristics can be mapped — for example, the nine geomorphic unit system developed by Jenkin and Rowan (1987), and published at 1:500000 scale in the Council's 'Statewide Assessment of Public Land Use' report. They were identified by their geology, landform, dissection, and elevation. Accordingly, they characterise areas that reflect differences in certain ecosystem processes and patterns.

The appropriate land area when considering a river system is its catchment, and for this classification, the geomorphic units comprising river catchments have been identified. The size of the catchment being considered limits this approach, and its range must be restricted to allow comparability. The recommended representative river catchments range from 150 sq.km to 1500 sq.km. Further, as more tributaries join the course of a large river, the likelihood of major variation in geomorphic units increases.

Despite this limitation, the broad division of the State into geomorphic units has been selected as one of the two factors in the descriptive classification of river-catchment types. Where unit mixtures cover extensive areas of river catchments, they have been recognised in the classification.

## Hydrology

The second factor in the river classification is the hydrological behaviour of a stream, as calculated from stream-flow records.

Climate has been widely used in classification systems. However it relates to the whole landscape. Climatic and topographic factors are integrated in stream flow. Since stream flow is a key feature of river systems, its use allows direct classification of rivers and streams. Variations in it are important for understanding stream systems, and when considering use of water for consumption, stream-based recreation, and other uses. Macmillan and Kunert's 1990 review of river classifications outlines the following associations of stream flow and geologic and topographic features, which relate to biological requirements.

- Flow, gradient, and geology determine the nature of the substrate.
- Flow and substrate are fundamental in determining biological habitats.
- In terms of the frequency and extent of flooding, flow is an important determinant in the development of riparian, particularly floodplain, vegetation.
- Stream chemistry is primarily related to catchment geology.
- Flow rate, substrate, water chemistry, and temperature are the most important factors regulating the occurrence and distribution of stream invertebrates.
- Streams with very similar non-biological features will usually have parallel and ecologically similar faunas.

The flow of Victorian rivers is highly variable; however, groups of rivers with similar hydrological behaviour can be identified and their distribution mapped. A statistical analysis of stream-flow records by Hughes and James (1989) has identified five regions with different flow patterns. Broadly, these can be separated according to changes in their run-off per unit of catchment area, from region 5 (wet) to region 1 (dry). 'Wet' and 'dry' are used here as shorthand references to a set of 13 stream-flow characteristics that distinguish the hydrological behaviour of each. They include annual and monthly run-off and flow variability, maximum and minimum flows, and duration of low-flow spells, and are listed in the Resources Report.

Identification of a region in this way is based on sites on watercourses with flow gauges that have adequate records. Consequently, regions cannot be defined in areas outside the gauge network. The stream flow at a flow gauge reflects its catchment, and in effect integrates the topographic and climatic variables that combine to determine run-off. Application of the hydrological region to a gauged catchment therefore 'averages' hydrological behaviour throughout the catchment.

With increasing catchment size, the hydrological region may change with progression down the catchment. The headwaters of rivers commonly fall into 'wetter' regions than the lower reaches.

For catchments smaller than about 2000 sq.km, use of hydrological regions is an effective tool for separating catchments by run-off behaviour. Large whole-basin systems seldom fall into one hydrological region, and it would be unreasonable to expect that they would.

The 138 flow gauges used to define hydrological regions are spread widely, and in many cases their catchments abut along drainage divides. Accordingly, as Map 10 in the Resources Report showed, the regions include a large proportion of the upland areas across the State, within the limitations mentioned above.

## Representative rivers

The combination of geomorphic units and hydrological regions results in the identification of 16 different river-catchment types.

A representative river typifies its river-catchment type, and forms part of a set characterising the geomorphic units in catchments and hydrological regions of rivers across Victoria. As such rivers form part of the State's system of public land use categories, wherever possible the one selected should be in a relatively natural condition, and the least degraded or altered of its type.

The level of protection recommended for a representative river is an issue distinct from the protection provided for identified high-value areas. Many land use activities would not affect the geomorphic and hydrological criteria that led to its allocation to a particular river-catchment type.

## Selection

Appendix IV lists the river-catchment types for 101 Victorian rivers. It does not include all rivers from all parts of the State, only those with a flow gauge that had recorded at least 15 years of flow data (since 1945) on an unregulated stream, and with a catchment area of 150–1500 sq.km. Most mountain and valley tracts and the basalt plains are included in this classification, except where rivers are highly regulated, or not gauged. In the plain tracts, rivers tend to lose their identifiable river-catchment 'type', as the areas they drain are larger and are frequently mixtures of geomorphic units and hydrologic regions, making characterisation less precise.

Additional factors could be considered. An increased number of river-catchment types could include, for example, rivers with terminal lake systems (e.g. Wimmera River); effluent streams (e.g. Dunmunkle Creek); streams occurring totally on the plain tracts (Tyrrell Creek, Lalbert Creek); or those with a distinctly different seasonal flow regime (in far East Gippsland).

Appendix IV also identifies the 16 proposed representative rivers (shown with an asterisk) and their land tenure. These have been selected on various grounds, including how 'typical' they are, their condition compared with others of that type, their catchment shape (irregular shapes excluded), and (other things being equal) their ease of management. Preference has also been given to those occurring within existing proclaimed water supply catchments. Also shown is their status — whether part of a proposed heritage river (H), or proclaimed water supply catchment (C).

Some of those proposed include freehold land. The Council stresses that its recommendations apply only to the public land in these catchments, although that may only be a narrow public land water frontage reserve. Freehold land is not affected by the Council's recommendations.

The following recommendations are not highly restrictive, but seek to fulfil the State Conservation Strategy requirement for maintenance of these rivers in at least their present condition.

# Representative Rivers

## Recommendations

### CI-C16

That the rivers indicated on Map 1 and listed in the schedule below be designated as representative rivers and used to:

- (a) maintain examples of the range of river-catchment types and their geomorphological and hydrological attributes
- (b) maintain, and where possible improve, the condition of the streams and their catchments

that

- (c) changes to flow regulation be permitted only where hydrological and geomorphic processes will not be substantially impaired
- (d) they be considered for inclusion in research projects relating to rivers, where they are suitable for the proposed research programs
- (e) where consistent with other goals for the protection of streams, they be given priority in programs for:
  - restoration of the stream-bank vegetation using local native species
  - catchment co-ordination activities where required

- weed and pest control on frontages
- removal of endangering activities (e.g. discharges that lead to high nutrient loads or the release of toxicants)
- environmental flow commitments (where partly regulated)
- restoration of degraded beds and banks
- programs for land protection and landscape restoration

- (f) where reaches have important recreation, nature conservation, cultural heritage or scenic values, these values be protected
- (g) other uses currently specified in existing approved recommendations continue where appropriate (see Note)
- (h) they be identified in management plans for land and water use, and guidelines for protection included
- (i) where, after consideration of other options, it is necessary to utilise the water resources in one of these rivers, an alternative representative river be chosen from Appendix IV and substituted in relevant plans and programs

and that they be managed by the Department of Conservation and Environment

Note:

Several of these rivers are in existing national or State parks, or proposed heritage rivers. In these cases the relevant uses must be in accordance with the land status, as appropriate.

**Table 2**  
**SCHEDULE OF REPRESENTATIVE RIVERS**

Recommendation	Geomorphic unit	Hydrological region	Representative river (gauge site)
C1	East Victorian dissected uplands	5 <sup>1</sup>	Upper Big River (above Glen Valley)
C2	East Victorian dissected uplands	4	Snowy Creek (below Granite Flat)
C3	East Victorian dissected uplands	3	Dargo River (at Dargo)
C4	East Victorian uplands, dissected plateau	3	Macalister River (at Glencairn)
C5	East Victorian dissected uplands	2	Buchan River (above Mellick Munjie Creek)
C6	East Victorian dissected uplands, riverine plains	2	Thurra River (at Point Hicks)
C7	East Victorian dissected uplands	1	Nicholson River (at Deptford)
C8	East Victorian dissected uplands, riverine plains	1	Cornella Creek (at Colbinabbin)
C9	West Victorian dissected uplands	1 <sup>1</sup>	Avoca River (at Avoca)
C10	West Victorian dissected uplands, volcanic plains	2	Lerderderg River (at O'Briens Crossing)
C11	West Victorian dissected uplands, volcanic plains	1	McCallum Creek (at Carisbrook)
C12	Otway Ranges, dissected plains	3	Gellibrand River (at Carlisle River)
C13	Sth Gippsland Ranges, riverine plains	2	Tarra River (at Yarram)
C14	Dissected coastal plains, volcanic plains	2	Kennedy Creek (at Kennedy Creek)
C15	Volcanic plains, coastal plains	1	Darlot Creek (at Homerton Bridge)
C16	Volcanic plains, west Victorian dissected uplands	1	Moorabool River (at Morrisons)

Note:

1. Hydrological region calculated from catchment yield data.

# Representative Rivers

## Recommendations

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- (i) where, after consideration of other options, it is necessary to utilise the water resources in one of these rivers, an alternative representative river be chosen from Appendix IV and substituted in relevant plans and programs

and that they be managed by the Department of Conservation and Environment

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Several of these rivers are in existing national or State parks, or proposed heritage rivers. In these cases the relevant uses must be in accordance with the land status, as appropriate.

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Note:

1. Hydrological region calculated from catchment yield data.

## D. Other Victorian River Values

### Rivers with known high values

This Investigation collected a large body of data on the various qualities of rivers and streams. The Resources Report contains a basin map set (Maps 11-13) that identifies many streams or reaches with high values. Further, it lists cultural values, Aboriginal archaeological sites, and historical places. Additional information has been provided in submissions, or in consultants' reports.

Many areas with significant values did not meet the criteria in Chapters A and B for heritage rivers or high-naturalness catchments. However, in accordance with the Order in Council, the recommendations in this chapter are intended to provide general protection for them, where appropriate. These values are included in Appendix V, but their locations are not shown on the proposed recommendation maps.

### Community use of rivers

Chapters A and B, above, refer to rivers and streams identified as having particular high values. Many other sites on public land along rivers have less significant but still important features, and are widely used and appreciated. Camping and picnicking along stream frontages, deer-hunting and bushwalking in catchments, and touring or four-wheel-driving on existing tracks adjacent to rivers are popular, along with appreciation of riverine scenery and ecological values.

Council wishes to reinforce the importance of rivers and streams across the State as a focus for a wide range of community uses. Land and water managers should recognise the breadth of their values and uses made of them, and should manage rivers, banks, and adjacent areas for a range of appropriate uses according to their capabilities. These recommendations include additional recognition and protection for areas along rivers with values of lesser significance, without changing the land use category.

Rivers and streams flow through areas with a variety of land tenure and existing recommendations for use. Some in State forest have natural features zones; others have buffers identified in forest management area plans.

National and State parks may recognise rivers by the appropriate zoning. In proclaimed water supply catchments, land use determinations may specify protective buffer strips along streams. Areas used primarily or exclusively for water supply often provide a high degree of protection, but diversions of water may be sufficient to adversely affect in-stream values and uses below an offtake.

Public land water frontage reserves in areas that are largely private land are covered in the next chapter. However, recommendations previously made by Council as a result of area studies and reviews have identified small localised areas — streamside reserves — for passive recreation and conservation. Other existing government-approved Council recommendations — whether specifically for rivers such as natural features zones or streamside reserves or for large areas containing rivers — will remain in force.

## Other Victorian River Values

### Recommendations

#### D1 That

- (a) rivers and streams and their catchments continue to be available for recreation and for appreciation of their cultural, scenic, and ecological values where appropriate, according to the existing land use category, unless otherwise specified in these recommendations
- (b) rivers and streams, and adjoining areas, continue to provide water, timber, minerals, and other resources, subject to (c) to (e) below, and where land status permits
- (c) the areas of high significance along rivers across the State, identified in the documents described above and listed in Appendix V, be recognised by land and water managers and taken into account when decisions that may affect them are being made, and in the development of management plans
- (d) detailed guidelines for the protection of identified high significance scenic landscape, cultural heritage, ecological, and

recreation values be developed in accordance with the guidelines in sections F1-4, and applied by managers

- (e) where ecological, cultural heritage, scenic landscape, or recreational values of local or greater significance are identified, these be managed by the appropriate authority for protection and use according to the value

and that

- (f) areas adjacent to rivers and streams not specifically referred to in these proposed recommendations continue to be used for the purposes agreed to by the government following publication of recommendations for public land across the State.

# E. Public Land Water Frontage Reserves

Along many rivers and streams in the State, a strip of public land has been reserved from alienation.

In 1881, Crown land consisting of the bed and a specified distance from each bank of certain major watercourses was permanently reserved for public purposes. The most common distance was 'one chain' (20 m), although along the Murray River the distance is 60 m. These reservations have a combined length of some 25000km. In many instances, the public land water frontage is discontinuous. Although some frontages were set aside in this way before 1881, it was common before that date to alienate land to the water's edge. Some of the smaller watercourses were even included with the land to be alienated.

As rivers wind across their floodplains, their course is often subject to change as they create new channels and abandon their old ones. Consequently it is sometimes possible to find an abandoned channel and its strip of associated public land many kilometres from the present stream, which now has private land to its banks. In many cases, these reserves have been licensed and managed with adjoining farmland for many years. They are often not fenced, and it may be difficult to visually identify whether the land adjacent to a river is public or private.

The locations of public land water frontages are shown on parish plans, which are available to the public from the Central Plan Office of the Department of Property and Services, and can also be inspected at the regional offices of the Department of Conservation and Environment. If the land abutting a frontage has been alienated, the common boundary shown on parish plans may consist of surveyed lines or of a series of unsurveyed broken lines, which in either case approximate the limits of the reserved land.

In some places the frontage has been reserved for public purposes under the *Land Act* 1958 and in others it is unreserved. The land usually comes under the administration of the Department of Conservation and Environment. In all but a few cases the Crown controls the water. Public benefit was fundamental to the concept of reserving river frontages from sale, thus

establishing public land water frontages. In the mid nineteenth century these were set aside to provide for the development of public utilities for the expanding river-boat trade. They were also an important means of access, particularly in mountainous areas, where the valley floor provided an easily followed path.

As land became more densely settled in the 1870s public frontages became important for the collection of domestic water supply, watering of stock, fishing and general recreation. They were also set aside and uses prescribed to maintain environmental values. For example, they were set aside along rivers, particularly the Murray and Goulburn, to prevent denudation by tree-felling.

Today frontages are important public assets, particularly those that are in good condition (or capable of being restored) with stable banks and a good cover of native vegetation. They also form an important buffer in reducing the impact of adjacent land uses on the stream environment.

Frontages produce and maintain aquatic habitat values. Riparian vegetation provides nutrients from leaf litter, creates specific in-stream habitats from fallen limbs, and regulates water temperature by shading. They often contain the only remnants of native vegetation in areas that are now extensively cleared. It has been suggested that these linear remnants be called 'lifelines', as they may form important corridors for wildlife migration. They may also provide important seed stocks for the restoration of degraded land. In addition, ground cover on a well-vegetated frontage reduces the erosive power of both falling rain and overland flow, thereby reducing the potential for bank erosion and consequent reduction of water quality.

Particularly where native vegetation has been retained, public frontages are integral to the visual character of rural landscapes. Their sinuous form and contrasting colour and texture compared with the surrounding cleared land make them a key visual element of high scenic value. These scenic values enhance the pleasure of many recreational activities, such as angling, picnicking, walking, or canoeing, especially in the many rural areas where much

of the land is privately held.

Not surprisingly, given the social and economic importance of watercourses and their banks over the last 40000 years or more, many features reflecting significant cultural events and associations occur there. Scarred trees from which Aborigines obtained bark to make canoes and port facilities associated with the nineteenth century river-boat trade are but two examples.

Private use of public frontages for agricultural purposes is also widespread. This legally occurs through the issue of a licence. Illegal use was, however, not uncommon in the past, although a current review of the occupation of Crown land, by the Department of Conservation and Environment, suggests that only about 5% of frontages are now grazed without a licence. Such licences are often granted to the adjacent land occupier, and approximately 10000 are current. Among other things, the licensee is required to control noxious weeds and vermin, but gains a number of advantages, including access for stock water in adjoining paddocks.

Recreational use of licensed frontages is permitted, however. The *Land (Amendment) Act 1983* provides for the public to 'enter and remain for recreational purposes'. Licensees are required to erect and maintain a suitable means of pedestrian access along the frontage or from other points of public access. The requirement for maintenance of pedestrian access has not been applied to the majority of existing licences. Council believes that in some situations — for example, along popular fishing streams — the provision of stiles would assist pedestrian access and would reduce damage to fences and avoid gates being left open. Public frontages that are unlicensed have no restriction on public access, although use of vehicles is controlled by the *Land Conservation (Vehicle Control) Act 1973*. They are, however, normally fenced off from adjacent freehold land, through which the landholder has no obligation to provide access.

The recreational use of licensed and unlicensed public frontages can create problems for adjacent land occupiers and licensees, who often discourage public access because of an understandable fear of damage, intentional or otherwise, to property. Vandalism and littering are problems in many areas open to the public,

and firm action by authorities with management responsibilities is often required. Control is obtained through the normal exercise of fire, litter, firearm, and other regulations, although it needs more effective policing, particularly during holiday periods and at weekends. Education of the public to understand the rural environment is perhaps the best solution in the long run.

Although in the past managing authorities have allowed cultivation and vegetation clearance for limited areas, the failure to effectively enforce legislation has resulted in the progressive illegal clearing of native vegetation from other public frontages. This, combined with agricultural use involving both grazing and cultivation, has seen the loss of many values. Regeneration of vegetation has not occurred in substantial areas. Across the State long sections of river frontage are now degraded and in need of management attention. The State of the Rivers Task Force report (1986), for example, identified the principal cause of river degradation and damage to public frontages as unrestricted stock access to the river, and stock camping on the river bank.

The financial and labour costs of maintaining frontages (survey, fencing, weed and vermin control) or restoring the values of degraded ones are high and are a major reason for the absence of change to past approaches to frontage management. Various programs do exist — for example, along the Wimmera River — that are leading to improved management.

Council believes that the introduction of a priority system for the identification, protection, and restoration of frontage sections would lead to a progressive improvement in frontage condition. It would benefit stream bank stability, in-stream and bank habitat, stock management and water quality, enhance scenic quality and protect cultural heritage sites, and increase property values on adjoining freehold land. The following guidelines for establishing priorities are considered appropriate.

## Guidelines

Priority for management action should be based on:

- recommended heritage rivers and representative rivers with public land frontages

- the presence of values significant at local level or above, particularly where current use places these values at risk or where they are sensitive to change (specific attention should be given to the values identified for particular frontages as described in Appendix V of these recommendations)
- highly degraded areas
- areas that are currently unstable and require action to prevent major bed or bank instability
- areas in which special measures are necessary to protect domestic water supplies, buildings and other public utilities

In accordance with these guidelines, high-priority areas should be identified and programs developed to maintain or restore the values associated with them. The protection and restoration of these values may involve a range of management options, depending on the proposed uses and the values to be protected. Options may involve, for example, fencing areas to protect flora or unstable banks from stock, control of excessive recreation use, or provision of hardened areas for stock access to drinking water.

Development and implementation of management priorities should occur through community-based organisations, such as catchment co-ordination groups associated with river management authorities, and local government. This will also provide opportunities for local identification and assessment of frontage values and priorities. Council considers that involvement of local communities and interest groups, and a co-operative approach, are integral to the success of regenerating degraded frontages. It is also important that the goals of any program and the priority of any works be clearly defined.

While existing Council recommendations recognise the value of public land water frontage reserves, they do not sufficiently emphasise the need to maintain these areas in good condition or the need for active restoration programs, nor encourage their use for their potential range of values, especially those associated with recreation. Accordingly, Council resolved to review the existing recommendation wording. The amended recommendation applies to public land water frontage reserves across the State.

## Public Land Water Frontage Reserves

### Recommendation

**E1** That public land water frontages:

- (a) be used to
  - (i) conserve native flora and fauna
  - (ii) maintain or restore indigenous vegetation, protect adjoining land from erosion, and provide for flood passage
  - (iii) protect the character and scenic quality of the local landscape
  - (iv) provide protection for cultural heritage features and associations
  - (v) provide access for recreational activities and levels of use consistent with (i)–(iv) above
  - (vi) where this does not conflict with (i)–(v) above, allow access for water and for grazing of stock by adjoining landholders under licence

that

- (b) where frontage reserves are currently licensed for grazing or other purposes, and where stream-bank or frontage vegetation is degraded, frontage vegetation is not regenerating, or stream banks are eroding, consultative groups be established by the public land managers, with waterway management, local government, and licensee representatives, as follows:
  - (i) at a State level, to develop programs for re-establishing or regenerating indigenous vegetation on frontage reserves
  - (ii) at a regional level, to develop strategies for managing frontage reserves while vegetation is being re-established or regenerated
  - (iii) at a local level, to set priorities and a time-table for frontage reserve vegetation re-establishment or regeneration

and these programs and strategies be implemented according to the priorities and time-table so determined (see Notes 1–3)

- (c) (i) where habitat and landscape are proposed to be restored, particularly in cleared or degraded areas, indigenous trees, shrubs, and ground species be planted
  - (ii) suitable areas for more intensive recreational use be identified and facilities established, if appropriate
  - (iii) where land exchanges are proposed that involve frontage land, efforts be made to prevent loss of frontage reserve values from the public land estate
  - (iv) a method be developed that will allow public land frontages to be readily identified, and such frontages be so marked where appropriate
- (d) (i) where a licence has been issued for a public land water frontage as in (a) (vi) above, recreation use by the public be permitted (activities such as walking, nature observation, or fishing be allowed, while the use of motorised forms of recreation be prohibited) (see Note 4)
  - (ii) licensees be required to provide stiles in any fences erected across their licence area if requested to do so by the land manager
  - (iii) cultivation for agriculture not be permitted (see Note 5)
  - (iv) in particular cases, licensees be required to fence off and exclude stock temporarily from some parts of the licence area where, in the opinion of the land manager, special measures are necessary to protect water supplies, to rehabilitate areas that

are eroding or salt-affected, or to permit regeneration of native plants that have particular value for nature conservation

- (e) the Department of Conservation and Environment be consulted prior to the proclamation of roads, the construction of roadways, or the creation of buildings on public land water frontages

and that

- (f) public land water frontages be permanently reserved under section 4 of the *Crown Land (Reserves) Act 1978* and managed by the Department of Conservation and Environment or the present manager.

Notes:

1. It is expected that Catchment Coordination Groups, where they exist, would carry out or facilitate stages E1(b) (ii) and (b) (iii) above.
2. Vegetation re-establishment or regeneration may require the temporary or permanent removal of stock from some frontage areas.
3. Identification of priorities in E1(b) (iii) should take into account the guidelines specified above.
4. Camping may be an inappropriate use on frontages in water supply catchments, and land use determinations for such catchments may limit camping.
5. Council is aware that some frontage reserve areas along major rivers currently have small areas licensed for cultivation. It is not proposed that such licences be cancelled in the near future; however, they should be reviewed by the land manager.

# F. Management Guidelines and Policy Recommendations

Previous chapters have outlined Council's specific proposals for the appropriate use of particular rivers and streams, and their associated public land.

This chapter outlines management guidelines and principles to be used when assessing particular issues, when establishing priorities for considering activities, or when protecting or restoring values associated with rivers and streams. The proposed recommendations apply to all rivers and streams in Victoria (outside cities and rural cities) and their associated public land.

In some instances, they are based on existing programs, or earlier recommendations of Council that have been updated in the light of new information or changed circumstances. Additional recommendations have also been prepared to meet the particular requirements of this Investigation. Together, these cover:

- F1 Recreation
- F2 Nature conservation
- F3 Cultural heritage
- F4 Visual resources
- F5 Flow regulation
- F6 Environmental and recreational flows
- F7 Water use efficiency
- F8 Environmental quality
- F9 River management
- F10 River restoration
- F11 Utilities and survey
- F12 Mineral and stone production

## 1. Recreation

Background information and recommendations published in previous Council recommendations have been revised to cover issues associated with motorised watercraft on rivers, recreational fishing, fossicking, public participation and resource inventory, the use of areas by large organised groups, and provision for a range of experiences.

Recreation embraces the wide range of activities that people undertake during their leisure time, including those undertaken outdoors where the participant experiences the elements. It is an intrinsic feature of our way of

life and has numerous and diverse social benefits. Participation in it and in the provision of recreational opportunities are also of economic benefit, forming part of our tourism industry.

Outdoor recreation is of particular interest to Council, as the rivers and streams of Victoria and the public land through which they flow provide important opportunities for a diverse range of activities.

In view of the sustained demand for outdoor recreation and the high capability of some public land to meet this demand, the Council, in making its recommendations, has suggested that most public land should be available for recreational uses of some sort. Accordingly it has identified a variety of areas providing opportunities for a wide range of water-related recreation including angling, camping, pleasure driving, canoeing, and picnicking. Council believes that activities such as these can be accommodated somewhere on public land without detriment to other values, and points out that outdoor recreation in general is an acceptable primary or secondary use of rivers and streams and adjoining public land (except reference areas and some water supply storages and their buffers). It has left the details, including the appropriate zoning and level of each activity, to the land and water managers.

Recreational activities vary in the type of water body they need, and the nature of the surrounding land. They also differ in their impact on the water body and surrounding land and on other activities (including other recreation). The impact on the environment depends on the interaction of a number of factors:

- the nature of the recreational activity involved
- the level of recreational use an area receives, as measured by the number of participants, and the frequency, timing, and duration of the use
- the physical environment's sensitivity to change
- changes made to the physical environment to make it less sensitive to recreational

impacts (changes may affect the recreational opportunity setting, as discussed later)

Generally, any one activity pursued at a low level of use poses little threat to the environment and seldom conflicts with other activities. With increasing level of use, conflicts and problems can arise, particularly the problem of recreation damaging the environment it seeks to use.

Council therefore believes that the land and water managers should aim at managing the levels and patterns of recreational use according to the capability of the area to sustain such use (without irreversible damage or significant conflict with its primary purposes), while at the same time avoiding unnecessary restrictions. Special care will be required in the location and management of areas used for intensive recreation, to prevent environmental damage. Thus, more stringent restrictions can be expected where river and stream-bank vegetation and soils are sensitive to damage, where the level of use is high, or where natural and cultural values are to be protected.

A number of recreational activities and issues that may require specific consideration by the land or water managers, whether now or in the future, are discussed below.

### **Motorised recreation**

Much outdoor recreation depends on motorised vehicles or watercraft. Two- or four-wheel-drive vehicles, or motorcycles, may be used to obtain access to particular destinations along a river, or other water body, where other forms of recreation are undertaken. Touring and sightseeing are also important.

Most visitors use two-wheel-drive vehicles and keep to the major through routes. Others use four-wheel-drive vehicles or motorcycles to gain access to more isolated areas via the secondary system of tracks. These tracks are seldom designed to cope with high levels of use, but challenging conditions can be sources of recreation in themselves. Consequently, even legal use of roads can pose maintenance problems. Authorities responsible for road maintenance on public land may close roads when traffic exceeds their physical capacity, for safety reasons, or when use by vehicles is in conflict with the area's primary use. Erosion-hazard areas may be proclaimed under the *Land Conservation (Vehicle Control) Act 1972*

and regulations, enabling strict control. If the increased recreational use of roads is to be catered for, adequate funding should be provided for road maintenance, otherwise deterioration leading to erosion is inevitable.

A number of four-wheel-drive clubs have acknowledged the need for restrictions on motorised recreation in certain areas and during some periods of the year. Clubs are often actively involved in track clearing, and also inform and educate participants about the environmental consequences of improper use of their vehicles. Authorities should continue to promote responsible attitudes to the use of four-wheel-drive vehicles and trail-bikes, in conjunction with user associations and the general public.

Growing numbers are becoming involved in recreational touring on public land. Motorised vehicles (including motorcycles) may only use public land if they are registered, and only on tracks formed for the passage of vehicles having four or more wheels. Driving off roads is prohibited on all public land, whether in parks, State forest, or other reserves.

Motorised watercraft range from high-powered boats capable of racing at speed, to houseboats, cruisers, dinghies, hovercraft, jet skis, and jet boats. They may be used to tow a water skier, for pleasure cruising, fishing, and sightseeing, with the majority of boats less than 5.5 m long being purchased specifically for angling. Sailing boats may also use motors for auxiliary power.

Launching and mooring facilities vary according to the size and weight of the craft. Larger craft require formed facilities and, in high-use areas, parking space. By comparison, smaller craft may be manually off-loaded from vehicles or trailers.

The wake produced by motorised watercraft depends on the design of the craft and its speed, and may have substantial erosive potential. In sheltered areas, free from wind-produced waves, wake-induced bank instability may become an erosion problem. Water turbidity may also increase.

Jet boats, jet skis, and hovercraft can use areas that are not accessible to other craft. Small hovercraft can negotiate shallow reedy areas or rapids in fast-flowing streams. In wetlands, for example, they may damage habitat for nesting

birds. Their ability may also allow them to negotiate sections of rivers where only rowed or paddled craft would normally be anticipated. This may be a source of annoyance to those seeking rivers free of motorised vehicles and watercraft, and an inappropriate use of particular recreational settings. Motorised watercraft may also, depending on the amount of noise emitted, disturb wildlife and be a source of annoyance to other recreationists.

Thus, for reasons of safety, noise controls, erosion risks, maintenance of recreational settings, and the protection of ecological values, areas are commonly zoned for use by motorised watercraft.

### **Recreational fishing**

This is one of the most popular activities on inland waters. A 1987 survey of Victorians showed that 916 000 people fish at least once a year, 49% fished mostly on marine and estuarine waters, 42% mostly on fresh-water rivers and lakes, and 9% interstate or on undisclosed waters. Sought-after species include native fish such as Murray cod, freshwater blackfish, Macquarie perch, and golden perch and introduced ones such as brown trout, rainbow trout, and English perch.

Habitat retention and restoration is important for the maintenance of fish populations. This includes in-stream habitat created by fallen logs, deeper pools, appropriate water quality, and a constant supply of nutrients provided by stream vegetation. Native vegetation is far more important in this respect than many introduced plants often found along rivers, such as willows. In some waters an active stocking program is used to maintain fish numbers for recreational purposes. Victorian angling organisations have promoted actions to protect the environment, as they recognise that these will preserve both fish stocks and future recreational opportunities. Issues related to the conservation of native fish are described in section F2.

Fishing along rivers may be undertaken from the bank, by wading (particularly in the shallow mountain streams), or from small boats. The skill required to catch fish varies. Knowledge of their habitat and diet helps, and successful fly-fishing is an art only achieved with much practice.

Surveys of anglers suggest that being 'out-

doors' and able to 'unwind and relax' are important aspects of the sport, and accordingly access and a picturesque setting are important. Fishing outings may involve a family, a small group of friends, or large numbers as part of an organised event like the annual competition on the Wimmera at Horsham. Here, participants are often widely spread and angling activities are considered to have a minimal impact on the river environment, and not threaten the conservation of fish or other biota. In some instances the impact of collecting bait, such as shellfish or bardi grubs, may require management attention. Large numbers of anglers may also gather when conditions favour good catches — for example, in the 'bream runs' on the lower Mitchell River.

Consequently the importance of rivers to anglers will differ, depending species sought, preferred access, and desired success rate.

### **Fossicking and recreational prospecting**

In these popular activities, most people seek gold, but there is also interest in gemstones. Fossicking along the creeks and rivers has a number of advantages: alluvial processes concentrate the heavy gold and gemstones; running water assists fossicking by allowing wet panning and sieving, and removing mud that may obscure the colour of precious and semi-precious gems. Recommendations for these matters are proposed in section F12 below.

### **Public participation and resource inventory**

Identification of peak recreation groups assists public participation in planning and management. So too do systematic documentation of recreation resources and an accepted method of identifying and evaluating these. The involvement of interest groups in the planning process is also likely to lead to the early identification of key issues and facilitate the development and implementation of management strategies.

In the Canoe Victoria Project, for example, a recreational group has been able to make an important contribution to planning. The project involves the classification of Victoria's waters according to the types of canoeing experience they offer (outings, day trips, or tours), the skill required, the visual characteristics of the river corridor, and the duration and time of year the resource is likely to be

available. It will lead to the classification of river reaches according to their significance for canoeing, and of activities that may reduce or enhance the canoe resource.

Other inventories of recreational resources, such as published handbooks that systematically compile resource data, are also of importance. Examples include 'A Guide to the Inland Angling Waters of Victoria', and 'Gemstones of Victoria — How and Where to Find Them'. Such handbooks provide views of the relative values of different streams, and also alert people to the range of recreational opportunities available across Victoria.

### **Recreational use by organised groups**

Such organisations as schools, clubs, youth groups, and private companies involved in outdoor recreation have a valuable role in providing community access. Moreover, they may provide equipment hire, transport arrangements, skilled instruction, and interpretation of the environment in which the activity takes place, and set models for appropriate codes of conduct. Those operating in particular areas may also provide an improved level of safety to other river-users. For some towns the recreation opportunities in surrounding areas are sources of economic prosperity.

Organised activities of this nature may involve large numbers of people, both participants and spectators, particularly if there is a requirement for economic viability. This may lead to overcrowding of some areas and demands for exclusive access to particular venues — a demand Council believes in general to be inappropriate.

### **Providing for a range of recreational experiences**

Outdoor recreation activities are undertaken in a variety of recreational settings, which are defined as the physical, biological, social, and management features of an area. Camping, for example, takes different forms in various settings, from highly developed camp-grounds, through designated camp sites with few facilities, to remote areas without facilities. Angling, hunting, canoeing, or fossicking, for example, can also be undertaken in a similar range. Settings for recreation experiences depend on interacting factors, such as type of access, facilities, level of regimentation, and the intrusion of other uses and users. They in turn

determine the range of recreation opportunities available. These concepts have led to the planning method known as the 'Recreation Opportunity Spectrum'.

Five categories of recreational setting can be recognised, as outlined in the glossary: remote, semi-remote, roaded natural, semi-developed and developed (see Department of Conservation and Environment, 1990). The less developed ones are particularly sensitive to change. Taken in isolation the individual changes along rivers such as the opening or closing of a road, the upgrading of roads, or provision of new facilities may not appear significant. Their aggregate impact may, however, be significant, and lead to the loss of a particular recreational setting.

The Recreational Opportunity Spectrum approach can identify changes likely to be made to recreation settings by development proposals, road closures, and so on. It also encourages planning for a wide range of recreation experiences by identifying different settings that contain a range of access conditions, facilities, and management intensities.

Although it is desirable to provide for all appropriate recreation activities across the full range of settings, limited availability or lack of certain attributes (as in places more than 3 km from a public road) may make it unpractical to provide the full variety of settings sought by the community in all parts of the State. Developed settings providing large camping or picnic areas catering for high levels of use are often on municipal or private land.

In some cases recreation may be a primary use of public land; where it is a subsidiary use then it should be allowed where it can be accommodated without detriment to the other values, in accordance with the following recommendations.

## **Recreation**

### **Recommendation**

**F1** That

- (a) public land continue to be available for a wide range of recreational uses
- (b) land and water managing authorities aim at planning for the types, levels, and patterns of recreational use according to the capability of particular areas to sustain

such use without irreversible damage or significant conflict with the primary purpose of the area

- (c) planning ensure:
  - (i) a range of recreational opportunity settings are maintained within Victoria
  - (ii) special attention is given to the cumulative impact of small changes that may affect recreational settings
  - (iii) compatibility of recreational activities is considered
- (d) use of river recreational resources by large groups — whether private, commercial, or institutional — be permitted where this is consistent with:
  - (i) (a), (b) and (c) above
  - (ii) the recommended uses of particular areas
  - (iii) enjoyment and access requirements of other users
  - (iv) other legislation
- (e) opportunities on inland waters for recreational and commercial fishing continue consistent with the maintenance of fish populations through natural replenishment and/or stocking, and in accordance with the management goals for the area
- (f) stocking of fish for recreational angling only occur where the released fish will not constitute a threat to indigenous fish populations or significant flora and fauna, and in accordance with the management plan for the area
- (g) codes of use be developed to encourage responsible behaviour in the recreational use of water and water frontages, particularly those with an extensive boundary with private land
- (h) to facilitate planning, key recreational groups be encouraged to assist the development of methods that enable the significance of recreational resources to be identified

and that

- (i) community use of the State's recreational resources be encouraged through the preparation and publication of information about these resources.

## 2. Nature Conservation

Various sections of these recommendations refer to nature conservation values. This section provides principles and guidelines for the protection of habitat values when logging riverine forest, for the protection of native fish habitat, and recommendations for research on in-stream biota, and fish stocking.

Nature conservation values associated with rivers and streams include communities of plants and animals that live within or beside streams, or on associated floodplains, wetlands, and estuaries. They also include the sites of geological and geomorphological significance along rivers, some of which have been included in recommendations outlined in previous chapters. Consideration of the latter features includes an understanding of the way the rivers behave, the processes that determine this behaviour, and interactions with biological systems.

The understanding of biological and non-biological systems associated with rivers is important in its own right and also because the failure to understand them may have major economic and environmental implications. Loss of habitat may lead to the loss of a range of animals useful in controlling crop-eating insects. Discharges of wastes may result in unpredictable changes in water quality, reducing the range of uses that can be made of the water without extensive or costly treatment. An incorrect understanding of river dynamics may lead to river management works having no impact on the problems they are seeking to rectify or, worse, increasing the problems.

By its very nature, the understanding of these systems comes from gathering basic data in the field, and the systematic compilation and assessment of those data. With the technology now available, updating, assessment, mapping, and the identification of areas with inadequate data coverage can be undertaken routinely.

Further research into the identification of in-stream plant and animal species is required. Many of the smaller ones are incompletely known and new discoveries can be expected. The consultants carrying out a survey for this Investigation highlighted the lack of ecological data for some parts of the State and for some taxonomic groups.

Basic data-gathering and new research have helped to clarify the range of ecological impacts associated with the use of rivers and their catchments. These include the measurement of water yield and quality under various catchment uses, and the impact of stream regulation on in-stream biological values.

### **Plant communities and habitat**

The protection of any community involves consideration of the system as a whole. A plant community may consist of a number of strata, such as an overstorey and shrub or grass layers. Each layer provides a range of niches for a variety of animals.

Land use activities may affect different parts of the system in different ways, leading to changes that are not always obvious. The loss of native riparian vegetation, for example, has the following effects. The supply of nutrients to the stream from litter and insect fall ceases immediately, leading to changes in the food chains dependent on such nutrients, from macro-invertebrates at low end to fish at the high end. The supply of woody debris by limb fall also stops. This debris is important for the creation of a range of in-stream habitats. Consequently as the debris already in the stream rots or is swept away, the particular niche created by woody debris slowly disappears. The impact on animals directly dependent on the vegetation is immediate. Similarly, mature river red gum overstorey may appear to be good habitat with many nesting hollows. However, the ground or shrub layer must also be able to provide food sources for animals making use of such hollows.

Among the many communities found along watercourses, the distribution of river red gum associations has been considerably reduced. Previously widespread, they occurred in areas and on soils favoured for agriculture, and as a consequence have been extensively cleared. Remnants of these communities are often now restricted to corridors along rivers, particularly in the north-west of the State. Because of their linear nature, the remnants are particularly susceptible to changes from edge effects and to a range of influences such as timber-harvesting, grazing, and altered fire regimes.

A recent assessment of the adequacy of conservation reserves (Frood and Calder 1987) identified riverine forests dominated by river red

gum and black box as having a 'high priority for further conservation measures'. Council believes that the application of the following principles and guidelines would assist the maintenance of the many components of these communities when timber-harvesting is considered.

### **Guidelines for timber-harvesting in river red gum associations**

- In order to implement the following, mark individual trees prior to felling.
- Harvest according to a low-intensity selection system
- The following areas should be excluded from harvesting:
  - a buffer strip along specified rivers and streams
  - areas adjoining popular recreation locations
  - sites with rare plant species or associations, or nests of significant animal species, and surrounding buffers
  - areas of river red gum woodlands and open forest with an intact understorey
  - areas with significant plant or animal habitat identified in future surveys
  - specific tall trees
  - areas of particular scenic importance
- Carry out operations so as to retain diverse ground and shrub layers.
- In areas important for reptile habitat, fire-wood collection must be restricted.

Riparian communities and watercourses meet the habitat requirements for many ground-dwelling and arboreal animals, and for birds. For example, the bat species large-footed myotis feeds exclusively over water, and the rare squirrel glider has been recorded in a number of riparian forests, such as at Edi on the King River and along the lower Goulburn River.

Apart from major floodplains associated with rivers such as the Murray, rivers and streams only provide minor waterfowl habitat in comparison with wetlands. For many visitors, however, birds are often the most conspicuous and delightful part of their fauna. Several species, particularly azure kingfishers and insectivorous birds such as swallows, martins, and common sandpipers, often use over-river and riparian areas for feeding.

## Fish

Among the 56 fish species found in Victoria's inland waters, 44 are native species, 26 of which are restricted to fresh water throughout their life cycle. The remaining 12 species were introduced over the last 150 years. Issues related to recreational angling are covered in section F1.

The size and health of native fish populations depend on the existence of particular habitats, water quality, and stream-flow conditions. Free passage along the watercourse is also important for migratory fish. Koehn and O'Connor (1990) review these and the matters discussed below.

Snags provide key in-stream habitats. Their removal and that of the native riparian vegetation that produces them, and which also adds nutrients through leaf litter, have adverse consequences. The removal of gravel may also adversely affect fish, as it often forms the riffles that oxygenate the water and provides habitat for macro-invertebrates that form part of the food chain for fish.

Fish are sensitive to a number of water-quality criteria, temperature being one. Riparian vegetation is important in regulating the warming of stream water through controlling the exposure to sunlight. Impoundment of water may also have a major impact on the temperature of discharges. Water drawn from deep within the reservoir is likely to be considerably colder and contain less oxygen than that occurring naturally in the stream. Changes in water quality through elevated sediment levels, nutrient levels, and the presence of toxic chemicals also adversely affect fish. Many changes in water quality can be traced to pollution from point sources such as drains, or dispersed sources such as agricultural land.

In some instances, pollution has resulted in 'fish kills' or the accumulation of compounds including heavy metals in fish tissue, leading to a gradual deterioration in the health of the fish.

Particular stream-flow conditions trigger spawning behaviour. For example, rising water levels accompanied by rising water temperature are important in triggering this in golden perch. Changed stream-flow conditions, particularly a general reduction in flow due to regulation, may change spawning behaviour

and will probably lead to a loss of key habitat through exposure of greater sections of the stream-bed.

The barriers that are often used to achieve flow regulation may prevent the passage of migratory fish. This is of particular importance for fish in coastal streams with both fresh and marine life cycle phases. Fish passage may also be affected by the construction of river crossings or drop structures built to prevent stream-bed erosion.

More research needs to be undertaken on the impact of introduced fish on native fish populations. Although in many instances certain native and introduced fish can be found within the same water bodies, there is some evidence that the introduction of species, including brown and rainbow trout, have had deleterious effects on some natives, particularly galaxiids. Some undesired introduced fish such as carp, which have been declared a noxious species, have been subject to active control programs.

Council believes that the application of the following principles and guidelines will assist when considering the maintenance or restoration of fish habitat.

### Principles and guidelines for in-stream habitat protection

- Implement programs to restore native bank vegetation — because of its importance as a source of food and woody debris, and to provide shade, filter overland run-off, and prevent erosion.
- To improve water quality, programs to reduce water turbidity, and to prevent toxicants reaching streams, should either continue to be applied or be developed and applied.
- To moderate the effects of altered flow regimes in regulated systems, investigations should be carried out to determine water-release regimes that minimise adverse effects on fish life cycles.
- To maintain in-stream habitat, avoid channelisation and retain snags wherever possible, or tether them into the bank rather than remove them.
- Maintain unimpeded fish passage — providing fish ladders to assist migration and movement on impoundments where possible.

- Maintain aquatic invertebrate habitat, by maintaining or restoring riparian vegetation, in-stream diversity of stream form, and natural flow regime.
- Do not introduce fish species outside their natural range unless recommendation F2(b) (v) is met, nor stock introduced fish outside of areas currently stocked.

**Table 3**  
**CONSERVATION STATUS OF NATIVE**  
**FRESH-WATER FISH SPECIES IN**  
**VICTORIA — 1990**

Status in Victoria	Fish species (common name)
Presumed extinct	Agassiz's chanda perch southern purple-spotted gudgeon
Endangered	freshwater herring trout cod brown galaxias Ewens pigmy perch
Vulnerable	Australian grayling freshwater catfish Macquarie perch Murray cod silver perch Tasmanian mudfish
Potentially threatened	Australian bass broad-finned galaxias dwarf galaxias spotted galaxias pouched lamprey golden perch Yarra pigmy perch
Indeterminate	flat-headed galaxias mountain galaxias Cox's gudgeon striped gudgeon freshwater hardyhead Lake Eyre hardyhead freshwater blackfish
Restricted	bony bream two-spined blackfish crimson-spotted rainbowfish
Uncertain	western carp gudgeon Midgley's/Lakes carp gudgeons dwarf flat-headed gudgeon Non-parasitic lamprey

Status in Victoria	Fish species (common name)
Presently common and/or widespread	short-headed lamprey short-finned eel long-finned eel common galaxias Australian smelt small-mouthed hardyhead estuary perch southern pigmy perch tupong flat-headed gudgeon blue-spot goby bridled goby Tamar River goby

Source: Koehn, J.D., & Morrison, A.K. (1990).

Combined with the impacts of habitat loss and reduction of water quality, changes in flow regime and possible competition with introduced fish species have led to a decrease in the range of particular species, and in fish population sizes. Two native species are now presumed extinct in Victoria.

The conservation status of Victoria's native fresh-water fish reflects many of these changes and a recent review of it is outlined in Table 3. It should be noted that the conservation status of some species varies according to whether the Victorian or Australian context is adopted. (For the Australian context, see Harris, 1985.)

Using the status of golden perch as an example, the following explains one reason for the difference. In Victoria this species is listed as a 'potentially threatened' taxon that could become vulnerable or endangered in the near future because: it has a restricted distribution; only small populations remain in a few areas; populations have been heavily depleted; numbers are continuing to decline; or the species depends on specific habitat for survival. Northern Victoria is the southern limit of its distribution. In an Australian context this species is not listed as threatened, being common, secure, and widespread in New South Wales.

### **Invertebrates**

Aquatic invertebrate fauna are of inherent importance. For instance, it has a greater species diversity, and hence genetic diversity, than that

found among the larger and more familiar vertebrates (such as fish, reptiles, and mammals). The maintenance of natural genetic diversity is a fundamental aim of conservation programs. Aquatic invertebrates are typically at the lower trophic levels of the food chains, consuming vegetative matter and detritus. In turn they are important as food to many vertebrate species higher in the food chains.

Invertebrate communities can have their composition or diversity changed by: alteration of water quality caused by polluted run-off; increased sunlight resulting from bank clearing; variation in the seasonal timing and abundance of fallen leaves; increases in suspended soil and organic matter concentration of stream water; changes in stream flow resulting from catchment clearing; and water temperature and flow-rate effects of impoundments.

Aquatic invertebrates can be good indicators of the general health of aquatic systems, and their use as indicators is discussed in section F8.

Invertebrates in Victoria's rivers and streams have not been widely surveyed. Department of Water Resources (1989) summarises current data. Only a few exceptional stretches of streams have to date been identified by workers in the field as 'high-quality' because of the presence of rare species, high species diversity, or long records of scientific monitoring.

It is expected that other sections of rivers will meet these criteria as knowledge improves. When the results of future surveys identify such high-quality reaches, then management actions should be taken to maintain the riverine conditions.

## Nature Conservation

### Recommendation

#### F2 That

- (a) (i) further research into and surveys of plants, animals including invertebrates, and other ecological values associated with rivers and streams be carried out by relevant authorities and research organisations
- (ii) research be carried out to determine the minimum width of natural stream buffers necessary to protect the aquatic communities from activities on adjacent land

- (iii) the results of future research and surveys be incorporated into management plans, and taken into account in land management decisions, wherever appropriate

and that

- (b) (i) the guidelines for the protection of fish habitats outlined above be taken into account in the assessment of actions likely to affect stream habitat
- (ii) further research be carried out to establish the biology and habitat requirements of native fish and determine the impact of introduced species
- (iii) further research be carried out to ameliorate the impact of barriers including the design of fish ladders appropriate to the requirements of Victoria's native fish
- (iv) once the biology and habitat requirements of native fish with the Victorian conservation status 'endangered' and 'vulnerable' are known, management plans be drawn up to ensure the survival of self-sustaining populations and that particular attention be given to their habitat, water quality, stream-flow, and migratory requirements (see Note 3)
- (v) stocking of fish only occur if the conservation status of other native fish species, or significant flora or fauna are not put at risk, and where this is in accordance with the management goals for the area
- (vi) the stocking of introduced fish species be excluded from streams east of the Snowy River, and from Wilsons Promontory, in recognition of their conservation status

Notes:

1. Recommendations elsewhere in these documents make reference to protection of nature conservation values. In particular refer to A1-15, B1-30, C1-16(e), D1(b), (c) and (d), E1(a)(i), F6, F8
2. In particular, ARWC river basins 4, 6, 7, and 8 have been poorly surveyed for ecological values.

3. As further information becomes available, fish species currently with an 'indeterminate' conservation status may be classified as 'endangered' or 'vulnerable' and hence this recommendation would then apply to them.

### 3. Cultural Heritage

This section provides background information and recommendations for the protection of Aboriginal and post-contact cultural heritage.

Watercourses provide a focus for human activity, and accordingly they have cultural values that are important to us as a community. The expression of these values reflects changes in social organisation and technology and use over thousands of years. One major change was initiated with the occupation, initially by Europeans, of what was to become the State of Victoria. This change resulted in the expansion and formation of a different range of cultural associations. Consequently it is useful to consider them in terms of those relating to Aboriginal society prior to the nineteenth century, and those following.

#### Aboriginal associations

Ability to use and adapt to the environment and, in particular, to impound and divert water, enabling permanent human occupation, depends on cultural, social, economic, and technological factors. Nevertheless environmental factors were an important constraint on Aboriginal society prior to European occupation. Many activities were concentrated around watercourses. This is borne out by Aboriginal oral traditions and creation beliefs, by the ethnohistorical accounts of early European explorers and settlers, and by the material traces that have become incorporated into the archaeological record.

Aboriginal society relied on the oral and visual transmission of information about history, heritage, and links to the land. European occupation disrupted both the transmission and the physical links. Observations made at that time can serve to replace some of this lost information, but it must be remembered that these observations were made by untrained people and are often flawed by biases. The archaeological record provides a means, and in some cases the only one, of gleaning additional

information about the Aboriginal occupation of south-eastern Australia.

The material traces that have become incorporated into the archaeological record represent only a small part of a diverse culture, yet still reflect a wide range of activities, most of which were carried out near watercourses. Oven mounds where the tubers of water plants were cooked and shell middens containing the discarded remains of feasts of fresh-water mussels, fish, and yabbies occur on the floodplains and along the banks of rivers and streams. Trees with slabs of bark removed for use as canoes or shelter are relatively common near watercourses. The remains of fish-traps, some of which still function when water-flows return to natural levels, may be found in places. Sand dunes bordering rivers and streams often contain Aboriginal burials and in north-western Victoria some dunes were used as cemeteries, with hundreds of individuals being buried over many generations. Industrial sites where stone tools and other artefacts were manufactured are also associated with watercourses and are today represented by axe-grinding grooves and scatters of stone tools.

These sites are important components of Australia's cultural heritage. To Aboriginal people, they provide an irreplaceable link with the past. To the population generally, they are a fragile and non-renewable asset with the potential to provide a great deal of information about the past, particularly the way in which Aboriginal society responded to major environmental changes.

Conservation of Aboriginal archaeological sites is put at risk by activities that alter the physical environment. Disturbance of the surface of the land may have a direct impact, as may clearance of natural vegetation. The identification of threatened sites and the avoidance of potentially disturbing activities in their vicinity will assist their preservation. However, activities in a catchment, which result in increased erosion, sedimentation, or land degradation some distance away, may cause unforeseen site disturbance that cannot be mitigated. Appropriate management of rivers and streams is essential for the long-term conservation of Aboriginal archaeological sites, which should be one of the goals of management. The desirability of protecting such sites and Aboriginal cultural heritage generally has been recognised in legislation.

Development of strategies to protect Aboriginal archaeological sites begins with identifying the size and nature of the resource base — that is, determining what types of sites are present and how they are distributed through the landscape. The results of surveys and a list of identified Aboriginal archaeological sites is kept by the Victoria Archaeological Survey, Department of Conservation and Environment. The second stage involves identifying obstacles to the protection of those sites, both on a site-specific basis and on a regional level. The third stage involves the assessment of the sites in order to identify:

- the 'key sites', which should be actively protected through the commitment of resources for site-protection works
- a representative sample of sites that should be managed through the prevention of activities that may have an adverse impact
- sites that can be disturbed by development or other activities

This process is both labour-intensive and time-consuming and it is unrealistic to expect that even a small percentage of all Aboriginal sites will be located and assessed in the medium term. Therefore it is essential to concentrate efforts on those watercourses that are under the greatest pressure from human activity. This will allow mitigating strategies to be developed for these watercourses and may also enable the construction of predictive models of Aboriginal site distribution. Such models would facilitate management decisions to be made for watercourses where the archaeology is uncertain.

### Post-contact cultural associations

The term 'post-contact' describes the era following the contact between Aborigines and peoples of different ancestry. Initially in Victoria (1830s), these were sealers, whalers, and squatters and by the 1850s gold-miners. These people and those who followed had diverse cultural, social, economic, and technological backgrounds; their activities led to substantial changes, and rivers reflect these changes.

Evidence of this changing association varies. Some material evidence such as buildings or bridges has survived, essentially intact, while no material trace may remain of transient and temporary uses associated with the river — for

example, explorers' crossing places and sites of prominent historical events and accidents. Similarly, the early pastoral use of rivers has produced relatively few lasting physical structures — except stone sheep-washes — particularly as pastoralists replaced and modified structures as needs and technologies changed. On the other hand gold-mining sites and associated features, such as tunnels through river bends and water races, are relatively prominent. One reason for this is that mining has been widespread in Victoria and known auriferous lands were not sold but reserved as Crown land. They were also less attractive for pastoral and agricultural uses. Mining artefacts are durable and, on their abandonment at the cessation of operations, became the property of the Crown. Thus, they remain widely distributed on public land and, together with early bridges, are among the best represented historical features.

In essence, the cultural value of rivers and streams is based on the ways they have been influenced by historical figures, events, and phases or activities, and because of their role in a region's development. To make some sense of the last 150 years of human influence on and associations with rivers and streams, five basic themes have been identified.

- **Rivers and communication** considers the way our society has treated rivers as assets and liabilities in terms of communication. Rivers have been viewed as assets and used as physical boundaries and as a means of transport. As liabilities rivers are barriers to communication. Technological adaptations such as bridges overcome the resultant obstruction and isolation. This theme impinges on the wider issue of the relationship between people and nature and the role of technology in providing certainty over nature's vicissitudes.
- **Rivers and water supply (consumption)** recognises the enduring need for water for survival. Given this, rivers and streams have been important determinants of the location of both pastoral stations and small rural towns.
- **Rivers and raw materials and energy** considers the role rivers, streams, and water systems have played as resource factors in agricultural production, power sources, and resources in industrial processes. This is a

dynamic relationship, as the use of rivers depends upon technological and economic changes.

- **Rivers and recreation** concerns personal associations with rivers, and how the recreational use of rivers impinges upon our spiritual and physical well-being.
- **Rivers and hazards** expresses the 'people/nature' dichotomy, in that rivers are natural features subject to flooding. The imperative has been to subdue rivers and make them safe by controlling their flow and adapting their natural features. In many instances rivers were treated as no more than drains.

The sheer degree of human activity over the last 150 years and consequent associations with Victoria's rivers and streams have provided us with a potentially vast array of sites with varying degrees of significance. Existing inventories and surveys of cultural heritage have some inconsistency in evaluation procedures, selection criteria, interpretation, and definition. Accordingly, it is appropriate that, as the notion of the cultural significance of rivers matures, identification and assessment be based on the principles of the Australian ICOMOS Charter for the Conservation of Places of Cultural Significance (the 'Burra Charter'). This outlines guidelines for the conservation of places of cultural significance. Assessment must involve a consistent methodological approach, on-site research, and the development of co-ordinated management strategies.

As is the case vast array of sites with varying degrees of significance. Existing inventories and surveys of cultural heritage have some inconsistency in evaluation procedures, selection criteria, interpretation, and definition. Accordingly, it is appropriate that, as the notion of the cultural significance with Aboriginal cultural links with significant sites, many areas representing important historical associations with more recent settlement are fragile and — due to ignorance, lack of planning protection, or the ravages of time — may be lost.

Any decision-making process that concerns aspects of cultural heritage should include participation by groups or individuals with an interest in that heritage. Aboriginal people often recognise and maintain strong links with

the material traces of their ancestors' occupation of the landscape — that is, the archaeological sites. To ignore the aspirations and needs of Aboriginal people in regard to those sites is to deny them access to their own culture. Likewise it is appropriate that decisions regarding historical features should be undertaken in consultation with relevant community interest groups.

## Cultural Heritage

### Recommendation

#### F3 That

- (a) the Aboriginal sites along rivers and streams be identified and assessed, and protected in the management of these areas
  - (b) priority be given to achieving (a) above for those rivers and streams that are under most pressure from development and/or environmental modification
  - (c) where substantial development and/or environmental modification must take place in the vicinity of Aboriginal sites, emphasis be placed on impact-mitigation
  - (d) consultation with, and involvement of Aboriginal communities in any matters that may affect Aboriginal sites be an integral part of the decision-making process
  - (e) significance assessment methods be further developed using themes relevant to the historical values of rivers and streams (a pilot project based on a river catchment could resolve these issues)
  - (f) post-contact sites be identified and their significance be assessed as a prerequisite to developing management strategies
- and that
- (g) consultation with relevant community-interest groups be an integral part of the decision-making process.

## 4. Visual Resources

The following background information and recommendations cover the management of spectacular and commonplace visual resources.

Victorian riverine landscapes have diverse and highly valued scenic qualities. As a result of population growth and development, scenic values have been subject to increasing change and, in some cases, have been lost. As with other natural resource protection issues, it is appropriate to consider the scenic qualities of a landscape as a resource whose management requires careful attention.

Many activities, such as clearing, the construction of utility installations, roads, and buildings, the development of plantations, harvesting of timber, quarrying, and river management works have a visual impact that in many instances can be managed to ensure that scenic values are maintained or enhanced.

Regionally, Victoria's visual resources vary according to major changes in landform and vegetation. Rivers reflect this variety. Some, such as the lower Goulburn and others on the northern plains, are slow-moving, surrounded by river red gum woodlands with their mosaic of grasslands and other understorey communities, wetlands, and abandoned river channels. Others, such as those that drain the mountain areas in Gippsland, flow across rocky cascades through steep-sided valleys with tall dense forest.

Over the last 150 years natural landscapes have been substantially transformed, through the clearing of native vegetation, the establishment of paddocks, buildings, crops, plantings of introduced tree species, and networks of roads and tracks. Mining and town construction have also introduced new visual elements. Such transformed landscapes provide a record of the outcomes of how people sought to modify their environment to suit their purposes or to accommodate the natural world around them.

These changes in the visual environment have created considerable variety in the visual resource. Leonard and Hammond (1984) mapped and described this variety, as defined by both natural and cultural settings.

Visual resources provide a significant backdrop for many recreational activities. They may enhance the pleasure derived from them or may even be the prime reason for recreation activity. Picnicking, for example, is likely to be more pleasurable when undertaken in an area of high scenic value. Scenic appreciation can also be a source of direct pleasure. Scenic

lookouts are a feature of many roads that wind through mountainous country. Likewise walking tracks may be routed to vantage points that overlook spectacular landscapes, waterfalls, or distant views along river valleys.

Attention is often directed to visually spectacular landscapes, and Council has previously made particular recommendations to protect examples through the 'scenic reserve' and 'natural features and scenic reserve' public land categories. The visual quality of the commonplace environment should, however, not be ignored. People see these areas on an everyday basis, but they are often subject to adverse changes through planning and development activities, especially where individual proposals are considered in isolation. Such changes have resulted in the degradation of scenic resources on long sections of rivers across the State, with banks perhaps denuded of trees, infested with weeds such as blackberries, or eroded. Poorly sited or designed structures along or on river-banks and the treatment of rivers as drains have also led to visual degradation.

Council recognises that such identification and assessment is subject to ongoing research, but emphasises that visual resources are important and consideration of them must be a part of any planning program.

The approach used to identify and assess the scenic value of rivers in Victoria (Scenic Spectrums, 1986) has been outlined in Chapter 17 of the Resources Report.

As their conservation in Victoria is often implemented through management guidelines, the following steps outline the approach used by the Department of Conservation and Environment, the 'Visual Management System', to establish these guidelines (Sandford and Moss, 1986).

### Step 1

#### Inventory:

- the visible features of the landscape, including landform, vegetation, waterform, and land use
- user considerations, including travel routes, destination points, numbers of users, user expectations, and the seen area comprising fore-, middle- and background

## Step 2

Combine the scenic values with user considerations to produce management zones.

## Step 3

Develop visual-quality goals for each management zone, so that subsequent activities occur in a manner that least disrupts the existing visual resource.

Appendix V lists reaches identified as having high scenic value, using a scale and level of detail relevant to a State-wide assessment of the scenic resources of rivers. It is appropriate that these reaches be reassessed at a larger scale and level of detail consistent with any proposed management activities.

## Visual Resources

### Recommendation

#### F4 That

- (a) the identification of visual resources and assessment of visual impacts be included in considerations of river corridor management
- (b) the maintenance or enhancement of visual resources along rivers be an aim of plans or activities likely to influence them
- (c) the value of the commonplace visual environment be recognised and managed to ensure that it is not subject to the cumulative adverse impact of unco-ordinated changes

and that

- (d) guidelines be developed that ensure that river-bank structures such as pump-houses are sited and designed to ensure any adverse visual impact is minimised

## 5. Flow Regulation

These guidelines and general recommendations would assist in the maintenance, enhancement, or restoration of riverine values when water resource developments are under consideration.

Regulation of streams and construction of major storages and their interconnection to ensure security of supply have been fundamental

to the social and economic welfare and development of Victoria. Water has been supplied for domestic, industrial, and agricultural purposes. In some instances the construction of dams has provided new recreational opportunities in areas without natural lakes. In rural towns scenic values have been enhanced through the construction of weirs, the ponded water and surrounding gardens providing a scenic backdrop to the town. In some areas components of the water supply system have become part of our cultural heritage.

The extent of water resource development across the State varies. Some areas have little opportunity for further development and the cost is likely to be high.

Demand for off-stream supplies of water will continue. Increases in population and industrial production, and expansion and consolidation of irrigation areas, may require additional water resource development, which may also be required to maintain or improve security of supplies, as we understand more about the long-term natural variability of rainfall and the implications of the 'greenhouse effect'. Given the high environmental and economic cost of additional storages, consideration should be given to assessing the effectiveness and efficiency of existing water allocations when responding to changes in demand. Improvements in efficiencies of water use and recycling offer opportunities to reduce demand, and may be the strategy with lowest costs.

In addition to supplying water for domestic, industrial, and irrigation use, several existing water supply storages have been developed for their hydro-electric potential. Other schemes involving dams and aqueducts have been constructed solely for that reason, such as the Kiewa Scheme. There is increasing interest in the generation of hydro-electricity as a means of reducing fossil-fuel dependence and associated carbon dioxide emissions, and also because of its flexibility in meeting short-term peak-power demands. However, such developments can have major effects on other stream values, and these should be taken into account in the planning stage.

Although its benefits have been widespread and diverse water regulation has caused many major and long-lasting changes to environmental, recreational, and other values.

Ongoing research, improved knowledge of riverine values, and the ability to predict the impact of further regulation or extraction now enables us to incorporate river and catchment values into decisions regarding existing and future water resource developments. A review of the existing projects may also identify flexibility for new operating strategies, particularly where the timing, duration, and volume of downstream discharges may be altered to incorporate environmental, recreational, or other social values.

## **Guidelines for water resource projects**

When considering flow regulation the Council believes that the application of the following guidelines would assist in the maintenance, enhancement, or restoration of riverine values.

### **New projects**

- Storage site selection should evaluate the existing environmental values and consequences of the storage construction and operation, together with options for the use of groundwater resources, the opportunities for efficient water supply and use, water conservation, and recycling.
- Water resource developments should be based on a detailed assessment of fauna and flora values — including those of in-stream, riparian, wetland, and estuarine habitats — and recreation, scenic, and cultural values. Particular attention should be given to the impact of flow regulation on those downstream ecosystems. The water supplied from the proposed development and its dollar cost should be calculated after taking into account the water required to maintain designated environmental or other values.
- Landscape design principles should be applied to the design and siting of quarries, roads, and any other utilities associated with the completed project, in order to enhance its visual appearance and minimise the loss of landscape values.
- Detailed attention should be given to land protection, and to preventing or minimising water pollution and other in-stream effects, due to physical disturbance to the downstream watercourse bed, and banks, during construction phases.

- During the construction and filling stages, stream flows should be maintained at sufficient levels and with appropriate variations of flow in order to protect designated values.

### **Existing projects**

- A review of water-release regimes from established storages should identify opportunities to provide the downstream environmental water requirements for maintaining in-stream, riparian, wetland, and estuarine ecosystems, and to ameliorate the impact of storage releases on water quality and riverbed and bank stability.
- The review should also seek opportunities for recreational flows, bearing in mind existing constraints on water use.

### **Diversion other than from storages**

- For existing diversions, a review of the diversion policy and operation should occur. Consideration should be given to altering any diversion policy causing loss of ecological or recreational values to minimise such losses.
- New diversions should be approved only after considering the outcome of the above guidelines, and the cumulative effect of existing diversions on designated values.

### **Decommissioning and maintenance of storages**

- Recognition should also be given to the environmental consequences of decommissioning and maintenance of storages, particularly where the release of sediment previously trapped behind the dam wall may be involved.

## **Flow Regulation Recommendation**

### **F5 That**

- (a) the guidelines outlined above be taken into account in the assessment, development, construction, operation, and maintenance of new water resource projects and in the operation of existing storages and diversions

- (b) the environmental effects of the decommissioning and maintenance of storages be investigated

and that

- (c) when decisions are taken to construct new storages, they be designed to realise any hydro-electricity generation potential, bearing in mind the primary use of the storage, and to ensure the subsequent release regime does not adversely affect other stream values.

## 6. Environmental and Recreational Flows

This section provides general recommendations that would assist in determining and implementing flow requirements necessary to maintain designated environmental and recreational values downstream of major diversions.

Water harvesting and regulation lead to downstream changes in the natural patterns of stream flow and levels of discharge. Changes in water quality may also result where stored water is discharged from the bottom of a reservoir. As a result of stratification within the reservoir this water is often colder, and has less dissolved oxygen and a higher nutrient concentration than would be expected in the natural unregulated flow. Section F8 covers issues related to changes in water quality.

Regulation can have adverse impacts on in-stream and riparian biological values of the rivers, wetlands, and estuaries downstream. Recreational and other values may also be adversely affected.

For watercourses subject to diversions, stream flow is reduced. Such reductions will have most marked effects during periods of low flow, but, importantly, may also reduce the frequency of smaller periodic floods. Reduced stream flow alters in-stream environments. For example, fish habitat is often diminished; the hydrology of wetlands is altered; and the reduction in dispersal and dilution capacity makes in-stream values particularly vulnerable to the addition of contaminants. Where the rivers discharge to the sea, salt water extends further upstream, changing estuarine dynamics.

The selective diversion of water during high flows, on the other hand, and its interim storage in off-stream reservoirs, offers one method of mitigating the effects of water harvesting on low flows.

For those river systems in which the watercourse is impounded and the water stored for later down stream release, changes in natural discharge patterns have numerous effects. They may disturb the spawning cycle of fish or reduce the composition and integrity of wetlands on floodplains, because of either unseasonal and sustained high flows or the removal of periodic floods.

The management and planning of water-related projects offer substantial opportunities to minimise adverse impacts on environmental, recreational, and other values. It may be possible to enhance some values, particularly for some recreational activities such as canoeing — when summer irrigation releases occur stream flow is naturally low, but recreational demand is higher because of the holiday period, warmer weather, and longer daylight hours. Some discharges, particularly those drawn from the deep and colder sections of a dam, may enhance habitat conditions for trout. Such circumstances occur on the Goulburn River below Eildon.

A number of approaches are required in order to determine the water requirements necessary to maintain particular values. As Australian stream flows and environments differ greatly from those of the Northern Hemisphere, where techniques for assessing them were developed, modifications have been necessary to suit local conditions. Recent Victorian research has determined environmental water requirements for several local fish species and river systems. Additional work is now required to further develop techniques to determine environmental water requirements for other faunal and floral species in this State. For wetlands along the Murray, particularly at Barmah, research is in progress to determine the necessary flooding regime. The 'Wetlands Conservation Program for Victoria' (Government of Victoria, 1988) commits the Victorian government to provide, where considered necessary, water to 'high value wetlands' in order to maintain or improve their conservation value. Estuaries are dynamic and complex environmental systems, particularly the

larger ones into which a number of rivers may flow. The research to establish their environmental requirements has only dealt with specific aspects and is generally at a preliminary stage.

An interdepartmental group convened by the Department of Water Resources (1989) has developed, 'Guidelines for Incorporation of Environmental Water Requirements in Planning New Water Projects'. In accordance with the requirements of the Water Act 1989, these apply to all new water allocations and new water resource projects that may have significant impacts on water environments. Existing developments, which influence most of Victoria's larger watercourses, are not subject to these guidelines. Council considered, however, that heritage rivers (see Chapter A) should be given priority in investigations undertaken to establish appropriate requirements for existing regulated systems.

The approach recently developed to calculate the environmental water requirements is based on maintaining designated environmental values associated with all downstream aquatic systems.

## Environmental and Recreational Flows

### Recommendation

**F6** That:

- (a) further research be undertaken on the application of techniques for determining the water regime requirements for Victoria's inland waters, and the development of models to determine environmental water requirements to maintain the ecological values of in-stream and riparian habitats, floodplain wetlands, and estuaries
- (b) the techniques necessary to maintain or enhance recreational opportunities downstream of water resource projects be established, and applied in the first instance to heritage rivers where appropriate.
- (c) guidelines be developed for recreational flows, which complement the 'Guidelines for Incorporation of Environmental Water Requirements in Planning New Water Projects', and be included in future

water resource planning

(d) for existing regulated systems:

- (i) guidelines be developed for the incorporation of environmental water requirements in discharge regimes
- (ii) heritage rivers be given priority in investigations undertaken to establish appropriate environmental water requirements
- (iii) where conflicts arise between water supply and in-stream, riparian, wetland, or estuarine ecological values or recreational values, current discharge regimes be reviewed

and that

- (e) the planning of future storages involve consideration of off-stream storage sites, and diversions to such storages be timed so as to minimise the environmental effects of reduced downstream flows.

## 7. Water Use Efficiency

These general recommendations would realise the opportunities provided by improved efficiencies of water use (harvesting, storage, transport, use, re-use and recycling) for the maintenance/restoration of riverine values.

On a State-wide basis, increases in water supply have nearly always been achieved through increased water harvesting and increased storage capacity, rather than from water conservation, efficiency measures, or the re-allocation of supplies to more appropriate uses. Development of Melbourne's water supply system, for example, was designed to meet the unrestricted growth in urban water consumption. The drought of the late 1960s was a major factor in the decision to construct Thomson and Sugarloaf dams.

Stresses on the aquatic environment increase with the expansion of water resource development. Additional developments extend environmental impacts, often affecting aquatic systems previously free from regulation. However, the efficient use and allocation of water can achieve a range of environmental benefits.

There are several ways to reduce water demand, notably through water conservation, increased efficiencies, recycling, re-use, and

demand management. A variety of measures are available to achieve water conservation and efficiency improvements. Releases from storages subject to high evaporative loss should precede those from storages with lower losses. Lining and enclosure of open and unlined supply channels reduce evaporative losses and leakage. In the Wimmera-Mallee Stock and Domestic Supply System, losses from over 16 000 km of open channels have been estimated to account for up to 80% of the water released from the headworks. Leakage from irrigation channels also has direct environmental costs, as it is one of the causes of high water tables in northern Victoria. The water saved as a result of system efficiency may often be less costly — environmentally and economically — than that supplied by new water resource developments. Cost savings, however, diminish as the supply system approaches its environmental and economic optimum.

Recognising the undesirability of an ever-increasing demand curve, the Board of Works has recently developed a comprehensive urban water demand management program. Initiatives include community education campaigns such as the 'Don't be a Wally with Water' series, revised pricing policies, and the design and promotion of more efficient appliances, such as the current water conservation rating and labelling scheme.

Irrigation management practices have undergone considerable changes in recent years, with improved efficiencies of water use resulting in techniques to reduce consumption and salinity problems. Pay-for-use water-pricing policies provide incentives.

Water re-use and recycling is now undertaken by several water-intensive industries and by many local government authorities, and there is potential for these practices to become more widespread.

Efficient use creates economic as well as environmental benefits, as reductions in use and in losses lower expenditure on water purchases and increase the economic efficiency of the water resource system.

The Council recognises that water saved through the implementation of F7(a), (b), and (c) below may enable allocations for environmental purposes.

## Water Use Efficiency

### Recommendation

#### F7 That

- (a) economic, social, structural, technical, and operational factors serving to sustain or encourage inefficient water use be identified, and wherever possible rectified, to provide for more efficient water use
- (b) opportunities for improved efficiency of water use including recycling be identified and promoted
- (c) the government continue to promote and encourage efficient water use to the community, industry, water authorities, and government agencies
- (d) the achievement of environmental benefits through the efficient use and allocation of water resources be a high priority of water management authorities
- (e) water saved through increased efficiency be considered for allocation to environmental purposes, either for environmental water allocations or for the reduction in the need for new projects to meet water demand

and that

- (f) where privately funded schemes result in a water saving in fully committed public supply systems, a proportion of the water saving be allocated to environmental purposes

## 8. Environmental Quality

This section outlines the research requirements needed to implement a water-quality monitoring program and 'Codes of Practice' so that designated in-stream values (sensitive to water quality) can be maintained.

The environmental quality of our rivers and streams is largely determined by the maintenance of natural flow conditions and water quality. Section F5 covers issues related to flow regulation, while this section discusses water quality and its effect on the health of the numerous plants and animals dependent on rivers and streams. Losses of environmental quality may also have an impact on recreational values, as discussed in section F1.

We can determine the health or environmental quality of our rivers and streams by measuring a range of physical and chemical water-quality parameters and the level of toxic contaminants in key aquatic organisms. Physical indicators often measured include temperature, light penetration, turbidity, colour, suspended solids, and settleable solids. Chemical indicators of water quality include acid/base level (pH), dissolved oxygen, nutrients (phosphorus and nitrogen), dissolved solids, conductivity, toxicants (persistent and/or cumulative chemicals such as DDT and non-persistent ones like chlorine), carcinogens, and genetically active materials (mutagens and teratogens).

Under natural conditions, quality changes through the water cycle. During its fall through the atmosphere, rain dissolves gases and picks up dust particles. Water flowing across and through the soil continues this process — dissolving more salts and picking up fine soil and organic particles — until it reaches the sea, evaporates, or enters the groundwater. Moreover, its physical and chemical character varies with the composition of the rocks and vegetation in the catchment, the characteristics of the stream, and changes in stream flow. Natural water quality also varies over time, and the physical and chemical parameters fluctuate accordingly.

The turbulence of river flow keeps the water temperature reasonably constant throughout its depth at any measured point. Over time some links have developed between the plants and animals found in and alongside rivers and the quality of the river on which they depend.

Agriculture, urban and industrial land uses, and waste discharges have lowered riverine water quality, causing changes beyond the natural variations, in several ways. Atmospheric discharges, as products from the consumption of fossil fuels or other industrial processes, may have a major impact on rainfall composition, and ultimately river water. Changing land use is also important.

Clearing of deep-rooted native vegetation, as has occurred over more than 50% of Victoria since 1869, has caused substantial changes to various elements of the water cycle — less transpiration, more surface run-off, and more infiltration into the soil. The increased run-off may cause soil erosion, introducing sediment into the stream. Run-off from intensively used

agricultural areas may add organic matter, phosphorus and nitrogen (from fertilisers and animal excreta), and various pesticides and herbicides to watercourses. Breakdown of organic matter depletes the oxygen dissolved in river water, while salty discharges from areas with near-surface saline water tables increase its salt content. Discharges and leaching from present and past mining operations can also introduce a range of chemicals that may not normally be present in stream water or sediment.

Industrial and domestic discharges and run-off from urban areas are major sources for a diverse range of pollutants. These include nutrients, suspended solids, bacteria and other pathogens, heavy metals and other persistent contaminants, and thermal pollution. Nutrient inputs cause stimulated plant growth, leading to de-oxygenation, and cumulative toxins affect in-stream plants and animals.

Storage of water behind dam walls is another action likely to result in changes in quality. Water in deep, still areas behind dams may develop layers — the warmest at the top and the coldest and most oxygen-deficient at the bottom. Consequently, releases drawn from the base of a dam may comprise much colder water with different physical and chemical properties from those that existed prior to dam construction. These altered properties can have major impacts on in-stream biota, and the water has to flow many kilometres before it returns to a condition similar to that occurring naturally. Recently constructed storages, such as Thomson and Blue Rock Reservoirs, use multi-level offtakes to draw water from different depths within the dam to alleviate this problem.

Changes in water quality may have severe impacts on aquatic ecosystems. Algal blooms for example, can lead to rapid changes in dissolved oxygen levels and may be induced by high nutrient levels or climatic conditions that result in stratification of the water column. In 1987 Gippsland Lakes suffered a major algal bloom. Apart from the impact on fish populations, this adversely affected the local tourism industry, which relies on the Lakes. The recent Draft Gippsland Lakes Management Plan recommends actions to address this issue. Changed water quality may also limit the use to which the affected water may be put without expensive treatment. Land use or land

management controls for the reduction of diffuse sources of pollutants may be required.

Mercury pollution, resulting from mining operations in the upper Goulburn catchment, has required restriction on the consumption of trout caught by recreational anglers from this area.

### Water-quality reporting

The 1988 State of the Environment Report, 'Victoria's Inland Waters', assessed the recorded levels for the following criteria, wherever sufficient data were available:

- physical and chemical criteria — turbidity, suspended solids, conductivity (a measure of salinity), dissolved oxygen, biochemical oxygen demand, pH, phosphorus, and nitrogen
- biological criteria — information on macro-invertebrates (such as insects, worms, and shellfish) fish, and streamside vegetation

The Report developed an index of environmental quality, which assessed conditions as ranging from 'excellent' to 'degraded'. Readers are referred to it for detailed information, but the following is a brief summary of part of that Report.

#### Turbidity

In general, those rivers draining directly from forested catchments had excellent water quality. The Yarra, La Trobe, Maribyrnong, and Werribee Rivers, the Thomson below the dam (while under construction), and the lower reaches of the Goulburn and Wimmera Rivers were poor or degraded.

#### Salinity

The Wimmera, Avoca, Loddon, and Campaspe river basins to the north-west and the Hopkins, Glenelg, Portland, Corangamite, and Barwon basins in the south-west showed poor to degraded salinity status.

#### Phosphorus

The general condition of the Wimmera, Werribee, Maribyrnong, Yarra and La Trobe Rivers appeared to be predominantly poor or degraded for this indicator.

#### Nitrogen

Available data suggests poor or degraded quality for many stations on the La Trobe and most river basins north of the Divide (Wimmera, Loddon, Campaspe, Avoca, and lower

Goulburn and Broken Rivers) and in most of the south-western basins (Corangamite, Barwon, Moorabool, Werribee, and Maribyrnong).

#### pH

There appeared to be no problems with acidification of Victorian rivers.

#### Dissolved oxygen

Assessments showed poor or degraded quality on the plain tracts of the La Trobe, Wimmera, Yarra, and Maribyrnong Rivers.

Although the data did not allow a systematic and detailed assessment across the State, the following pattern emerged for the criteria considered.

- Major river basins such as those in the north-west have water quality sufficiently low to adversely affect aquatic ecosystems dependent on them.
- Rivers with excellent environmental quality tend to be those draining forested catchments in the Eastern Highlands and Otway Ranges.
- Rivers draining land used for broad-acre agriculture often have elevated salt, nitrogen, and phosphorus levels — and hence low water quality.

One of the difficulties in determining the environmental quality of our streams is the lack of comprehensive data on a State-wide basis for most water quality and associated biological parameters. In addition, very little is known about the threshold levels at which decreases in quality will affect aquatic ecosystems or individual species.

#### Other reports

The Environment Protection Authority has published 'Recommended Water-quality Criteria' for aquatic ecosystems. However, their application depends on the availability of monitoring information about physical and chemical quality parameters, or the identification of key organisms and knowledge of their habitat requirements and life cycles. Much of this information is not available for many Victorian streams.

The State Conservation Strategy states the goal to 'protect, restore and enhance rivers ... to ensure that ecological processes, native species, and features of scientific, cultural or scenic

interest are maintained and to provide for future recreational and commercial uses'.

To fully achieve this goal, we need to know much more about our aquatic ecosystems and species that reflect changes in water quality. We also require more comprehensive baseline information about environmental quality in order to protect our waterways in accordance with the Strategy.

### **State Environment Protection Policy**

The government has declared a State Environment Protection Policy for the Waters of Victoria, which came into effect in 1988. This sets beneficial uses, establishes goals for a range of water-quality indicators, and specifies certain actions that can be taken to meet those goals. The Council supports the policy and believes that its implementation should be given a high priority.

The policy also refers to the development of codes of practice. In co-operation with other public and private bodies, the Environment Protection Authority plans to initiate and participate in the development of appropriate codes with the aim of minimising the impact of activities that are potentially detrimental to water quality. In particular, urban run-off, soil conservation practices, waste-water re-use, and salinisation require early consideration.

In addition, the Council believes that codes of practice covering the use of fertilisers, herbicides, and pesticides should be given a high priority. Very few studies have been conducted on herbicide or pesticide residues in freshwater fish and aquatic biota in Victoria. The 1982 Environment Protection Authority pilot survey of biocides in selected agricultural catchments (the Upper Yarra and the Werribee, Lerderberg, and Little Rivers) detected a variety of inputs, including DDT and its breakdown products DDE and TDE. Dieldrin in fish samples from two Yarra catchments exceeded United States health criteria for edible tissue. The study noted the need for further information on the implications for recreational fisheries, and the effects of pesticides on local aquatic ecosystems.

In 1984, an analysis of trout indicated the presence of low levels of dieldrin, DDT, DDE, and TDE in fish from the Buffalo, Ovens, King, Kiewa, and Buckland Rivers. DDT and dieldrin were in common use in that region

until 1976, but were deregistered as pesticides for use on tobacco (the main application there) in 1980. In 1987 the use of DDT was banned in Victoria. A 1989 study of biocide residue contamination of sediments and the water column along the King and Ovens Rivers detected a range of organochlorine biocide residues, including some concentrations exceeding the threshold values for safe drinking-water quality.

## **Environmental Quality**

### **Recommendation**

#### **F8 That**

- (a) research into the biology and habitat requirements of native aquatic life, especially key indicator species of environmental quality, be accelerated
- (b) a high priority be given to the development and implementation of a cost-effective State-wide monitoring program of key indicators
  - (i) to provide information on physical, chemical, and biological water-quality parameters as a basis for determining water quality and monitoring changes
  - (ii) to provide for the maintenance of designated values

and that

- (c) 'codes of practice' covering the use of fertilisers, pesticides, and herbicides, particularly in agricultural areas, be given a high priority for development and subsequent application by the Environment Protection Authority in consultation with other relevant public and private organisations.

## **9. River Management**

Principles and guidelines published in previous Land Conservation Council recommendations have been updated.

River management authorities (River Management Boards, River Improvement Trusts, Drainage Trusts) involve some 27 agencies across the State, including several with responsibilities other than river management. The Water Act 1989 provides for the above

authorities, each having a 'waterway management district', to have the following functions in relation to designated waterways within that district:

- to identify and plan for State and local community needs for the use and economic, social, and environmental values of land and waterways
- to develop and to implement effectively schemes for their use, protection, and enhancement
- to investigate, promote, and research any matter related to its functions, powers, and duties
- to educate the public

The Act stipulates that an authority 'must perform its functions in an environmentally sound way'.

The Board of Works also has responsibilities for river and stream management, drainage, and flood protection in the Yarra River Basin and the lower Maribyrnong River.

Management works in rivers are designed to:

- prevent stream degradation and siltation by control of stream erosion
- protect adjoining land from flooding and erosion
- maintain the security of structures such as bridges
- restore vegetation along streambanks and adjacent frontage, including the use of native species
- enhance environmental and recreation value
- maintain the water-carrying capacity (for water supply or drainage purposes)

The works carried out include:

- erosion-prevention works on or adjacent to the banks — for example, planting of trees, the use of various materials for bank protection, and river alignment works
- erosion-prevention works in channels by the construction of 'drop-structures' to provide for the control of the gradient of the stream-bed
- clearance of waterways, by removal or relocation of snags within the bed of the channel, to maintain or improve discharge

capacity; (current approaches place more emphasis on retarding the stream flow and lengthening the low-flow path)

- establishing vegetation on stream-banks and adjacent frontages

Such work is often made necessary by the changes that people have made to land in the river catchment and on the floodplain. The following changes have generally reduced the value of the rivers for various purposes.

- Clearing of vegetation has increased run-off and accelerated the rapid rise of storm flows. Clearing of stream-banks, overgrazing, and, in some cases, cultivation have contributed substantially to soil erosion and transport of sediment to the stream. An increase in urban development — with disposal of storm water directly to streams — has also altered flow regimes.
- Regulation of stream flow by water storages and use of streams to transport water diverted from other rivers or for the withdrawal of water for irrigation and domestic use also change the natural flow regime.
- Past alluvial mining activities, last century and early this century, involved disturbance of floodplain vegetation and of the bed and banks through hydraulic sluicing and dredging. This caused an increase in sediment loads, which severely disrupted the natural conditions of the river. It is not clear whether rivers affected in this manner have yet recovered.
- Events in streams themselves — such as floods or human-induced channel-straightening — have also played major roles.
- The construction of barriers such as road culverts and bridges, through which the river must pass, has often resulted in substantial modification of the bed and banks and may disrupt fish passage. Present legislation requires that proposed replacement or new structures across waterways, floodplains, and depressions be referred for approval to the Rural Water Commission and to the River Management Board (where one is involved) as required by those authorities.

River management authorities, in attempting to cope with the consequences of these changes, carry out works that may in the short

term adversely affect landscape, recreation, nature conservation, and cultural values. Ultimately, however, such works could maintain or enhance these values by the prevention of erosion and re-establishment of vegetative cover along the stream-banks. Careful planning ensures that long-term adverse impacts are minimised.

Removal of snags from the centres of wide streams damages fish habitat, but tethering these snags against the banks may provide alternative habitat, as well as protecting the banks from erosion. Realigning and regrading of eroding beds and banks often removes holes and backwaters that have value as fish habitat and for angling and swimming. On the other hand, these operations may serve to reduce erosion.

Management authorities will be required to act within their waterway management district. In the past, where Trust districts encompassed only the stream environs or part of the stream, they could sometimes treat only the symptoms of problems, the causes being in the catchments beyond the area of their responsibility. The design and implementation of works thus offered little opportunity for consideration of their likely impact on areas outside the authorities' districts.

In 1983 'The State of the Rivers' report, drawing attention to the undesirable changes in the river environment that occurred over the past century, developed the concept that river-management works should be based on a whole-catchment philosophy. Subsequently, the Minister for Water Resources adopted various proposals to provide for the formation of river management boards with districts embracing the whole or at least substantial parts of complete catchments (as has been achieved by the Water Act 1989) and the establishment of catchment co-ordinating groups, representing local interests and all appropriate agencies. These groups facilitate consultation and co-ordination between the numerous bodies and individuals with an interest in stream management.

Several such groups have subsequently been established, including those associated with the Mid-Goulburn, Mid-Gippsland, Wimmera, and Mitchell River Management Boards, with wide representation of not only catchment and water organisations involved in

management and use but also the community. The Ovens-King Rivers group is being set up. The Snowy River interstate catchment co-ordinating group and community-based groups for the Mt Emu Creek (in the Hopkins River basin), Seven Creeks (in the Goulburn River basin), Tullaroop Creek (in the Loddon River basin), and Lal Lal (in the Moorabool River basin), have also been established.

A number of other reports expand on the principles outlined above: Standing Consultative Committee on River Improvement (1983); State of the River Task Force (1986); Standing Committee on Rivers and Catchments (1990).

The Standing Committee was established to advise on priorities for catchment co-ordination around the State, approve catchment management plans, and resolve disputes between agencies. Its 'Environmental Guidelines' provide an introduction to river morphology and ecology, general environmental guidelines for river management, and specific guidelines with case studies for the most common in-stream and bank management strategies and works.

### **Integrated catchment management**

The philosophy of a co-ordinated approach to combating river degradation is central to integrated catchment management, which is 'the identification and marshalling of all available land, water, human and biological resources within a catchment to optimise the value of sustainable beneficial uses of the physical environment' (Australian Water Resource Council 1988).

We should consider the catchment and stream as a single integrated system, rather than as two interacting ones. This is consistent with the State Conservation Strategy, which emphasises the 'whole-catchment' approach. The critical relationship between land use activities in a catchment and the resultant condition of the associated river system needs to be recognised and managed. This involves the interactions of land and water, as well as the management of vegetation and habitat within waterways and their environs.

River Management Authorities' roles and functions, and related effects, are wider than just in-stream activities. The integrated approach should ensure that works plans and programs incorporate greater concern for

stream protection and management, and the protection of landscape, recreation, cultural heritage, and nature conservation values.

The flow regimes of some rivers must be modified and floodplains used for agriculture, but it is appropriate to look at the principles of the natural system in seeking solutions to the problems that thus arise.

### Principles for managing rivers

The Council believes that the following principles should apply in determining the need for and design of river management works.

#### Catchment-based solutions

- Where problems in river management arise, the whole catchment should be considered in seeking solutions.
- The principles of integrated catchment management should be applied to all rivers, with priority given to areas with river management problems.
- Catchment co-ordinating groups should continue to be established and should be adequately resourced where needs are identified, as they have key roles in detailed planning and management, and facilitate local consultation over river and catchment issues.

#### Flooding

- Where flood control is considered necessary, planning and land management strategies should include ways of reducing run-off from the catchment.
- Total flood control is seldom practicable nor appropriate for floodplain wetlands. In the case of minor flooding, it may often be appropriate to take action to minimise the consequences rather than attempt to prevent it.
- Continuation of moves to map floodplains, assess flood risks, and include appropriate measures in zonings should be encouraged. This information should be made readily available to potential users of flood-prone land.
- Structures such as road embankments and bridges on floodplains may interfere with natural patterns, and consideration should be given in their design to ensure their effect on the flood pattern is minimised.

#### Bank vegetation

- Vegetation cover should be maintained along stream frontages to stabilise the banks and reduce the velocity of floodwaters as they leave and re-enter the flood-course.
- Vegetation planted for river management purposes should preferably be native species of local provenance. This may require further research into the most effective use of native species.
- Establishment of vegetation on treated river frontages may require removal of stock, fencing, and provision of alternative stock water supplies (see Chapter E).

#### Bed and bank works

- Works carried out within the bed and banks of a stream to change the alignment, gradient, or cross-section should be kept to the minimum necessary.
- For bank and in-stream works the intention should preferably be to retard stream flow and lengthen a river's low-flow path, rather than expedite floodwater flow.

#### Other values of river courses

- In the design of works, careful attention should be given to protecting or enhancing the following values:
  - in-stream and riparian habitat
  - areas containing significant plant or animal species, or habitats
  - scenic landscape elements
  - features of cultural significance
  - recreation resources

### River Management

#### Recommendation

##### F9

That the assessment of the need for, and the planning and implementation of, river and stream management works involving any changes to the beds and banks of streams incorporate the principles outlined above.

## 10. River Restoration

This section outlines the impacts of salinity and degraded frontages on riverine values and the need to reduce their adverse consequences. Recommendations of 'Salt Action: Joint

Action' are endorsed, and additional recommendations provide for the restoration of riparian vegetation.

Salinity, catchment and river-bank erosion, removal of riparian vegetation or substitution of native riparian vegetation with introduced species, and the addition of pollutants from point and non-point discharges have all led to the degradation of Victorian rivers through the loss of environmental, recreational, scenic, and cultural values. These losses are also of major economic consequence to individuals and the State.

### Salinity

Described as the greatest single threat facing Victoria's environment, salinity is widespread throughout the northern and western parts of the State, affecting plains and highland areas as well as the waters of several major rivers. The Glenelg, Hopkins, Wimmera, Avoca, and Loddon Rivers and the lower reaches of the Murray all have high salt loads.

Rising water tables are at the heart of the salinity problem, but the effects can vary widely. Causes and effects can occur within a single farm or may be separated by hundreds of kilometres. Symptoms may appear within a matter of months of the cause, or within decades. Salinity can affect agricultural land, vegetated public land, rivers, supplies of water to farms and towns, and wildlife habitat.

The natural equilibrium between groundwaters and surface waters is finely balanced. A relatively small increase in water percolating through the soil surface can cause, with time, a significant rise in the level of the water table. Extra water may percolate to the water table because more is applied to the surface (especially in irrigation areas), or less water than usual is lost from the soil by natural evapotranspiration due to removal of native vegetation, especially trees. Rising groundwaters dissolve naturally occurring salts in the soil and bring them towards the surface, where they are concentrated by evaporation. Increased salt levels in the root zone may damage plants, and change soils (which can result in increased soil erosion risk and decreased agricultural productivity), degrade the natural environment (including loss of native vegetation and wildlife habitat), and spoil recreational areas. Domestic use of saline groundwater or river water can

damage water-using appliances. Rivers, being the lowest points in surface landscapes, are often recipients of natural and artificial saline discharges.

The extent and severity of salinity problems continue to increase, and present hydrological evidence indicates that salinity levels will not stabilise without dramatic changes in land use practices. The Government of Victoria (1988) strategy for managing land and water salinity, 'Salt Action: Joint Action', includes a comprehensive summary of the present situation and programs to combat it.

The broad subject of salinisation and its effects on general land use has been canvassed in Council recommendations for the Murray Valley Area (1985), and the Mallee Area Review (1988). Salinity issues as they relate to rivers and streams are twofold.

- Increased salinity of water flowing in rivers can adversely affect many riverine features (especially invertebrate fauna) and downstream uses for irrigation, stock, or domestic supplies.
- The salinisation of land immediately adjacent to watercourses can lead to loss of riparian vegetation, riverbank erosion, increases in sediment load, and consequential damage to the aquatic floral and faunal communities in the river.

Salinity management plans for Barr Creek, Shepparton Irrigation Region, Goulburn Dryland, Campaspe West, and Tragowel Plains, were approved by the government in May 1990. Their primary concern is to improve the productivity of agricultural land in these regions, and eventually reduce the salt load being passed to the Murray River (as evaluated by a model of the electrical conductivity at Morgan, South Australia, between 1975 and 1985). All watercourses discharging to the Murray are now governed by a salt-load quota — set by this model and developed by the Murray Darling Basin Commission.

The present system takes only limited account of very high peak concentrations of salt in Victorian rivers, although many aquatic plants and animals may be killed by a high salt concentration event. Hart et al. (1989) suggests that adverse biological effects will occur in rivers and streams when salinity reaches about 1000 mg per L (about 1670 EC units) — a value that

is sometimes exceeded in a number of Victorian rivers. However, as yet no long-term programs have sought to measure peak salt concentrations in the State's rivers, although regular monthly salinity measurements have been taken in many streams of the Goulburn, Campaspe, and Loddon River basins since 1976.

Of the 57 recording stations throughout these catchments, 21 have shown a statistically significant trend in salt concentration. Seven stations have shown a rise in average salinity; 14 have shown a decrease. However, the years of low rainfall in the late 1970s and early 1980s (when higher river salinities were expected) and the years of high rainfall more recently (which would dilute river salinities), might have obscured any long-term trend of rising salinity. A clear rise in salinity of about 1% per year has occurred in some streams of the upper Goulburn River basin. These catchments are forested and low-salt-producers, and should not experience an increase. Furthermore, it has been estimated that the Goulburn River generally will ultimately reach an equilibrium level of salinity that is twice the original natural levels. These findings give cause for concern.

Treatments to improve the agricultural capability of dryland agricultural areas may also lower the salinity of adjacent watercourses. Such treatments include the planting of native trees in recharge areas (particularly on the tops of rocky hills), and changing pastures to species that use more water. However, the planting of trees in irrigated agricultural areas does not greatly reduce the salinisation of the land or waterways. Instead, measures now being taken in irrigated areas include the more efficient distribution of the irrigation water (to reduce accessions to the groundwater table) and groundwater pumping. Generally, these actions only lower the water table by a small amount that, although useful for agriculture, still does not return it to the natural level and therefore does not significantly benefit the adjacent and lower-lying rivers and streams. More attention needs to be paid to specifically reducing the accessions of salt to rivers and streams that pass through salt-affected irrigation areas.

### **Erosion**

This is a natural process in landscape

formation, and events such as floods, drought, fire, or landslides may contribute to it. However, certain human activities can lead to major increases in erosion and sedimentation rates. Today the severe erosion and much of the massive increase in sediment loads being carried by many Victorian rivers have resulted directly or indirectly from the clearing of native vegetation for land or resource development.

Most of the land affected is in agricultural use; but activities associated with timber-harvesting, mining, tourism and recreation, urban development, and transport and communications, where poorly managed, can produce similar effects locally. In the case of transport and communications, the facilities can have a disproportionately large effect on land and water relative to the small total area they occupy. For example, roads may be a significant source of sediment, both during and after construction.

A return to stable conditions (which may differ from the past regime) can take decades. Where the catchment has been severely disturbed, stability may only be achieved with active intervention. Improvements in land management, combined with active stream management, may be required. Improved management may mean treatment with engineering works (such as erosion-control structures), catchment or frontage revegetation, improved land management practices, or a combination of these.

### **Restoration of riparian vegetation**

Much of the State's substantial in-stream and stream-bank erosion problem has been caused by the clearing of native vegetation from the river-bank, and human alteration of the stream-course. Vegetation typically slows the movement of water across the land surface. This allows more water to percolate into the soil and leaves less to run off; it also spreads over time the peak run-off. Conversely, clearing of catchment vegetation causes higher and shorter peak flows. Overgrazing and unwise cultivation in the catchment and along the river-banks allow loosely bound topsoil to be eroded by a storm and to be transported to the watercourse.

Bed and bank erosion, the principal form affecting rivers, is caused in part by greater peak flows and the removal of vegetation.

Recommendations for river management are covered in section F9.

In some cases, past river-bank stabilisation has involved the use of exotic species such as willows and poplars and, while they are effective for that purpose, they can proliferate, choking watercourses. Other effects of proliferating exotics include the loss of habitat for native animals and changes in the nature and timing of the supply of nutrients to streams from leaf litter, an important food supply for in-stream fauna. Exotic tree leaves arrive in the period of lowest aquatic productivity (winter), whereas the leaves of native vegetation fall throughout the year, but predominantly in the period of highest aquatic productivity (summer).

Under exceptional stream-bank erosion conditions, willows may still be the most effective plant to use for the initial stage of control, although they are not a long-term option. However, in such circumstances, supplementary plantings of native species, preferably indigenous, should be made, and the willows removed when stability is achieved and can be maintained. *Casuarina cunninghamii* and *C. glauca* have been successfully used for bank-erosion control. Programs to restore river-bank vegetation can actually lead to financial benefits rather than costs to adjoining landholders, although this is not yet generally recognised.

## River Restoration

### Recommendations

#### Salinity

##### F10 That

- (a) where appropriate, the techniques that have been developed to control salting, such as those outlined in 'Salt Action: Joint Action', be applied to salt-affected public land
- (b) in the preparation and execution of regional salinity management plans
  - (i) specific attention be given to reducing accessions of salt to rivers and streams
  - (ii) financial support be provided to landholders for appropriate programs for protection of the natural environment from induced salinity.

and that

- (c) in dryland salt-affected areas, the

government continue to encourage and expand the development of tree-growing assistance schemes, agroforestry, cropping and grazing techniques, and the use of deep-rooting plants to reduce the accession of rainfall to groundwater, in order to alleviate the effects of salting and improve the condition of public land.

### Restoration of riparian vegetation

#### F11

That watercourses currently vegetated with exotic species (such as willows and poplars) be progressively replanted with indigenous species, taking account of erodible stream-banks.

Priorities for doing this may be determined by taking into account the following guidelines.

- Exotics should be removed where their presence is causing or is likely to cause stream-bank erosion or channel-narrowing.
- In some rural landscapes exotic trees, with their seasonal displays of colour, may be a major scenic feature. Sometimes exotic trees may be the predominant or only ones present. In such areas, removal of the exotics may not be necessary; but if removal is carried out it should proceed gradually, accompanied by replanting with native species.
- Some specific stands of exotic trees may have cultural heritage significance, arising from the circumstances in which they were planted.
- For stream-bank stabilisation, new plantings of willows should only be used in exceptional circumstances where they are the only effective method. In such cases, once stability is achieved, they should be removed and replaced where possible by native, preferably indigenous, species.

## 11. Utilities and Survey

Recommendations for utilities have been extensively covered in previous Council investigations. These have been reviewed to meet the particular requirements of this Investigation.

Many utilities occupy public land along rivers and streams. They include roads, pipelines, power lines, public buildings, garbage and sanitary depots, and sewage-treatment works.

These recommendations do not specifically refer to many of the small areas used for those purposes, as no change is proposed, and it is intended that their existing legal uses and tenure should continue.

From time to time proposals are made for the construction of new or altered utility sites or alignments, some of which are likely to be sited close to, or cross, rivers or streams. In the absence of firm planning proposals, accompanied by the necessary detailed information, it is not possible for the Council to provide for future requirements of land for such survey and utility sites, which will be considered when the need arises.

Government agencies concerned with provision and installation of communications equipment, transmission lines, water pumps, hydro-electric generation stations, pipelines, roads etc., and associated water needs are requested to submit proposals to the appropriate land managers at an early planning stage. This would assist in achieving co-ordinated planning, and perhaps avoid the necessity for costly re-surveys.

It should be noted that the provision of utilities and their easements can have substantial impacts on many of the values likely to be found in riverine areas and surrounding land. This is particularly the case for catchments whose identified value is their essentially natural condition (see Chapter B). Vistas of high scenic value are also sensitive to the installation of some utilities. Alternative strategies for the provision of utilities should be sought where such adverse impacts are likely.

## Utilities and Survey

### Recommendations

#### General utilities

##### F12 That

- (a) existing easements continue to be used to provide access and services
- (b) new power-lines, pipelines, communications equipment, and other utilities be planned to avoid disturbance to the values of rivers and streams, particularly, heritage rivers (see Chapter A), and essentially natural catchments (see Chapter B), and to the river values identified in Appendix V

- (c)
  - (i) new pipelines and power-lines follow easements already in use if possible (this may require widening of some easements)
  - (ii) generally, utilities not be sited along or across rivers and streams, but where this cannot be avoided the agreement of the management authorities for the river or catchment be sought
  - (iii) wherever possible, utilities such as power-lines and pipelines not be located along streams or beside lakes
  - (iv) new garbage depots not be located in essentially natural catchments, and elsewhere be sited with particular care to avoid contamination of water resources and to cause minimum conflicts with conservation values, especially those of heritage rivers and those rivers with values listed in Appendix V.
- (d) existing legal use and tenure continue for areas that are at present reserved and used for utility purposes such as sewage-treatment works and public buildings

and that

- (e) where such installations produce potentially polluting discharges, steps be taken to implement the provisions of Environment Protection Authority licences (where these exist) or State Environment Protection Policies, in order to minimise impacts on river systems and values.

#### Railway lines

Rail-lines become a concern of the present Investigation where they pass along or across watercourses, especially heritage rivers. Bridges across rivers may be of cultural significance — for example, those stone, brick, or steel bridges on the Bendigo and Castlemaine lines or the timber trestle-bridges in East Gippsland and the north-east. Council has, in the past, made specific recommendations for the protection of such bridges.

##### F13 That

- (a) where disused rail-lines and associated easements along or across rivers or streams are to be disposed of, special

consideration be given to the nature conservation values of any remnant vegetation, the cultural significance of the line and associated structures or equipment, and the recreational or scenic value of the easement or associated features

and that

- (b) landscape and conservation values of railway easements be protected by observing the guidelines in Council's past recommendations.

#### **Survey, navigation, and communication**

New access roads, cleared lines-of-sight, and clearings for towers and other structures can have a substantial impact on heritage rivers, essentially natural catchments, remote recreational settings, or scenic vistas.

#### **F14 That**

- (a) new utility constructions or clearings in such circumstances only be built after consultation and agreement between the constructing authority and the authorities responsible for managing the river and its catchment

and that

- (b) the minimum area necessary for survey purposes around trigonometrical stations, and for access to and maintenance of navigation aids and communications installations, be temporarily reserved on public land where it would otherwise remain as unreserved Crown land.

## **12. Mineral and Stone Production**

Recommendations for mineral and stone production have been extensively covered in previous recommendations. These have been reviewed to meet the particular requirements of this Investigation.

Modern society depends on the availability of earth resources. Knowledge of the location of these is far from complete. New methods of exploration will be developed and new deposits of commercial significance will undoubtedly be found. Some currently uneconomic deposits of important minerals may become

economically exploitable, while other deposits of minerals, stone, and energy materials not used at present may become of industrial importance.

#### **Exploration for minerals**

The government has the responsibility to establish the existence and extent of the State's earth resources. In the main, provisions in the *Mines Act 1958* and the *Extractive Industries Act 1966* provide the tenure under which private enterprise is encouraged at its own cost to locate new deposits. When a new deposit is discovered in an area where extraction is not a currently approved land use, it may be of such importance that a change in the land use is required in the State's interest. The decision on whether such a change is in fact necessary can only be made against a background of the best available knowledge of the location and extent of the particular deposit, and how it may be developed. This requires ongoing exploration.

Exploration encompasses a wide range of methods for evaluating an area's earth resources. Some methods are not compatible with the conservation of sensitive values, while others can have minimal impact if carried out carefully. The latter include remote sensing, geological mapping, many types of geophysical and geochemical surveys, exploratory slim-hole drilling, and ditch-witching. In certain circumstances and beyond particular levels, these activities may cause disturbance. The size of samples for geochemical analysis and the diameter and depth of drilling are important aspects.

Exploration methods can often be confined to the use of existing tracks, but if new tracks or minor disturbances to vegetation are made, effective rehabilitation methods would be required. Minimum-impact exploration may not compete with environmental values. On the other hand, exploration directed at mineral evaluation including intensive drilling and certain types of geophysical and geochemical surveys involving surface disturbance (e.g. costeaming and bulk sampling), are generally not compatible with the conservation of sensitive values.

It is important therefore that the reservation of conservation areas should not automatically exclude exploration for mineral and fossil fuel resources. Attention should rather be directed

towards ensuring that other values and interests are protected. As discussed later, however, some areas should remain undisturbed.

The protection of other values — particularly those historical values around old mine sites — should never be enforced to the point that it places human life at risk. In relation to public safety, nothing in the recommendations affects the powers of Inspectors under the *Mines Act* 1958 and the *Extractive Industries Act* 1966.

### **Fossicking and prospecting**

These are often taken to mean one and the same thing. In mining terms a fossicker is a person who casually works over old mine workings and waste-rock heaps in the hope of finding small amounts of gold or other minerals. On the other hand prospecting is a systematic activity, defined in the *Mines Act* 1958 as 'all operations conducted for the purpose of discovering or establishing the presence or extent of mineralisation or of a mineral'. In this sense prospecting is exploration, and it is necessary to hold an exploration licence, or a Miner's Right, before undertaking it. Most individuals operate under a Miner's Right, which does not permit prospecting on private land.

Unlike prospecting, the term 'fossicking' has no basis in legislation. Fossicking is also accepted as a recreational activity embracing the search not only for minerals — including gemstones — but also for other items such as old bottles or coins. A Miner's Right is required to fossick for minerals but not for other items.

Under current legislation prospecting is not permitted on some 35% of public land in the State. This includes national, State and wilderness parks, some flora reserves, and areas used for community purposes such as golf-courses and cemeteries.

Council considers that fossicking and prospecting are legitimate uses of public land and as such should not be unduly restricted or regulated. However, in accordance with Council recommendations, there are some places — reference areas, some water production areas, and essentially natural catchments (see Chapter B) — where these activities may not be permitted. In addition, limited areas of land surface may, because of their special public importance or inherent instability, warrant either permanent or temporary exclusion from

fossicking and prospecting. They may include:

- land that, if disturbed, may detrimentally affect water quality, especially where the water is used for domestic consumption
- important habitats for plants or fauna
- important cultural features that could be damaged
- sites of high erosion hazard
- community assets such as recreation areas and water or sewerage installations
- important geological features

These limited areas of land surface have not been specified in the recommendations, but will be determined by consultation between the Department of Conservation and Environment and the Department of Industry.

Fossicking and prospecting, where they involve minimal disturbance to soil or vegetation, will be permitted on public land other than these limited areas and those specifically nominated in the recommendations. Areas currently exempted or excepted under existing legislation should remain so, unless otherwise specified in these recommendations or unless the Departments of Conservation and Environment and Industry together determine that such exemptions or exceptions should no longer apply.

Recreational activities are addressed in the Mineral Resources Development Bill, currently before Parliament, which provides for a 'tourist fossicking authority' and a 'tourist mine authority'. The Miner's Right is to be retained to enable the holder to 'search for' minerals. The term 'prospecting' is not used in the Bill. It is not expected that the new legislation will alter any of these proposed recommendations.

### **Stone**

Materials covered by the definition of 'stone' in the *Extractive Industries Act* 1966 (including rock, gravel, clay, sand, and soil) are widespread in the State. There is a strong community demand for new and better roads and buildings, and so for the materials necessary for their construction. Most of these materials are provided from private land, but public land is also an important source — particularly for road-making material. Gravel, sand and soil are frequently extracted from rivers and their floodplains.

The Council is concerned by the complexity of legislation and procedures governing extraction of 'stone'. (For example, the Roads Corporation and municipal councils are not bound by many provisions of the *Extractive Industries Act 1966*.)

There is need for:

- review of existing legislation and procedures to enable more rational use of the 'stone' resource of the State
- provision of adequate resources for the reclamation of old extraction sites on public land

Poorly planned and located excavations can affect surrounding lands through noise, dust, unsightliness, and erosion and can diminish the value of the land. With care, however, these effects can be avoided or minimised. In the past, some extraction activities were carried out with little attention to these matters; however, more recent extraction has been subject to more effective environmental and rehabilitation controls.

## Principles and guidelines

The principles detailed below have been specified in numerous of Council's past recommendations. Current practices of the Department of Industry are in line with them. In addition, activities carried out under provisions of the *Mines Act 1958* and *Extractive Industries Act 1966* are subject to assessment by the Department's Environmental Unit. The terms 'exploration and extraction' below do not relate to prospecting under a Miner's Right and fossicking.

The Council believes that the following principles should apply.

- Some areas of land surface — because of their inherent instability or special public significance (for example, community assets or areas with important scenic, cultural, recreation, or nature conservation values) — warrant permanent or temporary exclusion from extraction of 'minerals', and from exploration where the methods proposed would adversely affect the identified values. The Department of Industry and the Department of Conservation and Environment should together determine these areas. Consultation should take place as required between officers of the two Departments to

determine which areas should be excluded and the conditions under which particular areas of public land are used for exploration for, and production of, minerals, stone, and energy materials.

- When tenure is issued for operations under the *Mines Act 1958* on public land, the land manager should be consulted regarding the conditions to apply and the supervision should be in accordance with the agreed conditions as specified in the claim, licence, or lease and with the requirements of the Act.
- Consultation should continue between the Department of Industry, the Department of Conservation and Environment, and other land managers and relevant authorities with respect to the procedures to be adopted for the exploration and extraction of 'stone' on public land. Any operations on public land should continue to be subject to the approval of the land manager. In all cases, the procedures that are established should apply to municipal councils, the Roads Corporation, and other public authorities as well as to commercial operators. To ensure this, the relevant Acts may have to be amended.
- A system should be established (where it does not already exist) to ensure, before work commences, the availability of funds for progressive and final reclamation of any excavation or operation. Provision should also be made to enable the acceleration of the rehabilitation of all existing extraction areas on public land.
- Royalties for materials extracted from public land, including site rental when appropriate, should be more closely related to the market value of the material. This would eliminate any temptation to use public land purely on the grounds of the nominal royalties sometimes levied in the past.

The following guidelines should apply to all extraction from public land.

- The Department of Industry should continue with its policy not to issue leases for petroleum production or for the mining of 'minerals' unless satisfied with the program submitted by the applicant. In the case of Miner's Right claims, prior assessment is not practical and the Department should ensure the lodgement of a bond as surety that is

adequate for rehabilitation. It should continue to require identification of end-use options and where possible require the lodgement of mining plans that show the expected post-mining state of the land. The Department should state operating conditions to achieve an appropriate standard of rehabilitation acceptable to itself and the land manager. End-use options should be continually reviewed during the term of the title.

- No sites for the extraction of 'stone' should be opened in areas that the land manager, in consultation with the Department of Industry, considers to be of greater value for other uses — including scenic, recreational, cultural, or nature conservation values. The advice of the Department should also be sought as to the desirability of proposed excavations, having regard to alternative sources of 'stone' and the siting of any associated works.
- Extraction of 'stone' should generally be concentrated on the fewest possible sites in an area, and any one site should be substantially worked out, and where possible reclamation ensured, before a new site is exploited. The type of excavation should be that with the lowest environmental impact consistent with the effective use of the resource. In general, and where the nature of the resource permits, excavations for 'stone' should be deep and limited in area in preference to shallow excavations over a wide area. The extraction of granite sand occurring as shallow deposits in the weathered profile should be discouraged unless it has been established that no suitable alternatives are available. In the special circumstances where approval is given for this form of extraction, particular attention should be given to the prevention of soil erosion.
- Where an application for the removal of 'stone' from a stream-bed is considered, the land manager must take particular care to ensure that the operations will not directly or indirectly cause erosion of the bed or banks, adversely affect stream nature conservation, recreation, cultural heritage, or scenic landscape values, or cause undue pollution of the stream. In addition to the arrangements outlined above for 'stone', the land manager should consult with the

relevant waterway manager and catchment co-ordination group.

- Alternative sources, with a lower environmental impact, should be used where they are available. The environmental effect of extraction may be reduced if alluvial stone is obtained from properly managed quarries on the river terraces, rather than from the present stream-bed. Where the environmental impact is likely to be significant, an *environmental effects statement* should be prepared.
- All extraction sites should be fully reclaimed where possible. Reclamation should follow extraction progressively when possible, but otherwise should begin immediately extraction is completed. The requirements for reclamation should continue to be included in the conditions of the lease or licence before any approval to extract is granted. Adequate bonds should be applied at all times and reviewed on a regular basis. The reclamation may include, for example, restoring the site as closely as possible to its original topography and revegetating it with indigenous species, or where appropriate, replacing topsoil, revegetating the site with plantation forest, allowing a quarry to fill with water and developing the site as a park, using a gravel pit for off-road vehicles, or using a quarry for garbage disposal prior to reclamation.

In addition to the above, approval under the *Soil Conservation and Land Utilisation Act 1958* should continue to be sought for exploration or extraction operations for 'minerals', 'petroleum', or 'stone', where the subject land is within a proclaimed water supply catchment.

## **Mineral and Stone Production**

### **Recommendations**

- F15** That public land (other than reference areas and certain water production areas) continue to be available for exploration under licence and extraction of 'minerals' subject to the principles and guidelines set out above, where land status permits.
- F16** That
- (a) public land (other than reference areas

and certain water production areas) continue to be available for exploration of 'stone' subject to the principles and guidelines set out above, where land status permits

and that

- (b) new licences or permits for extraction from stream-beds not be issued where the managing authority considers stream values could not be maintained or that opportunities for the restoration of degraded reaches would be severely restricted.

**F17** That public land (other than reference areas and certain water production areas) continue to be available for exploration and production of 'petroleum', subject to the principles and guidelines set out above, where land status permits.

**F18** That fossicking or recreational prospecting under Miner's Right, involving minimal disturbance of soil or vegetation, be permitted on public land other than:

- (i) those areas specifically excluded in these proposals, previous recommendations, or by land status constraints
- (ii) those areas that the land manager and the Department of Industry together may determine (outlined in the section on fossicking and prospecting)
- (iii) those areas of public land currently exempted or excepted from occupation for mining purposes under a Miner's Right, unless the land manager and the Department of Industry together determine such exemption or exception should no longer apply.

Notes:

1. Mining and some forms exploration are proposed for exclusion from essentially natural catchments — see Chapter B.
2. Recent legislation has excluded new mining and exploration tenements from scheduled national, State, and wilderness parks.

# Glossary

## **Agricultural River Setting**

See River Setting

## **Barrier (as it relates to streams)**

Artificial barrier constructed to restrict the flow of water. These barriers often restrict the passage of fish and may restrict movement of other in-stream fauna, flora, nutrients and sediments.

## **Basin**

See River Basin

## **Buffer Zone**

A zone surrounding a designated area which has an essential influence on the physical state of the area and/or the way the area is perceived. Buffer zones are used to reduce the impact of human activities and some natural processes on the area to be protected.

## **Conservation Status**

The likelihood of a feature continuing to exist.

## **Developed Recreational Setting**

see Recreational Setting

## **Diversion**

The artificial removal of water from the stream channel. This may occur through pumping or by gravity flows where the watercourse height has been artificially raised behind a barrier.

## **Indigenous**

Belonging to, or found naturally, in a particular environment.

## **Introduced Plants or Animals**

Introduced plants or animals are those that occur outside their natural range. They may have been introduced from outside Australia, such as trees which have been used for riparian planting (willows, peppercorns and poplars), and fish, such as carp. They may have also been introduced from other regions of Australia or Victoria.

## **Environmental Water Requirement**

The water required to maintain particular in-stream, riparian, floodplain, wetland or

estuarine biological values. It is commonly measured in terms of depth or volume requirements at a particular time of year.

## **Farm-forest River Setting**

see River Setting

## **Native Plants or Animals**

Plants or animals that occur within their original range. The genetic characteristics of any plant or animal species varies, consequently it is important that where recommendations specify the use of native species for restoration programs, wherever possible species local to the area be used.

## **Natural River Setting**

see River Setting

## **Riparian**

Of or on a river or stream bank.

## **Recreational Flow**

The water required to maintain particular in-stream, riparian, floodplain, wetland or estuarine recreational values. These values may be water-based or water-enhanced. Recreational flows are commonly measured in terms of depth or volume requirements at a particular time of year.

## **Recreational Setting**

The physical, biological, social and management features of an area which provide for particular recreational experiences. Five categories of setting, which describe a range of opportunities, have been identified and are listed below. (*Source:* Department of Conservation and Environment; Recreation — Policy, Planning and Monitoring; draft 2nd edition, October 1990).

Note: The size and remoteness criteria necessary for a particular recreational experience may change with river topography. For example, the deeper the valley, the more likely that features along the valley will dominate the recreational experience compared with features along the valley ridge or adjacent to it.

**Remote:** Essentially unmodified environments generally over 2000 ha in size and at least 3 km from public vehicle tracks and private property. Interaction between users is very low and evidence of other users is minimal. Evidence of restrictions and

controls is absent. Motorized access and horse-riding by the public is not permitted. The recreation emphasis is on self-reliance, independence, closeness to nature, and tranquillity. Such areas offer a high degree of challenge and risk.

**Semi-remote:** Predominantly natural environments of moderate to large size, generally greater than 800 ha in size and at least 1 km from primary and secondary roads and private property. Interaction between users is low, but there may be evidence of other users. Minimum on-site controls and restrictions are obvious. Limited vehicle tracks exist, predominantly four-wheel-drive, for which access is permitted. High to moderate probability of experiencing: isolation from the sights and sounds of humans; independence; closeness to nature; tranquillity; and self-reliance. Such areas offer a moderate degree of challenge and risk.

**Roaded natural:** Natural-appearing environments (which may be within 1 km of primary and secondary road access) with moderate evidence of the sights and sounds of humans. Interaction between users may be low to moderate, but evidence of other users is prevalent. Scattered structures may be present and site hardening may occur. Opportunities for both motorised and non-motorised forms of recreation are available with a high degree of interaction with the natural environment. Overall, impressions of nature are not dominated by modifications and recreation facilities.

**Semi-developed:** Substantially modified natural environments. Sights and sounds of humans are readily evident, and interaction between users is often moderate to high. Includes facilities designed for use by large numbers of people and those provided for special activities. Management controls may be obvious and numerous.

**Developed:** Substantially urbanised and heavily modified environments, although the background may have natural-looking elements. Vegetative cover is often exotic and usually heavily managed. Sights and sounds of humans are predominant and large numbers of users can be expected. Opportunities for competitive and spectator sports and for passive users are common. Management controls and regimentation are obvious and numerous.

## Regulation

The artificial management of streamflow. This may involve the net removal of water from a watercourse through diversion, the storage of water behind a dam and its later release, or the addition of water to a streamcourse from another catchment.

## Remote Recreational Setting

See Recreational Setting

## River Basin

An area that forms the catchment to a major river. As part of a national network, the AWRC has identified 29 major river basins across Victoria, from 1 (Upper Murray) to 8, 14 and 15 (Wimmera) north of the Great Dividing Range, 21 (East Gippsland) to 38 (Glenelg) south of the Divide, and 39 (Millicent coast). Maps 1, 2, 11 to 13, and 17 in the Resources Report show the basins.

## River Setting

A classification of the visual characteristics of an area based on the visual presence of natural and cultural features. Six categories of river setting have been identified and are listed below:

**Natural:** Cultural changes are not visually apparent. The river has not been modified and the area can usually only be reached on foot.

**Semi-natural:** Cultural changes may be visually apparent but do not dominate. These changes may include isolated structures such as dam walls and diversions. Road and rail access may exist, but is not along the river banks.

**Farm-forest:** Visually dominant changes are scattered through more natural areas, such as occurs where natural vegetation is mixed with areas used for agriculture. River works may occur and small farm dams are common. Vehicle tracks to and along the river are common, but are screened by surrounding vegetation.

**Agricultural:** Major clearing for agricultural uses has occurred. Patches of natural vegetation may remain, but are usually restricted to stream-sides and along fences or roads. Changes to the river may be common. Small and large dams are very common as are farm buildings and structures. Vehicle

access to and along the river is likely to be well established and clearly visible.

**Small town-suburban:** Suburban housing dominates visually. Rivers may be substantially modified by flood-mitigation works. Rivers may flow through parks or undeveloped areas. Vehicle access to and along the river is likely to be well established.

**Urban-industrial:** High-density urban, commercial or industrial uses dominate. High-use parklands are likely to occur. The river is likely to be highly regulated and modified, and crossed by bridges and powerlines.

#### **Roaded Natural Recreational Setting**

See Recreational Setting

#### **Semi-developed Recreational Setting**

See Recreational Setting

#### **Semi-natural River Setting**

See River Setting

#### **Semi-remote Recreational Setting**

See Recreational Setting

#### **Significance Assessment**

The systematic application of explicit criteria to determine the level of importance of a value against a particular scale.

#### **Small town-suburban River Setting**

See River Setting

#### **Stream Order**

This describes the position of a stream in a drainage network. The lower the number, the smaller the stream and its catchment. The stream order system used in this Investigation (Strahler's) starts at 1 and increases in units of 1. First order streams are the smallest unbranched streams. When two of these streams meet, the stream below becomes second order. Third order streams form when two second order streams meet. Low order streams are commonly clustered around the edge of major drainage basins or along major streams. In this Investigation, stream order was based on the drainage network shown on the 1:250,000 map series for Victoria. Allowances were made for systematic differences in the recording of the drainage network between mapsheets.

#### **Third-order Stream**

see Stream Order

#### **Urban-industrial River Setting**

see River Setting

#### **Wetlands**

Wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent, seasonal or cyclical, with water that is static or flowing, fresh, brackish or salt, including mudflats and mangrove areas exposed at low tide. (Source: Wetlands Conservation Program for Victoria, 1988.)

## References

- Australian Water Resources Council (1988). Proceedings of the national workshop on integrated catchment management. *Australian Water Resources Council Conference Series* No. 16.
- Byrne, N., and Vise, R. (1990). An inventory of recreation opportunity settings on major areas of public land in Victoria. *Department of Conservation and Environment — National Parks and Wildlife Division Occasional Paper Series* No. 4.
- Department of Water Resources (1989). Guidelines for the incorporation of environmental water requirements in planning new water projects. Water Resource Management Report Series No. 48. (Department of Water Resources: Melbourne.)
- Department of Water Resources (1989). Water Victoria: A resource handbook. (Victorian Government Printing Office: Melbourne.)
- Department of Water Resources (1989). Water Victoria: An environmental handbook. (Victorian Government Printing Office: Melbourne.)
- Frood, D., and Calder, M. (1987). Nature conservation in Victoria. (Victorian National Parks Association: Melbourne.)
- Gordon, N.D., McMahon, T.A., and Finlayson, B.L. (in preparation). Stream Hydrology: An introduction for biologists (John Wiley and Sons: United Kingdom.)
- Government of Victoria (1988). Wetlands conservation program for Victoria. (Victorian Government Printing Office: Melbourne.)
- Government of Victoria (1988). Salt Action: Joint Action. Victoria's strategy for managing land and water salinity. (Victorian Government Printing Office: Melbourne.)
- Harris, J.E. (ed) (1985). Proceedings of the conference on Australian threatened fishes. (Division of Fisheries, New South Wales Department of Agriculture: Sydney.)
- Hart, B.T., Bailey, P., Edwards, R., James, K., Swedling, K., Meredith, C., McMahon, A., and Hortle, K. (1989). Biological effects of saline discharges to stream and wetland. A report to the Salinity Bureau. (Centre for Stream Ecology, Chisholm Institute of Technology: Melbourne.)
- Hughes, J.M.R., and James, B. (1989). A hydrological regionalization of streams in Victoria, Australia, with implications for stream ecology. *Australian Journal of Marine and Freshwater Research*, 40, 303-26.
- Jenkin, J., and Rowan, J. (1987). Physical Resources. In 'Agriculture in Victoria', ed. D.J. Connor and D.F. Smith (The Australian Institute of Agricultural Science: Melbourne)
- Koehn, J.D., and Morrison, A.K. (1990). A review of the conservation status of native freshwater fish in Victoria. *Victorian Naturalist*, 107, 13-25.
- Koehn, J.D., and O'Connor, W.G. (1990). Biological information for the management of native freshwater fish in Victoria. (Department of Conservation and Environment — Arthur Rylah Institute for Environmental Research: Melbourne.)
- Leonard, M., and Hammond, R. (1984). Landscape character types of Victoria. (Forests Commission of Victoria: Melbourne.)
- Macmillan, L. (1987). Assessing the nature conservation values of rivers and streams with particular reference to the rivers of East Gippsland, Victoria. M.App.Sci. Thesis. (Chisholm Institute of Technology: Melbourne.)
- Macmillan, L., and Kunert, C. (1990). Conservation value and status of Victorian rivers — Part 1. Methodology — classification nature conservation and strategies for protection. (Royal Melbourne Institute of Technology: Melbourne.)
- Read Sturgess and Associates, Midas Consulting, and Members of the Resource and Environmental Economics Group, Latrobe University (1990). Social and economic appraisal of the draft proposed recommendations for the Land Conservation Council's Rivers and Streams Special Investigation. *Report to the Land Conservation Council*.
- Sandford, M.K., and Moss, S.K. (1986). Visual resource management. A method for integrating change in the visual environment. *Proceedings of the National Environmental Engineering Conference, Melbourne*, 40-5.
- Scenic Spectrums (1986). A preliminary scenic assessment procedure for Australia's river landscapes. *Report to the Victoria National Estate Committee: Melbourne*.

Scotts, D., and Seebeck, J.H. (1989). Ecology of *Potorous longipes* (*Marsupialia: Potoroidae*); and preliminary recommendations for management of its habitat in Victoria. *Department of Conservation, Forests and Lands — Arthur Rylah Institute for Environmental Research Technical Report Series No. 62.*

Sheahan, M. (1990). Timber resource implications of the candidate rivers and catchments for the Land Conservation Council's Rivers and Streams Investigation. *Report to the Land Conservation Council.*

Standing Committee on Rivers and Catchments (1990). Environmental guidelines for river management works. (Department of Conservation and Environment — Office of Water Resources: Melbourne.)

Standing Consultative Committee on River Improvement (1983). The state of the rivers, Victoria, Australia. (Victorian Government Printing Office: Melbourne.)

Standing Consultative Committee on River Management (1982). Revegetating Victorian streams. (Victorian Government Printing Office: Melbourne.)

State of the Rivers Task Force (1986). Policies and practices for better waterways — State of the Rivers Task Force report. (Department of Water Resources: Melbourne.)

State of the Rivers Task Force (1987). Better rivers and catchments — State of the Rivers Task Force report. (Victorian Government Printing Office: Melbourne.)

## LIST OF SUBMISSIONS

Submission number/ number of addendum	Name	Affiliation	Submission number/ number of addendum	Name	Affiliation
1	RICHARDSON		39	BERICK	THE COUNCIL OF VICTORIAN FLY FISHING CLUBS INC
2	RICHARDS	BENALLA WATER BOARD			
3/1	MIDDLETON	SHIRE OF BANNOCKBURN	40/1	GARDINER	GELLIBRAND RIVER SYSTEM COMMITTEE
4	MOORE	SHIRE OF NEWSTEAD	41/1	KUNERT	
5	BANFIELD	LODDON-CAMPASPE REGIONAL PLANNING AUTHORITY	42/1	FARIS	CONSERVATION COUNCIL OF VICTORIA
6	ENTWISLE	SCHOOL OF BOTANY - UNIVERSITY OF MELBOURNE	43/1	SENIOR	BOARD OF WORKS
7	MARTIN		44/1	BARNETT	VICTORIAN NATIONAL PARKS ASSOCIATION INC
8	SENIOR	RIVER BASIN MANAGEMENT SOCIETY INC	45	DRUMMOND	IAN DRUMMOND AND ASSOCIATES PTY LTD
9	ANDERSON	ROCHESTER WATER BOARD	46/1	COLVIN	
10	McDONALD	SHIRE OF KERANG	47	EDDY	
11	TURNER	CASTLEMAINE HISTORICAL SOCIETY INC	48	TANNER	MORNINGTON PENINSULA AND DISTRICT WATER BOARD
12	JACKEL	SHIRE OF ROCHESTER	49/1	BURNS	FEDERATION OF VICTORIAN WALKING CLUBS INC
13	WALLIS	SHIRE OF WANNON	50	MOLONEY	SHIRE OF DIMBOOLA
14	THOMPSON	LATROBE VALLEY FIELD NATURALISTS	51	QUINLAN	VICTORIAN NATIONAL PARKS ASSOCIATION INC - LINEAR PARKS COMMITTEE
15/1	WHITE	SNOWY RIVER IMPROVEMENT TRUST			
16	REDWOOD	UPPER BRODRIBB PROTECTION COMMITTEE	52	BIRD	
17/1	OSBORN	MARYBOROUGH FIELD NATURALISTS CLUB	53	FINLAYSON	CENTRE FOR ENVIRONMENTAL APPLIED HYDROLOGY - UNIVERSITY OF MELBOURNE
18/1	WHITE	LAND PROTECTION ADVISORY COMMITTEE - ORBOST REGION	54	LEACH	INSTITUTE OF WATER ADMINISTRATION
19	RIMMER	THE VICTORIAN MOUNTAIN TRAMPING CLUB	55	BRIODY	LEXTON LANDCARE GROUP
20	WILSON	DEPARTMENT OF INDUSTRY, TECHNOLOGY AND RESOURCES	56	WRIGHT	FRIENDS OF MALLACOOTA
			57	HAYNES	SHIRE OF STAWELL
21	WALLIS		58	BALLARD	RURAL WATER COMMISSION OF VICTORIA
22	WILLIAMSON	SCENIC SPECTRUMS PTY LTD	59	BALKIN	SHIRE OF DIAMOND VALLEY
23	McLAUGHLIN		60	HOGG	DEPARTMENT OF SPORT AND RECREATION
24	EDDY		61	LAMBERT	ORBOST DISTRICT ENVIRONMENT GROUP
25	SEMPLE	VICTORIAN FIELD AND GAME ASSOCIATION	62	WILKINSON	COLAC DISTRICT WATER BOARD
26	HORGAN	STATE ELECTRICITY COMMISSION OF VICTORIA	63	VALE	BARMAH FOREST PRESERVATION LEAGUE
27	MEAKIN	VICTORIAN PISCATORIAL COUNCIL	64	LAW	SHIRE OF NATHALLA
28	ODDIE	MT JEMU CREEK CATCHMENT CO-ORDINATING GROUP	65	HUON	VICTORIAN ASSOCIATION OF FOREST INDUSTRIES
29	LEVY	ANIMAL LIBERATION	66	HASLER	VICTORIA ASSOCIATION OF FOUR WHEEL DRIVE CLUBS INC
30/1	HOPGOOD	VICTORIAN RECREATIONAL FISHERMEN'S ADVISORY COUNCIL	67/2	FRASER	
31	FOSTER	DEPARTMENT OF CONSERVATION, FORESTS AND LANDS	68	TAYLOR	COLLINGWOOD HISTORICAL SOCIETY
32	BLIZZARD	MACEDON WATER BOARD	69	COLES	ENVIRONMENT PROTECTION AUTHORITY
33/1	CROUCH	WYPERFELD NATIONAL PARK & LAKE ALBACUTYA ADVISORY COMMITTEE	70	BRIGGS	
34	JONES	VICTORIAN AMATEUR CANOE ASSOCIATION INC - TOURING COMMITTEE	71	WHITEHEAD	VICTORIAN APIARISTS' ASSOCIATION INC
35	TREPAYNE	WILDLIFE RESCUE CONSULTANCY	72	HALLS	MELBOURNE BUSHWALKERS
36	LARKIN		73	MARSHALL	AUSTRALIAN HERITAGE COMMISSION - HISTORIC ENVIRONMENT
37/12	WOODROFFE	ROYAL HISTORICAL SOCIETY OF VICTORIA	74	TONTA	CITY OF MORDIALLOC HISTORICAL SOCIETY
38/1	CURTIS	CONCERNED RESIDENTS OF EAST GIPPSLAND	75	COOKE	LAND PROTECTION ADVISORY COMMITTEE MILDURA REGION

## Appendix II

### EXTRACT FROM THE SOCIAL AND ECONOMIC APPRAISAL REPORT

*The following is an edited version of the Summary and Conclusions extracted from the report prepared by Read Sturgess and Associates in association with Midas Consulting and members of the Resource and Environmental Economics Group, LaTrobe University, titled: Social and Economic Appraisal of the Draft Proposed Recommendations for the Rivers and Streams Special Investigation.*

The purpose of the study was to provide a social and economic appraisal of the draft proposed recommendations of the Rivers and Streams Special Investigation. These draft proposals aim at protecting the nature conservation, cultural heritage, recreation and scenic values of particular rivers and their corridors in Victoria, and include protection of 46 small essentially natural catchments.

The nature of protection is proposed to vary according to the values being protected. In river corridors with sensitive values, a high degree of protection is proposed, similar to that in the most important conservation reserves. This could lead to the restriction of some resource uses. Many potential land uses would modify the essentially natural catchments, so where the catchments are to be protected, these uses would need to be excluded.

Existing public land tenure of the areas potentially affected includes State and national parks, reference areas, wilderness areas, natural feature and scenic reserves, State forests, and public land water frontage reserves. Freehold land was excluded from the study.

The draft recommendations may have implications for: water resource use; timber production; mineral and stone exploration and production; hydro-electricity generation; livestock production; tourism; nature conservation, cultural heritage, recreation and scenic values; and industry.

The study brief did not call for a complete social benefit-cost analysis of the draft proposals. It also recognised the difficulties involved in evaluating some social costs and benefits associated with the protection of streams and catchments, in particular because of the widespread nature of the draft proposals, both geographically and in content.

#### Methods and Results

The core methodology of the study is standard benefit-cost analysis. As required by the brief, the consultants have employed social benefit-cost analysis, not financial analysis. Consistent with widely accepted practice in benefit cost analysis, we have not considered multiplier effects for any of the activities compared. Any industry output or employment leads to 'flow-on' or 'multiplier' effects and estimates of such effects generally serve only to mislead or confuse.

The study considers in some detail the evaluation of 'non-market' or 'unpriced' social benefits and costs. The dollar value of non-market benefits and costs is intrinsically difficult to estimate as they involve goods and services that are not traded in markets in the usual way. These 'hard to value' items include recreation, cultural heritage, scenic values, and species preservation.

Despite the general availability of techniques for valuing 'hard to measure' items, their application is expensive, requiring substantial surveys and effort to collect the necessary data. Such surveys were beyond the scope of this study given the range of environmental values to be covered and the time and funds available. Instead, the consultants collated environmental economics research estimates from Australia, USA and New Zealand.

#### Environment

In evaluating the environmental and recreational benefits, what we would ideally like to measure in dollar terms is the net addition to the welfare of Victorians that is expected to be brought about by the recommendations. Many of the forms of recreation that may occur in areas being considered in the Council's draft proposals are readily available elsewhere in the State, or would not be significantly affected on the candidate rivers even if the recommendations were not adopted. To simplify the analysis and reduce the risk of over-stating environmental and recreational values, the consultants have attempted to exclude recreational activities whose resource requirements are readily met, such as bushwalking, camping, wildlife hunting and most forms of flat water boating.

That is, we have assumed that the Council's draft proposals will generate no net benefits in these areas.

Instead, we have focussed on valuing the special environmental and recreational characteristics that were used by the Council as selection criteria for the candidate heritage rivers. We have assumed that the Council has accurately identified the set of river segments having the highest standards for these characteristics in the State, that the segments are individually unique, and that there are no 'next best' alternatives for providing the values identified on the segments.

The assumption that the segments are unique and that there are no next best alternatives to providing the values to be found on them leads to over-stating of the environmental benefits. However, the use of 'willingness to pay' rather than 'willingness to accept' measures of dollar value leads to under-estimation of the values. The latter criterion commonly gives dollar values that are three to five times those obtained by the former criterion.

It is also assumed that the environmental characteristics identified by the Council will be under immediate threat if the draft proposals are not followed. In most instances in practice, the values would only be threatened over a period of time, therefore this is another source of over-estimation. *Off-setting this effect is the fact that we were also not able to estimate the likely effect of income and population changes on the demand for environmental attributes over time.* These effects are normally assumed to be the same across all components of a social benefit-cost analysis. However, we would expect future demand for the on-site use values and off-site preservation values of the candidate river corridors and catchments to increasingly dominate their use for mineral extraction, timber harvesting, and water diversion as the Australian population grows. These effects are therefore a source of under-estimation of environmental dollar values.

We have used regional visitor data to national and State parks as a measure of current demand and the extent to which the candidate heritage rivers and essentially natural catchments will be valued in dollar terms, either through use or preservation values.

We have attempted to offset 'additivity' as a potential source of serious over-estimation of environmental values by: collating the values for categories rather than individual components; taking estimates from studies which, for example, gave dollar values for wildlife preservation generally rather than for individual species; and by the way in which the valuations are weighted across the State from regional visitor data. A check on the dollar values estimated for the State revealed a total for all candidate river corridors of about \$50-54 per household per annum (assuming 1 M households). For the proposed essentially natural catchments the total was \$1.60-3.20 per household per annum. We do not believe that these totals are unrealistically high for the environmental attributes considered. The 'public good' nature of environmental goods helps explain why they appear to attract so much value in proportion to essentially 'private' goods such as timber, water or minerals.

The methodology of contingent valuation relied upon by the consultants was described in detail as the methods and concepts underlying the estimates used in this study are not widely known or understood. The development of contingent valuation techniques has enabled the measurement of non-market values such as option and existence values. The addition of these values to the cost-benefit analysis of social programs involving aspects of environmental protection and conservation, will improve the allocation of society's resources as well as accommodate the interests of a broader spectrum of individuals in the community.

Although a number of methodological issues remain to be resolved, contingent valuation is capable of providing policy relevant information in many environmental and conservation circumstances, where only guesses were previously available. Further research and application of the technique is necessary to refine the approach and extend its use to other areas.

Contingent valuation procedures are now used extensively in the United States to value environmental goods, both in the area of government regulations of land use and in the litigation of compensation for environmental damage. The Australian Resource Assessment Commission intends applying contingent valuation procedures to measure the difference in the monetary valuation Australians may place on the Kakadu Conservation Zone if the Conservation Zone is mined compared to their valuation if the Conservation Zone is not further mined. Society can expect to see the approach applied more extensively in the future as land use conflicts become more widespread.

In the 'first-best' world of some economists, it is sometimes argued that where there are no markets there are no prices, and that rather than use techniques such as contingent valuation to estimate

dollar values of non-market items, we should focus on establishing the institutional arrangements and systems of property rights which permit markets to operate. The consultants do not believe that this 'first-best' situation will ever be achieved for some areas of the economy, and that it is therefore impractical for policy makers to wait until the markets are in place.

In the particular case of the Council's draft proposals, it is difficult to imagine conditions under which any market arrangements would offer a similar package of protected rivers and catchments to the public. In addition, because the proposals are confined to public land and also involve the assessment of timber, water and mineral resources (which are under public management to varying degrees), the draft proposals are ideally suited to the application of contingent valuation procedures within a social benefit-cost framework.

### **Water Resources**

Proposed water resource developments and alternative water resource options were determined by reviewing submissions from the major water authorities and by interviewing their staff. With some important exceptions, there were few developments identified which would be likely to be affected by the draft proposals.

Water for irrigation was valued at \$60 per ML and urban water supplies at \$750 per ML for those opportunities to use streamflows which might be foregone due to the impact of the draft proposed recommendations. If it is felt that environmental flows are necessary to achieve and maintain environmental attributes, they should be regarded as additional, and possibly substantial, costs which we have not included in our comparisons.

Of the 23 candidate rivers, the draft proposals would have a definite impact (associated with regulation or diversion of streamflows) only for the Big River. However, there is the possibility of impacts for the Goulburn, Howqua, Wimmera, Snowy, Tyers, Bunyip and Glenelg Rivers<sup>1</sup>.

The impact of the Council's draft proposals for the Big River would be considerable as it would mean that the flows would be retained in-stream (for downstream irrigation purposes) rather than being diverted in the headwaters by the Board of Works at some point next century to augment the urban requirements of Melbourne. The Board of Works would have to substitute flows from alternative sources and we have estimated that this would represent differences in real present costs of \$2-4m per year.

### **Timber Resources**

The consultants reviewed a number of methods for valuing the timber that may be foregone in river corridors and essentially natural catchments as a consequence of the draft proposals. The methods included use of the impacts on regional sustainable yield figures, and the standing timber volumes provided by the Department of Conservation and Environment. It was considered that the former figures may understate the impacts on localised areas, while the latter figures imply immediate harvesting and would not be consistent with approved forest management practices.

The Timber Resource Implications project (Sheahan 1990) identified the volumes and quality of timber potentially affected. Further information, provided by regional staff of the Department of Conservation and Environment, indicated the likely timber harvesting schedules that would be followed in the affected areas should the draft proposals not materialise. These data were assessed over 40 years in each case - or approximately half a timber rotation. Discounted values beyond this time period would not affect comparisons. The assessments were only done for areas where significant timber volumes are involved. For other areas it may be assumed that the economic consequences of not being able to harvest the timber are insignificant, even on a local scale.

The implications of the draft proposals for employment in the timber industry were also assessed but the consultants provide several arguments for not placing emphasis on these implications when comparing the benefits and costs of timber production with those for protecting environmental attributes.

The net returns from timber production may be over-estimated in this study due to under-estimation of thinning, harvesting and other costs. On the other hand, where the Department of Conservation and Environment cannot meet contractual agreements due to the withdrawal of timber from logging

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1. The possible impacts for the Goulburn, Wimmera, Snowy, and Glenelg Rivers would arise only if Council were to propose the provision of environmental flows. This has not been proposed.

there would probably be cases presented for compensation and the sums involved could be substantial. However, we believe that these sums should be regarded as transfer payments which do not affect the outcome of social benefit-cost analysis.

### **Mineral Resources**

There appears to be no 'proven' mineral resources affected by the draft proposals, apart from gravels and sands. In the time available it was not possible to compile a detailed inventory of the latter. Estimates of the value of gravels and sand operations within river corridors were provided by the Department of Industry (DOI). There are no data for the local, regional or State importance of gravel and sands within the corridors in comparison with other sources. However, in most cases there will be close substitutes - largely constrained only by transport costs due to the bulk nature of the products.

Staff within the Department of Industry provided estimates of the mineral potential of the areas covered by the draft proposals. The consultants have analysed these estimates to provide rankings of river corridors in terms of their potential mineral importance. The dollar values obtained may be in error by several orders of magnitude and are not comparable with other values in this study. In the face of this uncertainty, it is rational to allow 'benign' exploration to continue within the areas covered by the draft proposals. Subsequent proposed mining operations should be subject to environmental and economic assessment.

There are no sound economic arguments for blanket bans on benign exploration. A ban carries the implication that there is no point in allowing exploration as environmental values will always exceed mineral values. We can only be sure that this will be the case if we assume that environmental values are extremely high, approaching infinity. This may be a reasonable assumption in situations where the environmental values being protected are unique or irreplaceable, and therefore have *no* substitutes, but it is not likely to be the case in all national parks or in all the river corridors and catchments covered by the draft proposals.

### **Agricultural Production**

The draft proposals do not have direct implications for the grazing of water frontage reserves on public land, or for the use of freehold land. Currently, there is no grazing in any of the essentially natural catchments. However, the information compiled for agriculture will be useful background to any future investigations into grazing of public land water frontages.

The areas covered by grazing licences were assessed from information provided by the Land Information Management System Group - Department of Conservation and Environment - and by staff in the Land Conservation Council. The income effects were based on data from other projects being run by the consultants.

Grazing on public land water frontages is often important at the local level but is of negligible importance at the level of the regional or State economy.

The costs of fencing the public land water frontages were estimated for each candidate river. The costs of providing watering points were also examined. However, other costs of restricting the licensed use of these areas may include fire hazard control, vermin and noxious weed control, revegetation and reclamation. The benefits after fencing in comparison with pre-fencing benefits would depend on the management system employed. These costs and benefits are highly location-specific and it was not possible to compile a detailed account of them for all the proposed river corridors.

While there will be no costs to adjacent landholders as a consequence of the draft proposals, the heritage status of the rivers *may* lead to increases in market value of adjacent freehold in the medium to long run. If licensed uses are restricted at some future date, the final effect on market values would depend on perceptions of the effects of restriction on private benefits and costs.

### **Industrial Activities**

From discussions with staff from DOI and other departments the consultants determined that there were few potential industrial developments which would be significantly affected by the draft proposals. However, there are some notable exceptions, including water for mineral sands operations near the Wimmera River, the East Gippsland pulp mill proposals on the Snowy River near Orbost, and the direct and indirect effects on the demand for water if the Very Fast Train proposal is implemented for the Gippsland route. Because most of these are large projects which

are still being evaluated it was not possible for the consultants to fully evaluate the implications of the draft proposals. However, it should be noted that the draft proposals do not prohibit the *diversion of water for industrial purposes unless environmental values are likely to be impaired*. In many cases, the quantities of water required to be diverted for industrial purposes would be small relative to river flows or relative to the quantities used for irrigation.

Another large-scale issue that was referred to several times in the course of consultations was the implications of the Greenhouse effect - for energy production in particular. The view was often put that this global issue must be addressed by Australia and that greater use of hydro-electric power would be a responsible policy response which may have implications for the draft proposals. The consultants do not accept this view and point out that energy pricing policies are likely to be far more cost-effective in reducing greenhouse gas emissions than policies which emphasise the subsidisation of hydro-electric generation.

### **A Summary of the Social and Economic Evaluation for Candidate River Corridors**

Detailed individual summary tables for the candidate rivers are attached. These tables condense the results for the draft proposals under three categories: those which are expected to lead to net social benefits; those which *may* lead to net social benefits; and those which are expected to lead to net social costs<sup>2</sup>.

The rivers for which there are no apparent conflicts between environmental values, and water, timber and mineral values are also identified in the tables.

The overall impression to be gained is that the draft proposals for protecting the rivers and streams are likely to lead to net increases in the welfare of Victorians. The Big River and Decimal Creek catchment are the only two cases where the recommendations are likely to lead to decreases in net welfare.

The methods employed in this study involved rapid appraisal over wide areas and the results are not amenable to detailed examination of individual cases. For example, we were not able to study in detail the environmental values of particular species at specific locations, the net returns from timber production for particular catchments, the benefits and costs of specific alternative sites for proposed water diversions, or the benefits and costs of providing environmental flows in selected rivers. Partly for these reasons, it is difficult to arrive at firm conclusions on the comparisons for the Goulburn, Wimmera or Thomson Rivers, or for Front Creek or South Buller Creek catchments. In these areas, the values for environmental attributes are close to those for the resource uses with which they are in conflict, or there is too much uncertainty surrounding the estimates.

We have often provided range information for the results of analyses, however, the time available to the project did not permit exhaustive sensitivity analysis of all the assumptions that we have specified. In any case, past experience leads us to believe that analyses of this type can often be difficult to interpret. Instead, we have assumed that some of the sources of over- and under-estimation of values offset each other.

It is the consultants' view that for the rivers and catchments for which we have indicated net social benefits arising from adoption of the Council's draft proposals, there would need to be substantial changes in the values estimated before our conclusions would be altered. In other words, for the large majority of candidate rivers and catchments, the draft proposals should lead to increases in the net welfare (or to the avoidance of decreases in the net welfare) of Victorians, if not other Australians.

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2. A summary of the timber resources for the essentially natural catchments has been provided in Table 1 - Chapter B.

**SUMMARY OF ENVIRONMENTAL AND RESOURCE VALUATIONS AND IMPLICATIONS**  
(Extracted from Consultants' Report)

Environmental values <sup>1</sup>	Water sector	Timber resources	Minerals and stone <sup>2,3</sup>	Industry	Economic assessment
<b>A1 - Mitta Mitta River</b>					
Economic valuation \$0.3-1.5*m/yr	RWC - No implications; possible hydro-electric development	Very small State forest area; little resource likely to be present	Alluvial and vein gold, tin, lead, copper, silver, antimony	Possible hydro-electric development but not likely to proceed	The environmental values are likely to exceed resource values
	<\$.01m/yr	<\$.01m/yr	\$0.13m/yr; Rank 4	Recommendations have negligible impact	
<b>A2 - Ovens River</b>					
Economic valuation \$0.7-6.3*m/yr	No specific proposals	No impact of recommenda- tions on operations in riverine forest, beyond Code of Forest Practices buffer	May have alluvial gold, and coal	Re-activation of gold dredging considered unlikely	The environmental values are likely to exceed resource values
	<\$.01m/yr	<\$.01m/yr	<\$.01m/yr	Recommendations have negligible impact	
<b>A3 - Howqua River</b>					
Economic valuation \$1.1*-8.1m/yr	RWC - No implications	Flows through State forest; some resource affected, 5800 m <sup>3</sup> C+ sawlogs	Alluvial and vein gold, some copper		The environmental values are likely to exceed resource values
	<\$.01m/yr	\$6520-7940/yr; direct employment 1.5 persons/yr for 5 yrs	<\$.01m/yr	Recommendations have no impact	

## Environmental and Resource Valuation and Implications (continued)

Environmental values	Water sector	Timber resources	Minerals and stone	Industry	Economic assessment
<b>A4 - Big River</b>					
Economic valuation \$0.9*-8.3m/yr	RWC - no implications Board of Works - important water source for the future; would hope to obtain approval for small diversion without affecting values	Flows through State forest; some resource affected, 2280 m <sup>3</sup> C+ sawlogs	Vein gold, antimony		Cost of next best option for augmenting Melbourne water supply is likely to exceed environmental values  Diversion ~50% of flow
	\$2-4 m/yr	Value <\$6500/yr; direct employment effects negligible	\$0.06m/yr; Rank 5	Recommendations have negligible impact within corridor - but implica- tions for Melbourne- based industry through Board of Works proposal	
<b>A5 - Goulburn River</b>					
Economic valuation \$0.6-3.6*m/yr	RWC - No current proposals; would prevent a future dam at Trawool  Trawool development not a current proposal	No impact on operations in riverine forest below Goulburn Weir, beyond Code of Forest Practices buffer	Gravel and sand, alluvial and vein gold	Hydro scheme at Goulburn Weir not assessed - not likely to impair values  Possible future tourist resorts likely to be based on lakes rather than river segments. Other developments such as canneries, food processing are not likely to impair values	The environmental values are likely to exceed resource values
	<\$.01m/yr	<\$.01m/yr	\$0.56m/yr; Rank 2	Recommendations have insignificant impact	

**Environmental and Resource Valuation and Implications (continued)**

Environmental values	Water sector	Timber resources	Minerals and stone	Industry	Economic assessment
<b>A6 - Wimmera River</b>					
Economic valuation \$2.9*-16.1 m/yr	RWC - No current proposals	May have implications for operations in Wail Forest (very small area)	Heavy mineral sand potential; vein gold, base metals, sand and gypsum extraction	Mineral sands operations may require significant diversions of water	Mining potentially competitive with environmental values in economic terms. But, due to widespread availability of mineral sands deposits, likelihood that next best option to mining in corridor will be no more costly for next several decades, even if present technical obstacles to commercial mining are overcome
	<\$.01m/yr	<\$.01m/yr	\$2.8m/yr; Rank 1		
	Note: Mineral sands operations may be paying capital costs of \$470/ML and operating costs of \$217/ML for water				
<b>A7 - Bemm, Goolengook, Arte, and Errinundra Rivers</b>					
Economic valuation \$0.8-2.3*m/yr	RWC - No implications	Flows through State forest; follows Natural Features Zone	Alluvial and vein gold, lead, zinc, silver	Low-key tourist potential - caravan parks and camping	The environmental values are likely to exceed resource values
	<\$.01m/yr	<\$.01m/yr	<\$.01m/yr	Recommendations have negligible impact	
<b>A8 - Snowy River</b>					
Economic valuation \$0.4-2.6*m/yr (State basis)	Possible use of high flows for pulpmill proposal	Above Buchan River confluence - no implications (in national park); between Buchan River confluence and Bete Bolong - no impact as there is an existing Natural Features Zone; operations allowed outside this	Potentially prospective - minor occurrences of zinc, copper, silver, lead, barium in upper and mid reaches; in national park	Possibility of Pulp Mill at Orbost - with implications for water flows in Snowy River and tributaries, and prices for residual roundwood	The environmental values are likely to exceed resource values
\$1.9-13.1*m/yr (national basis)				Possible intersection with VFT route	Implications of East Gippsland Pulp Mill proposal not evaluated due to lack of economic data
	<\$.01m/yr	<\$.01m/yr	<\$.01m/yr		

**Environmental and Resource Valuation and Implications (continued)**

Environmental values	Water sector	Timber resources	Minerals and stone	Industry	Economic assessment
<b>A9 - Suggan Buggan and Lower Berrima Rivers</b>					
Economic valuation \$0.2*-0.7m/yr	RWC - No implications	No timber resource implications - in national park or water frontage	Mineral potential; in national park		The environmental values are likely to exceed resource values Grazing arrangements not evaluated
	<\$.01m/yr	<\$.01m/yr	<\$.01m/yr	Recommendations have no impact	
<b>A10 - Upper Buchan River</b>					
Economic valuation \$0.3*-0.9m/yr	RWC - No implications	No timber resource implications - in national park	Limestone, marble, minor base metal potential in headwaters; in national park		The environmental values are likely to exceed resource values
	<\$.01m/yr	<\$.01m/yr	<\$.01m/yr	Recommendations have no impact	
<b>A11 - Mitchell and Wonnangatta Rivers</b>					
Economic valuation \$1.5-8.1*m/yr (State basis) \$7.5-40.5*m/yr (national basis)	RWC - Mitchell River Dam recently under active community consideration but not an economic proposition and not a current proposal for RWC	Small areas of State forest along the Wonnangatta River	Minor alluvial gold downstream of Dargo River; gravel in lower reaches	Hydro 55 megawatt development not an economic proposition Possible intersection with VFT route	The environmental values are likely to exceed resource values
	<\$.01m/yr	<\$.01m/yr	\$0.01m/yr; Rank 7	Recommendations have insignificant impact	
<b>A12 - Thomson River</b>					
Economic valuation \$1.2*-10.5m/yr	RWC - No implications; possible storage site above Cowwarr	Some timber resources affected	Copper, gold, platinum group minerals at Coopers Creek		The environmental values are likely to exceed resource values
	<\$.01m/yr	<\$.01m/yr	<\$.01m/yr	Recommendations have negligible impact	

**Environmental and Resource Valuation and Implications (continued)**

Environmental values	Water sector	Timber resources	Minerals and stone	Industry	Economic assessment
<b>A13 - Yarra River</b>					
Economic valuation \$5.2*-31.7m/yr	RWC, Board of Works - no implications	No State forest areas affected	Minor alluvial gold		The environmental values are likely to exceed resource values
	<\$.01m/yr	<\$.01m/yr	<\$.01m/yr	Recommendations have negligible impact	
<b>A14 - Lerderderg River</b>					
Economic valuation \$0.7-2.0*m/yr	RWC - no implications	Some timber resource affected, around Blackwood and above 18 975 m <sup>3</sup> C+ sawlogs	Alluvial and vein gold		The environmental values are likely to exceed resource values
	<\$.01m/yr	\$7370-7670/yr; direct employment 0.2 persons/ yr long-term	<\$.01m/yr	Recommendations have insignificant impact	
<b>A15 - Glenelg River</b>					
Economic valuation \$1.0-5.8*m/yr (State basis) \$5.0-29*m/yr (national basis)	RWC - No ability to provide environmental flows to both the Glenelg and Wimmera Rivers - will be a trade-off	No timber resource implications - in national park and water frontage	Limestone		The environmental values are likely to exceed resource values
	<\$.01m/yr	<\$.01m/yr	<\$.01m/yr	Recommendations have negligible impact	

Notes:

1. \* - indicates likely end of range for environmental values
2. Dollar values for minerals taken as 10% of estimated values
3. Rank given for minerals only, from highest importance (1) to lowest importance (7)

## Appendix III

### RECOMMENDATIONS FOR ESSENTIALLY NATURAL THIRD-ORDER CATCHMENTS

Recommendation number	Catchment name	Grid reference of lowest point	Tributary of	Area (ha)	Basin	Public land tenure
B1	Shipwreck Creek	8822-382296	Tasman Sea	2990	21	National Park
	Benodore River	8822-310242	Tasman Sea	3360	21	National Park
	Red River	8822-256215	Tasman Sea	3870	21	National Park
	Easby Creek	8822-220199	Tasman Sea	1810	21	National Park
B2	Rodger River headwaters	8623-393724	Snowy River	2730	22	National Park
	Cattle Creek	8623-340718	Rodger River	1400	22	National Park
	Wrong Creek	8623-337713	Rodger River	1330	22	National Park
	unnamed tributary 1	8523-239637	Rodger River	2050	22	National Park
	unnamed tributary 2	8523-299710	Rodger River	1090	22	National Park
	Mountain Creek headwaters	8523-273789	Snowy River	12810	22	National Park
B3	New Country Creek	8523-273789	Mountain Creek	4750	22	National Park
	Avon River headwaters	8222-887460	Avon River	1340	25	Wilderness
	unnamed tributary	8222-901370	Avon River	2200	25	Wilderness
	Turton River	8222-907276	Avon River	6450	25	Wilderness
	Ben Cruachan Creek	8222-751312	Avon River	3900	25	Wilderness
	Mount Hump Creek	8222-835341	Avon River	1130	25	Wilderness
	McColl Creek	8222-879260	Avon River	970	25	Wilderness
	Little River headwaters	8222-814272	Ben Cruachan Creek	1920	25	Wilderness
	Dolodrook River headwaters	8222-787406	Dolodrook River	2700	25	Wilderness
	Thiele Creek	8222-758420	Dolodrook River	1770	25	National Park
B4	O'Shannassy River headwaters	8022-976368	O'Shannassy River	7210	29	Public Land vested in the Board of Works
	Smiths Ck	8022-946294	O'Shannassy River	2750	29	Public Land vested in the Board of Works
B5	Log Bridge Creek - East Branch	8425-640782	Cudgewa Creek	2590	1	State Forest
B6	Front Creek	8424-767206	Morass Creek	1590	1	State Forest

#### Appendix III (continued)

Recommendation number	Catchment name	Grid reference of lowest point	Tributary of	Area (ha)	Basin	Public land tenure
B7	Mount Tabor Creek	8424-457569	Mitta Mitta River	900	1	State Forest
B8	Banimboola Creek	8424-456594	Mitta Mitta River	2290	1	State Forest
B9	Devils Creek - Middle Branch	8224-899284	Buckland River	2710	3	State Forest
B10	Yarrarabula Creek	8224-773233	Buffalo River	6940	3	State Forest
B11	* Long Jack Creek	8224-639112	Dandongalala River	2480	3	State Forest
B12	South Buller Creek	8123-442841	Howqua River	2130	5	National Park/ State Forest/ Alpine Resort
B13	Williams Creek	8123-270658	Goulburn River	1010	5	State Forest
B14	Double Creek	8822-366419	Mallacoota Inlet	1590	21	National Park
B15	unnamed tributary	8723-146624	Genoa River	1120	21	National Park
B16	Winnot Creek	8723-001745	Cann River-East Branch	1280	21	National Park
B17	Errinundra River - East Branch	8363-694661	Bemm River	2480	21	National Park
B18	Gattamurh Creek	8524-305120	Snowy River	990	22	National Park
B19	Swamp Creek	8623-481812	Deddick River	1140	22	State Forest
B20	Wallaby Creek	8624-392040	Tingaringy Creek	2660	22	National Park
B21	* Mount Gelantipy Creek headwaters	8523-196826	Snowy River	1900	22	National Park
B22	Cavender Creek	8523-231579	Yalmy River	1490	22	State Forest
B23	Musk Creek	8523-195573	Rodger River	770	22	National Park
B24	Brodribb River headwaters	8623-519661	Brodribb River	7610	22	National Park
B25	* Stony Creek	8423-670914	Tambo River	1110	23	State Forest
B26	Wongungarra River headwaters	8323-053980	Wongungarra River	1710	24	State Forest/ National Park
B27	Blue Rag Creek	8323-055911	Wongungarra River	1290	24	National Park
B28	Pinnacle Creek - East Branch	8323-084582	Wonnangatta River	1520	24	National Park
B29	Swamp/Punchen Creeks	8322-317471	Swamp/Mitchell Rivers	2770	24	State Forest
B30	* Mount Vereker Creek	8120-510853	Bass Strait	2560	27	National Park

\* Informal place name

## REPRESENTATIVE RIVERS

### Geomorphic/Hydrological River-Catchment Types

The river candidates column lists a number of gauged catchments which have been identified as belonging to each of the river-catchment types. Not all rivers are listed for each type. One river has been recommended as the 'representative river' for each type, and this is marked with an asterisk (\*).

Type	Geomorphic unit	Hydrological region	River candidates	Basin/flow, gauge <sup>2</sup>	Status <sup>3</sup>	Land tenure, comments
1	East Victorian dissected uplands	5 <sup>1</sup>	* Upper Big River (above Glen Valley)	1/412	C	Mainly Alpine National Park, historic area
		5 <sup>1</sup>	Kiewa River (at Coral Bank)	2/203		Park, hydro, State forest, freehold
2	East Victorian dissected uplands	4	Big River (above Anglers Rest)	1/216	H, C	Some freehold, State forest, Alpine National Park; sudden change from region 5
		4	Kiewa River (at Kiewa)	2/200		Freehold, State forest
		4	Big River (above Lake Eildon)	5/227	H, C	State forest
		4	Nariel Creek	1/212	C	State forest; isolated in region 3 area
		4	* Snowy Creek (Granite Flat)	1/210	C	State forest
		4	Acheron River	5/209		Freehold, State forest, State park, pines
		4	Upper Goulburn River (above Jamieson)	5/219	C	State forest; region 3 in upper reaches
		4	Buckland River (Buckland)	3/206	C	State forest, Alpine National Park
3	East Victorian dissected uplands	4	King River (Powers)	3/227	C	Alpine National Park, State forest
		3	Timbarra River	23/207	C	State forest; too much high plain - not typical; isolated wetter area
		3	* Dargo River (Dargo)	24/205	C	Alpine National Park, State forest; adjacent to rain-shadow area
		3	Wongungarra River	24/207	C	State forest; drier (region 2) tributary upstream (Crooked River)
		3	Tanjil River	26/216	C	State forest, freehold; sudden change from region 4
		3	Mitta Mitta River (Hinnomunjie)	1/203	H, C	Freehold, Alpine National Park, State forest
		3 <sup>1</sup>	Gibbo River	1/217	C	Alpine National Park, State forest
		3	Cudgewa Creek	1/208	C	Pines, freehold, State forest, national park; unusual shape
		3	Ovens River (Bright)	3/205	C	State forest, freehold, pines, Alpine National Park
		3	Yea River	5/217		Freehold, State forest, pines; western limit of region
		3	Latrobe River (Willow Grove)	26/204		State forest, freehold, etc.
		3	Latrobe River (Noojee)	26/205		State forest, freehold, pines
		3	Tyers River	26/007	C	State forest, freehold, Baw Baw National Park; region changes too quickly
4	East Victorian uplands, dissected plateau	3	Woori Yallock Creek	29/215		Freehold, some public land
		3	Buffalo River (Abbeyard)	3/222	C	State forest, some freehold; too little plateau
		3	Rose River	3/217	C	Freehold, State forest, Wabonga State Park
		3	Wonnangatta River (at Waterford)	24/201	H, C	Alpine National Park, State forest, freehold; contains region 2 tributary
		3	Wonnangatta River (at Crooked River)	24/206	H, C	Alpine National Park, some State forest
		3	Delatite River	5/214	C	Freehold, State forest, alpine resort
		3	Barkly River	25/217	C	State forest, some freehold
		3	Macalister River (Licola)	25/209	C	Alpine National Park, State forest, freehold
		3	* Macalister River (Glencairn)	25/219	C	Alpine National Park, State forest; good representation of plateau

## Appendix IV (continued)

Type	Geomorphic unit	Hydrological region	River candidates	Basin/flow, gauge <sup>2</sup>	Status <sup>3</sup>	Land tenure, comments
5	East Victorian dissected uplands	2	* Buchan River (above Mellick Munjie Creek)	22/403	H, C	Alpine National Park, State forest, freehold
			Suggan Buggan River	22/213	H	Alpine National Park, freehold; part catchment in New South Wales
			Tallangatta Creek	1/218	C	Freehold, State forest
			Yackandandah Creek	2/204		Pines, freehold, State forest
			Hurdle Creek	3/224	C	Freehold, pines, State forest; isolated region 2 catchment
			Seven Creeks (Euroa)	5/237		Freehold, some State forest, flora reserve, pines; fringe of region
			Cann River (West Branch)	21/201	C	State forest
			Brodribb River	22/202	C	State forest, some Errinundra Park; unusual shape
			Aberfeldy River	25/213		State forest; rain-shadow between regions 4 and 3
			Rodger, Yalmy Rivers	22/217	H	State forest, Snowy River National Park
			Combienbar River	21/211	C	State forest, freehold
			Murrindal River	22/216		State forest, freehold
			Bunyip River (Tonimbuk)	28/212	H	State park, State forest; small
			Dandenong Creek	28/204		Freehold; semi-urbanised
			Fifteen Mile Creek	3/213	C	State forest, pines, freehold
Holland Creek	4/207		Freehold, State forest, pines			
Avon River (above Valencia Creek)	25/211	H	Wilderness, State forest, natural features reserve			
		2 <sup>1</sup>	Freestone Creek	25/218		State forest
6	East Victorian dissected uplands, riverine plains	2	* Thurra River (Pt. Hicks)	21/204		State forest, Croajingolong National Park; could extend to estuary
			Genoa River	21/210		Coopracambra National Park; 60% in New South Wales
			Bemm River (lower)	21/205	H	State forest, some parks, freehold
			Cann River (lower)	21/214	C	State forest, Coopracambra National Park, freehold
7	East Victorian dissected uplands	1	Morass Creek	1/215	C	Freehold, State forest
			Tambo River (Swifts Ck)	23/202	C	State forest, freehold
			* Nicholson River (Deptford)	23/204	C	State forest
			Livingstone Creek	1/209	C	State forest, freehold, historic area
			Wentworth River	24/214	C	State forest
			Deddick River	22/210		Freehold, Snowy, Tingaringy National Parks; 20% in New South Wales
8	East Victorian dissected uplands, riverine plains	1	Pranjip Creek	5/226		Freehold
			* Cornella Creek (Colbinabbin )	5/230		State forest, freehold
			Castle Creek	5/226		Freehold
			Major Creek	5/248		Freehold, some State forest
9	West Victorian dissected uplands	1	Axe Creek	6/214		Freehold, State forest etc.
			Avoca River (Amphitheatre)	8/202		Freehold, some State forest; very small
			* Avoca River (Avoca)	-		Freehold, State forest
			Wimmera River (Elmhurst)	15/207	C	Freehold, State forest
			Dwyer Creek	38/221		Grampians National Park, freehold; not typical
			Wando River	38/223		Freehold; not typical
10	West Victorian dissected uplands, volcanic plains	2	Jim Crow Creek	7/221	C	Freehold, pines, Hepburn Regional Park
			* Lerderderg River (O'Briens Crossing)	31/213	H, C	State forest, Lerderderg State Park, some freehold
			Upper Loddon River (Vaughan)	7/217	C	State forest, freehold, others
			Birch Creek (Smeaton)	7/227	C	Freehold, State forest
			Creswick Creek	7/214	C	Freehold, State forest, park; very small
					2 <sup>1</sup>	

## Appendix IV (continued)

Type	Geomorphic unit	Hydrological region	River candidates	Basin/flow gauge <sup>2</sup>	Status <sup>3</sup>	Land tenure, comments
11	West Victorian dissected uplands, volcanic plains	1	Bet Bet Creek	7/220	C	Freehold, State forest
		1	Loddon River (Newstead)	7/215	C	Freehold, State forest etc.
		1	* McCallum Creek (Carisbrook)	7/213	C	Freehold, State forest etc.
		1	Leigh River	33/215		Freehold, few small State forest areas, reserves
		1	Woody Yaloak River	34/201		Freehold, few small public land areas, pines etc.
12	Otway Ranges, dissected plain	3	* Gellibrand River (Carlisle River)	35/208	C	Freehold, State forest, Carlisle State park; mixture of rock types
13	Sth Gippsland Ranges, riverine plains	2	Morwell River (Morwell)	26/408		Freehold, some public land
		2	* Tarra River (Yarram)	27/200		Freehold, some public land
		2 <sup>1</sup>	Tarwin River (Tarwin)	27/202		Freehold, some public land
		2 <sup>1</sup>	Traralgon Creek (Traralgon)	26/023		Freehold, some public land
14	Dissected coastal plains, volcanic plain	2	Fitzroy River	37/202		Freehold, State forest, some pines
		2	* Kennedy Creek (Kennedy Creek)	35/211		Heytesbury settlement, freehold, State forest, pines, bushland reserve; best shows incision through Tertiary material
		2, 2 <sup>1</sup>	Curdies River Surrey River	35/203 37/207		Freehold State forest, freehold, flora reserve
15	Volcanic plains, coastal plains	1	* Darlot Creek (Homerton Br.)	37/205		Freehold, Mt Eccles National Park, some State forest
		1	Eumeralla River	37/206		Freehold, some Mt Eccles National Park
		1	Moyne River	37/200		Freehold
16	Volcanic plains, West Victorian dissected uplands	1	Creswick Creek	7/214	C	Freehold, pines, State forest
		1	Tullaroop Creek	7/222	C	Freehold, small public land areas
		1	Maribyrnong River (Keilor)	30/200		Freehold, less than 2% public land
		1	Maribyrnong River (Bulla)	30/205		Freehold, less than 2% public land
		1	Little River	32/200		Freehold, Brisbane Ranges National Park
		1	* Moorabool River (Morrison's)	32/204	C	Freehold, State forest, water production
		1	Moorabool River (Batesford)	32/202		Freehold, State forest, Brisbane Ranges National Park, water production
		1, 1 <sup>1</sup>	Mt Emu Creek Merri River	36/203 36/205		Freehold, small public land areas Freehold; no west Victorian uplands

### Notes:

1. Hydrologic region calculated from catchment yield data
2. Rural Water Commission flow gauge code number
3. H - proposed heritage river; C - proclaimed catchment

## RIVER AND STREAM VALUES

This table lists Victorian rivers and streams for which natural, recreational, cultural heritage, and scenic values have been identified. Values used in identifying proposed heritage rivers, and those referred to in recommendation D1, are included. Aboriginal archaeological sites are not listed. The Victoria Archaeological Survey, Department of Conservation and Environment, maintains a register of known sites. Essentially natural mainstream segments are not listed; sites of faunal significance are not listed for streams in basins 15, 21-28, and 30-36.

The table has been compiled from published reports, consultants' studies and information in submissions. It does not identify where on a stream a particular value exists. Users are advised to consult the source documents which provide information on the nature of each value and its location. The codes for entries in each column, and the source documents, are listed at the end of the table. The grid number refers to the point at which the stream meets the named mainstream. The grids and their numbers are shown on Map 1 in the Resources Report.

Stream basin	Grid no.	Tributary of	Angling Intro.	Angling Native	Canoe	Car camp	Flora	Fauna	Geo./geom.	Fish div.	Fish stat.	Cult. herit.	Scenic value
<b>BASIN 1</b>													
BENAMBRA CK	007	MORASS CK					2,S,21						
BIG R	007	MITTA MITTA R				P							EH/F,25
BOGGY CK	N06	DRY FOREST CK										1,S,16	
BOUNDARY CK	006	CUDGEWA CK										3,S,16	
BUCHHEEN CK	N06	TALLANGATTA CK					1,S,21						
BULLHEAD CK	N06	MITTA MITTA R					1,S,21						
BUNDARRA R	N07	MITTA MITTA R	P,23		1,S,20		2,S,21						
BUNROY CK	P06	MURRAY R					1,S,21						
BURROWYE CK	005	MURRAY R					1,S,21						
COBUNGRA R	007	MITTA MITTA R	P,23									3,X,1	
CORRYONG CK	006	MURRAY R									C,23		
CUDGEWA CK	006	MURRAY R		P,23							C,23		EH/A,22
DEEP CK	007	MORASS CK					1,S,21						
DIGGERS CK	N07	LITTLE SNOWY CK	P,23	P,23									
GIBBO R	007	DARTMOUTH DAM					1,R,21						
GIBBO R	007	DARTMOUTH DAM			1,R,20		1,S,21					2,X,1	
GLEN WILLS CK	N07	BIG R										1,X,1	
INDI R	P06	MURRAY R			3,N,20	P							EH/N,22
INDI R	P06	MURRAY R											EH/A,22
KOETONG CK	N06	LAKE HUME										1,S,16	
LIMESTONE CK	P07	INDI R										1,X,1	
LIVINGSTONE CK	007	MITTA MITTA R										1,X,1	
LIVINGSTONE CK	007	MITTA MITTA R										1,S,16	
LUCYVALE CK	006	CUDGEWA CK					1,S,21						
MIDDLE CK	N07	BIG R					1,S,21						
MITTA MITTA R	N06	MURRAY R	P,23	P,23	4,S,20	P	1,R,21	1,N,21			C,23	1,R,16	EH/N,25
MITTA MITTA R	N06	MURRAY R			1,R,20		3,S,21	1,R,21					EH/A,25
MITTA MITTA R	N06	MURRAY R											EH/S,25
MITTA MITTA R	N06	MURRAY R											EH/F,25
MORASS CK	007	DARTMOUTH DAM					1,S,21						
MURRAY R	N05	LAKE HUME					3,S,21					1,S,16	FH/A,22
MURRAY R	N05	LAKE HUME					1,R,21					1,R,16	EH/A,22
NARIEL CK	006	CORRYONG CK											EH/A,22
REIDS CK	006	BOUNDARY CK										1,S,16	
SANDY CK	N06	LAKE HUME					1,S,21						
SCRUBBY CK	N07	MITTA MITTA R									C,23		
SNOWY CK	N07	MITTA MITTA R			2,S,20	P							
SNOWY CK	N07	SNOWY CK			2,R,20								

VICTORIA R	N08	COBUNGRA R						1,S,21				1,X,1	
WATCHINGORRA CK	N07	MITTA MITTA R	P,23					1,S,21					
WISES CK	N06	LAKE HUME											
<b>BASIN 2</b>													
BOGONG CK	N07	KIEWA R						1,S,21	1,R,21				
COMMISSIONERS CK	M06	YACKANDANDAH CK	P,23	P,23	3,R,20	P		1,S,21	1,N,21	C,23		1,S,16	EH/T,22
KIEWA R	M06	MURRAY R						1,S,21	1,S,21			1,S,16	
KIEWA R	M06	MURRAY R						1,S,21					EH/S,22
KIEWA R, EAST BR	N07	KIEWA R											EH/S,22
KIEWA R, WEST BR	N07	KIEWA R											
MOUNTAIN CK	N07	KIEWA R				P							
MURRAY R	N06	MURRAY			1,S,20								MBP/A,22
PRETTY VALLEY CK	N07	KIEWA R						1,S,21	1,S,21				
ROCKY VALLEY CK	N07	KIEWA R											
YACKANDANDAH CK	M06	KIEWA R								C,23		1,S,16	
<b>BASIN 3</b>													
BARAMBOGIE CK	M06	BLACK DOG CK										1,R,16	
BARWIDGEE CK	M07	OVENS R			1,R,20								
BLACK DOG CK	L06	OVENS R								C,23		4,S,16	
BOGGY CK	L07	KING R										2,R,1	
BUCKLAND R	M07	OVENS R	P,23		1,R,20	P						1,S,16	
BUCKLAND R	M07	OVENS R										1,X,5	
BUFFALO CK	M07	OVENS R	P,23						1,S,21				
BUFFALO R	M07	OVENS R			2,S,20					C,23			EH/A,22
BUFFALO R	M07	OVENS R			3,R,20								
DANDONGADALE R	M07	BUFFALO R								C,23			
FIFTEEN MILE CK	L06	OVENS R										3,R,1	
HAPPY VALLEY CK	M07	OVENS R										1,R,16	
KING R	L06	OVENS R	P,23	P,23	2,X,20	P	1,S,21	1,S,21		D,23	C,23	1,X,5	EH/S,22
KING R	L06	OVENS R			1,R,20							21,R,1	
MEADOW CK	L07	KING R								D,23	C,23		
MURRAY R	M06	MURRAY R										1,R,16	MBP/F,22
MURRAY R	M06	MURRAY R											MBP/A,22
MURRAY R	M06	MURRAY R											MBP/T,22
NINE MILE CK	M06	YACKANDANDAH CK										2,S,16	
OVENS R	L06	MURRAY R	P,23	P,23	1,R,20		2,S,21	1,S,21		D,23	C,23	4,S,16	MBP/F,22
OVENS R	L06	MURRAY R										17,R,1	EH/A,22
OVENS R	L06	MURRAY R											EH/T,22
REEDY CK	L06	OVENS R			1,R,20	P						4,R,16	
REEDY CK	L06	OVENS R										2,S,16	
ROSE R	M07	DANDONGADALE R	P,23										
ROSE R	M07	BUFFALO R			4,R,20	P							
SPRING CK	M06	REEDY CK										1,S,16	
TEA GARDEN CK	L06	OVENS R										1,R,1	
<b>BASIN 4</b>													
BROKEN CK	I05	MURRAY R						3,S,21					
BROKEN R	J06	GOULBURN R			1,R,20			1,S,21		D,23	C,23	2,S,16	
MURRAY R	L06	MURRAY R			2,R,20	P							
MURRAY R (BARMAH)	J05	MURRAY R						5,N,21	2,S,21				MBP/S,22
MURRAY R (BARMAH)	J05	MURRAY R						1,R,21	1,R,21				MBP/T,22
MURRAY R (BARMAH)	J05	MURRAY R						5,S,21					
RYAN CK	K07	HOLLAND CK										1,R,16	

Stream basin	Grid no.	Tributary of	Angling Intro.	Angling Native	Canoe	Car camp	Flora	Fauna	Geo./ geom.	Fish div.	Fish stat.	Cult. herit.	Scenic value
SAMARIA CK	L07	BROKEN R				P							
SPRING CK	L06	BROKEN R										1,R,16	
<b>BASIN 5</b>													
ACHERON R	K08	GOULBURN R	P,23		2,R,20		6,S,21						
ACHERON R	K08	GOULBURN R			2,R,20		1,R,21	2,N,21					
BIG R	L08	LAKE EILDON	P,23		2,S,20	P		3,S,21					EH/N,25
BIG R	L08	LAKE EILDON			3,R,20								EH/S,25
BRANKEET CK	K08	LAKE EILDON										1,R,16	
CORNELLA CK	107	LAKE COOPER						1,L,21					
DELATITE R	L08	LAKE EILDON			2,S,20						C,23		
DELATITE R	L08	LAKE EILDON			1,R,20								
FRENCHMAN CK	L09	BIG R					1,S,21	2,R,21					
GAFFNEYS CK	L08	U.GOULBURN R										1,S,16	
GOBARUP CK	107	WANALTA CK						1,S,21					
GOULBURN R	106	MURRAY R	P,23	P,23	1,N,20	P	4,S,21	3,S,21		D,23	C,23	1,X,1	MBP/A,22
GOULBURN R	106	MURRAY R			8,S,20							1,N,16	FA/A,22
GOULBURN R	106	MURRAY R			1,R,20							3,S,16	EH/S,22
GOULBURN R	106	MURRAY R										1,R,16	EH/F,22
GOULBURN R	L08	LAKE EILDON			18,R,20							1,S,16	EG/F,25
HAMILTON CK	J08	KURKUVA CK							1,S,8				
HANDFORD CK	L08	JAMIESON R										1,S,16	
HOWQUA R	L08	LAKE EILDON	P,23		1,N,20			2,S,21	1,N,26			1,S,16	
HOWQUA R	L08	LAKE EILDON			1,S,20								
HUGHES CK	J07	GOULBURN R									C,23	2,S,16	
JAMIESON R	L08	GOULBURN R			1,S,20			2,S,21					EH/S,22
KILMORE CK	108	KURKURAC CK										3,R,16	
KING PARROT CK	J08	GOULBURN R			1,R,20		3,N,21				C,23		
LITTE R	K08	ACHERON R				P							
MOLLISON CK	J08	KURKURUC CK										1,S,16	
MOUNTAIN HUT CK	K07	SEVEN CKS										1,X,1	
MURRAY R	105	MURRAY R											MBP/S,22
MURRINDINDI R	J08	YEA R		P,23									
OAKS CK	L09	BIG R					1,S,21						
PRANJIP CK	J07	GOULBURN R										1,S,16	
SEVEN CREEKS	J06	GOULBURN R		P,23						D,23	C,23	3,X,1	
SPRING CK		GOULBURN R						2,R,21					
SUNDAY CK	J08	GOULBURN R										1,R,16	
TAGGERTY R	K08	STEAVENTSONS R					1,R,21						
TAGGERTY R	K08	STEAVENTSONS R					1,S,21						
TAPONGA R	L08	BIG R			1,R,20								
TORBRECK R	L09	BIG R					1,S,21						
WAKITI CK	J06	GOULBURN R	P,23								D,23		
WANALTA CK	107	GOULBURN R						2,S,21					
YEA R	J08	GOULBURN R											FH/A,22
YEA R	J08	GOULBURN R											FH/T,22
<b>BASIN 6</b>													
BACK CK	108	PLOWMAN CK										1,S,16	
CAMPASPE R	106	MURRAY R					2,S,21				C,23	7,S,16	FH/A,22
CAMPASPE R	106	MURRAY R										3,R,16	WCH/A,22
COLIBAN R	H07	LAKE EPPALOCK									C,23	1,S,16	

COLIBAN R	H07	LAKE EPPALOCK						3, R, 16	
CURLY DOG CK	I07	MCIVOR CK						1, R, 16	
FIVE MILE CK	H08	CAMPASPE R						2, S, 16	
MURRAY R	I06	MURRAY R	1, R, 20	P				8, R, 16	MBP/T, 22
MURRAY R	I06	MURRAY R						4, S, 16	

### BASIN 7

BACK CK	G08	TULLAROOP CK						1, S, 16	
BACK CK	G08	TULLAROOP CK						3, R, 16	
BARKERS CK	H08	LODDON R						2, S, 16	
BARKERS CK	H08	LODDON R						2, R, 16	
BENDIGO CK	H06	PICANINNY CK						1, S, 16	
BENDIGO CK	H06	PICANINNY CK						1, R, 16	
BET BET CK	G07	LODDON R						1, S, 16	
BET BET CK	G07	LODDON R						2, R, 16	
BIRCH CK	G08	TULLAROOP CK	P, 23					2, S, 16	
BIRCH CK	G08	TULLAROOP CK						4, S, 16	
BUCKEYE CK	H08	BULLOCK CK						1, S, 16	
BULLOCK CK	H05	PYRAMID CK					2, S, 21		WCH/A, 22
COGHILL CK	G08	CRESWICK CK						2, R, 16	
CRESWICK CK	G08	TULLAROOP CK					1, S, 21		WCH/T, 22
CRESWICK CK	G08	TULLAROOP CK						3, S, 16	
DAISY HILL CK	G08	MIA MIA CK						3, R, 16	
FIVE MILE CK	H07	BENDIGO CK					1, S, 21		
FOREST CK	H08	CAMPBELLS CK						1, R, 16	
GUNBOWER CK	H05	MURRAY R					1, S, 21		
JIM CROW CK	H08	LODDON R	P, 23					1, S, 16	
LANGDONS CK	G08	LODDON R						1, S, 16	
LITTLE MURRAY R	G04	MURRAY R						1, R, 16	
LODDON R	G04	MURRAY R	P, 23	P, 23	2, R, 20		1, R, 21		MBP/A, 22
LODDON R	G04	MURRAY R					1, S, 21		MBP/T, 22
LODDON R	G04	MURRAY R						5, R, 16	WCH/A, 22
MCCALLUM CK	G08	TULLAROOP CK						2, R, 16	
MT HOPE CK	H05	KOW SWAMP						1, S, 21	
MURRABIT CK	G05	LODDON R							
MURRAY R	I06	MURRAY R						3, S, 21	
MURRAY R	I06	MURRAY R						1, R, 16	MBP/S, 22
MURRAY R (GUNBOWER)	H05	MURRAY R					2, S, 21		MBP/A, 22
PYRAMID CK	G05	LODDON R					3, S, 21		
SAILORS CK	H08	SPRING CK					1, S, 21		
SERPENTINE CK	G06	LODDON R							
STONY CK	G08	TALBOT RES						1, R, 16	
TULLAROOP CK	G07	LODDON R						1, S, 16	WCH/A, 22
TULLAROOP CK	G07	LODDON R						1, R, 16	

### BASIN 8

AVOCA R	G05	KERANG LAKES						2, S, 21	D, 23	C, 23	1, S, 16	WCH/A, 22
AVOCA R	G05	KERANG LAKES									1, R, 16	
LAKE MARMAL CK	G06	LAKE MARMAL						1, R, 21				
LALBERT CK	F04	LAKE TIMBORAM						1, R, 21				
MOUNTAIN CK	F08	AVOCA R										
MURRAY R	G04	MURRAY R	1, R, 20								2, R, 16	
No 2 CK	F08	AVOCA R										
TYRRELL CK	E04	LAKE TYRRELL						2, R, 21				

Stream basin	Grid no.	Tributary of	Angling Intro.	Angling Native	Canoe	Car camp	Flora	Fauna	Geo./geom.	Fish div.	Fish stat.	Cult. herit.	Scenic value
<b>BASIN 14</b>													
LINDSAY R	B02	MURRAY R		P,23	1,S,20		1,N,21	1,s,21			C,23		
LINDSAY R	B02	MURRAY R					1,S,21						
MURRAY R	F04	MURRAY R			1,S,20	P	32,S,21					5,S,16	MBP/S,22
MURRAY R	F04	MURRAY R					5,R,21					4,R,16	MBP/F,22
MURRAY R	F04	MURRAY R											MBP/A,22
MURRAY R	F04	MURRAY R											MBP/T,22
WALLPOLLA CK	C02	MURRAY R	P,23	P,23			1,N,21	2,s,21			C,23		
WALLPOLLA CK	C02	MURRAY R					2,S,21						
<b>BASIN 15</b>													
AVON R	E07	RICHARDSON R			1,R,20								
FYANS CK	E08	MOUNT WILLIAM CK					1,B,19						GR/S,22
GOLTON CK	D07	MOUNT WILLIAM CK					1,B,19						GR/S,22
MCKENZIE R	D07	WIMMERA R											GR/S,22
MOUNT WILLIAM CK	E08	WIMMERA R											GR/S,22
OUTLET CK	C05	LAKE BRAMBRUK					1,A,19						
OUTLET CK	C04	WIRRENGREN PLAIN											
PLEASANT CK	E08	LAKE LONSDALE										1,R,16	
RICHARDSON R	E06	LAKE BULOKE										1,S,16	
RICHARDSON R	E06	LAKE BULOKE										1,X,1	
WATTLE CK	E07	STATION CK										1,R,16	
WIMMERA R	C06	TERMINAL LAKES	P,23	P,23		P	5,X,19		1,N,19	D,23	C,23	1,X,1	MBP/S,22
WIMMERA R	C06	TERMINAL LAKES										2,S,16	
WIMMERA R	C06	TERMINAL LAKES										6,R,16	
YARRIAMBIA CK	D07	WIMMERA R					1,A,19					3,X,1	MBP/T,22
YARRIAMBIA CK	D07	WIMMERA R										1,S,16	
YARRIAMBIA CK	D07	WIMMERA R										2,R,16	
<b>BASIN 21</b>													
ADA R	Q08	ERRINUNDRA R				P							
BEMM R	Q09	SYDENHAM INLET		P,23			1,N,27	1,x,28	1,s,6	D,23	C,23	2,s,16	
BEMM R	Q09	SYDENHAM INLET					2,S,27						
BENEDORE R	S09	TASMAN SEA											
BETKA R	S09	TASMAN SEA											
BOLA CK	Q08	ERRINUNDRA R											
CANN R	R09	TAMBOON INLET	P,23	P,23	3,S,20	P					D,23	1,R,16	FH/F,22
CANN R	R09	TAMBOON INLET											FH/A,22
CANN R	R09	TAMBOON INLET											FH/T,22
CANN R, EAST BR	R08	CANN R			1,S,20								
COMBIENBAR R	Q08	BEMM R					1,O,13				C,23		
DINNER CK	S08	GENOA R					1,O,13						
DOWELL CK	S08	MALLACOOTA INLET					1,H,13						
EASBY CK	S09	TASMAN SEA									D,23	C,23	
EUCHRE CK	Q09	BEMM R					1,O,13						
GENOA R	S08	MALLACOOTA INLET										1,R,16	FH/N,22
GENOA R	S08	MALLACOOTA INLET											FH/S,22
GENOA R	S08	MALLACOOTA INLET											FH/F,22
GENOA R	S08	MALLACOOTA INLET											SL/S,22
GENOA R	S08	MALLACOOTA INLET											SL/A,22
HARRISON CK	S08	MALLACOOTA INLET					1,O,13						



Stream basin	Grid no.	Tributary of	Angling		Canoe	Car camp	Flora	Fauna	Geo./geom.	Fish div.	Fish stat.	Cult. herit.	Scenic value
			Intro.	Native									
NICHOLSON R	009	LAKE KING											FH/F,22
NICHOLSON R, EAST BR	008	NICHOLSON R										1,S,16	
PERCH CK	009	LAKE KING								D,23			
SALT CK	009	SLAUGHTERHOUSE CK	P,23										
SHADY CK	009	TAMBO R										1,S,16	
STONEY CK	009	LAKE TYERS										1,S,16	
SWIFTS CK	008	TAMBO R										4,X,1	
TAMBO R	008	TAMBO R	P,23	P,23	3,R,20	P		1,X,1		D,23	C,23	2,X,1	
TAMBO R	008	TAMBO R										1,S,16	
TAMBO R	008	TAMBO R										1,R,16	
TIMBARRA R	009	TAMBO R				P							
<b>BASIN 24</b>													
BOGGY CK	009	MITCHELL R										1,R,16	
CLIFTON CK	009	MITCHELL R		P,23						D,23			
CONGLOMERATE CK	M08	WONNANGATTA R					1,0,13						
CROOKED R	N08	WONGUNGARRA R				P					C,23		
DARGO R	N09	MITCHELL R			2,R,20	P					C,23		EH/N,25
DARGO R	N09	MITCHELL R											EH/F,25
MITCHELL R	009	LAKE KING		P,23	1,N,20	P	1,N,13		1,1,7	D,23	C,23	4,R,16	FH/N,22
MITCHELL R	009	LAKE KING			2,S,20				3,S,7				EH/N,22
MITCHELL R	009	LAKE KING			1,R,20								EH/A,25
MOROKA R	M08	WONNANGATTA R					1,H,13		1,S,7				
WENTWORTH R	N09	MITCHELL R										1,S,16	
WONNANGATTA R	N09	MITCHELL R	P,23		1,S,20	P	1,H,13			D,23	C,23		EH/F,25
<b>BASIN 25</b>													
ABERFELDY R	L09	THOMSON R			1,R,20	P							
AVON R	N10	LAKE WELLINGTON				P				D,23	C,23	4,R,16	EH/N,25
AVON R	N10	LAKE WELLINGTON										2,S,16	EH/S,25
AVON R	N10	LAKE WELLINGTON										2,S,16	EH/A,25
BARKLY R	M09	MACALISTER R		P,23	2,S,20	P							
COOPERS CK	L10	THOMSON R										1,S,16	
DOLODROOK R	M09	WELLINGTON R							1,S,7				
FREESTONE CK	N09	AVON R			1,R,20	P							
JORDAN R	L09	THOMSON R				P						1,S,16	
LaTROBE R	N10	LAKE WELLINGTON							1,S,7				
MACALISTER R	M09	THOMSON R				P					C,23	1,X,4	EH/N,25
MACALISTER R	M09	THOMSON R			2,S,20							2,R,16	EH/F,25
MACALISTER R	M09	THOMSON R			4,R,20								EH/A,25
PERRY R	N10	DISHER BAY		P,23									
RAINBOW CK	M10	THOMSON R											
STONY CK	M09	VALENCIA CK											
STRINGERS CK	L09	THOMSON R				P						1,S,16	EH/N,25
THOMSON R	N10	LA TROBE R		P,23	3,S,20	P				D,23	C,23	2,R,16	EH/S,25
THOMSON R	N10	LA TROBE R										3,S,16	EH/N,25
THOMSON R	N10	LA TROBE R										1,S,24	
VALENCIA CK	M09	AVON R				P					C,23		EH/N,25
VALENCIA CK	M09	AVON R											EH/A,25
WELLINGTON R	M09	MACALISTER R				P							

### BASIN 26

BULL BEEF CK	L10	TANJIL R				1, S, 14					
EAGLEHAWK CK	M10	LATROBE R					2, S, 7				
LATROBE R	N10	LAKE WELLINGTON								1, N, 16	
LATROBE R	N10	LAKE WELLINGTON								1, S, 16	
LATROBE R	N10	LAKE WELLINGTON	P, 23	1, R, 20	P	1, S, 14		D, 23	C, 23		SL/A, 22
LITTLE MORWELL R	L10	MORWELL R			P						
MORWELL R	L10	LA TROBE R	P, 23		P			D, 23			
MORWELL R, WEST BR	L10	MORWELL R				1, S, 14					
RINTOUL CK	M10	LATROBE R					1, S, 7				
SERPENTINE CK	L10	TANJIL R				1, S, 14					
TANJIL R	L09	TANJIL R		1, R, 20							FH/S, 22
TOORONGO R	L09	LATROBE R			P						
TRARALGON CK	L10	LATROBE R						1, S, 7	D, 23		
TYERS CK	L10	LA TROBE R								1, R, 16	
TYERS R	L10	LA TROBE R			P	1, S, 14		2, S, 7	D, 23		FH/S, 22
TYERS R, EAST BR	L09	TYERS R				1, S, 14					
TYERS R, WEST BR	L09	TYERS R				1, S, 14					

### BASIN 27

AGNES R	L11	CORNER INLET						1, S, 8	D, 23	C, 23	
ALBERT R	M11	BASS STRAIT	P, 23		P				D, 23	C, 23	1, S, 16
BASS R	K10	WESTERN PORT						1, N, 8			
BERRYS CK	L10	TARWIN R	P, 23								
BODMAN CK	M11	TARRA R						1, S, 8			
BRUTHEN CK	M11	BASS STRAIT	P, 23								SL/F, 22
CHINAMANS CK	L11	CORNER INLET							D, 23		
DARBY R	L11	BASS STRAIT							D, 23		
DINGO CK	L11	AGNES R				1, S, 14					
FRANKLIN R	L11	CORNER INLET				1, S, 14			D, 23	C, 23	SU/F, 22
FRANKLIN R	L11	CORNER INLET									SU/A, 22
FRESHWATER CK	L12	BASS STRAIT							D, 23	C, 23	
JACK R	M11	ALBERT R			P						
LITTLE ALBERT R	M11	ALBERT R									1, S, 16
MACKS CK	M11	TARRA R							D, 23		
MERRIMAN CK	N10	BASS STRAIT	P, 23			1, N, 14			D, 23	C, 23	SF/F, 22
MERRIMAN CK	N10	BASS STRAIT						1, S, 8			SL/F, 22
MORNING STAR CK	L09	DONNELLY CK									1, S, 16
POWLETT R	K11	BASS STRAIT	P, 23								
ROARING MEG CK	L12	BASS STRAIT									
TARRA R	M11	BASS STRAIT									
TARWIN R	K11	BASS STRAIT			P	1, I, 14			D, 23	C, 23	C/A, 22
TARWIN R, EAST BR	K11	ANDERSON INLET	P, 23	1, R, 20	P				D, 23	C, 23	
TIDAL R	L12	TARWIN R			P						
TIN MINE CK	K09	BASS STRAIT									1, S, 16
WARRAGUL CK	N10	BLACKWOOD CK									1, S, 16
		BASS STRAIT									

### BASIN 28

BACK CK	K09	BUNYIP R				1, S, 15					
BUNYIP R	K10	WESTERN PORT	P, 23			1, N, 15				C, 23	
BUNYIP R	K10	WESTERN PORT				1, S, 15		1, S, 8			
CARDINIA CK	J10	WESTERN PORT							D, 23	C, 23	
DIAMOND CK	K10	BUNYIP R				1, S, 15					
EAST CK	J10	WESTERN PORT						1, S, 8			

Stream basin	Grid no.	Tributary of	Angling Intro.	Angling Native	Canoe	Car camp	Flora	Fauna	Geo./ geom.	Fish div.	Fish stat.	Cult. herit.	Scenic value
LABERTOUCHE CK	K10	TARAGO R		P,23									
LANG LANG R	K10	WESTERN PORT		P,23					1,N,8		C,23		
LANG LANG R	K10	WESTERN PORT							1,S,8				
O'MAHONY CK	K10	LANG LANG R		P,23						D,23			
RYSON CK	K09	BUNYIP R					1,N,15						
TARAGO R EAST BR	K09	TARAGO R		P,23			1,X,3			D,23		1,X,1	
TIN CK	K09	BUNYIP R					1,N,15						
YALLOCK CK	J10	WESTERN PORT BAY							1,N,8				
<b>BASIN 29</b>													
ARMSTRONG CK	K09	YARRA R					1,S,21						
BAKER CK	K09	YARRA R						1,N,21					
BRITANNIA CK	K09	LITTLE YARRA R					2,S,21	2,L,21					
CEMENT CK	K09	YARRA R					1,N,21						
CEMENT CK	K09	YARRA R					1,S,21						
CHUM CK	K09	MEYERS CK										1,X,1	
CLEAR CK	K09	YARRA R					1,R,21	1,N,21					
CONTENTMENT CK	K09	WATTS R					1,S,21						
CROOKED CK	K09	YARRA R							1,S,9				
DEEP CK	K09	O'SHANNASSY R						1,N,21					
DON R	K09	YARRA R		P,23								1,R,16	
GRACE BURN	K09	WATTS R					2,N,21	1,R,21					
GRACE BURN	K09	WATTS R					1,R,21						
GRACE BURN	K09	WATTS R					3,S,21						
LITTLE YARRA R	K09	YARRA R	P,23				1,R,21	1,R,21					
MCCRAE CK	K09	WOORI YALLOCK CK						1,L,21					
MCAHON CK	K09	YARRA R					1,S,21						
MERRI CK	I09	YARRA R					2,S,21						
MICKS CK	K09	WATTS R										1,X,1	
O'SHANNASSY R	K09	YARRA R					3,N,21	2,N,21					
O'SHANNASSY R	K09	YARRA R					2,S,21						
OLINDA CK	J09	YARRA R					1,S,21						
OLINDA CK	J09	YARRA R					1,R,21						
PLENTY R	J09	YARRA R					1,S,21						FH/A,22
STARVATION CK	K09	YARRA R					1,S,21						
STEELES CK	J09	YARRA R						2,R,21					
TOMAHAWK CK	K09	SHEPHERD CK					1,S,21						
WALKER CK	K09	YARRA R						1,N,21					
WALSH CK	K09	YARRA R						1,N,21					
WANDIN YALLOCK CK	K09	WOORI YALLOCK CK					1,S,21						
WATSON CK	J09	YARRA R					1,R,21		1,S,9				
WATTS R	J09	YARRA R					4,S,21	1,N,21					
WATTS R	J09	YARRA R					2,N,21	3,R,21					
YARRA CK	J09	PLENTY R											
YARRA R	I09	PORT PHILLIP BAY	P,23	P,23	6,S,20		1,N,21	1,N,21	1,S,9	D,23	C,23	3,X,1	FH/F,22
YARRA R	I09	PORT PHILLIP BAY			10,R,20		4,R,21	1,R,21	10,R,9				EH/T,22
YARRA R	I09	PORT PHILLIP BAY					9,S,21						
<b>BASIN 30</b>													
BOLINDA CK	I08	EMU CK										1,X,1	
DEEP CK	I09	MARIBYRNONG R								D,23		3,S,16	
EMU CK	I09	DEEP CK	P,23						1,S,10				

JACKSON CK	109	MARIBYRNONG R				1,S,21				2,X,1	WP/A,22
JACKSON CK	109	MARIBYRNONG R								1,S,16	
MARIBYRNONG R	109	PORT PHILLIP		1,S,20				1,N,10	D,23	C,23	2,S,16
MARIBYRNONG R	109	PORT PHILLIP		4,R,20							1,R,16
MARIBYRNONG R	109	PORT PHILLIP									1,X,1
RIDDELLS CK	109	JACKSON CK									1,X,1
SUNBURY CK	109	JACKSONS CK									1,S,16
TAYLORS CK	109	MARIBYRNONG R						1,N,10			

### BASIN 31

CATARACT CK	H09	PYRITES CK						1,S,10			
DJERRIWARRH CK	109	MELTON RESERVOIR									1,S,16
DJERRIWARRH CK	109	MELTON RESERVOIR									1,R,16
KORJAMUNIP CK	H09	PYKES CK RES						1,S,10			
KORKUPERIMUL CK	H09	WERRIBEE R						1,I,10			
KOROROIT CK	109	ALTONA BAY									1,R,16
LERDERDERG R	H09	WERRIBEE R	P,23	1,R,20	P	1,R,21		1,I,10			FH/N,22
LERDERDERG R	H09	WERRIBEE R				2,S,21		1,S,10			FH/S,22
LERDERDERG R	H09	WERRIBEE R						1,N,10			FH/T,22
LERDERDERG R	H09	WERRIBEE R									WP/A,22
PARWAN CK	H09	WERRIBEE R						1,S,10			
PYRITES CK	H09	COIMADAI CK									FH/S,22
SKELETON CK	109	PORT PHILLIP BAY				1,S,21					
TOOLERN CK	109	WERRIBEE R						1,N,10			
WERRIBEE R	109	PORT PHILLIP BAY	P,23	P,23		1,R,21		2,S,10			3,R,16
WERRIBEE R	109	PORT PHILLIP BAY						1,N,10			4,S,16
WERRIBEE R	109	PORT PHILLIP BAY									FH/S,22
YALOAK CK	H09	PARWAN CK						1,S,10			4,S,16
											WCH/T,22

### BASIN 32

COWIE CK	H10	CORIO BAY									1,S,16
HOVELL CK	H10	PORT PHILLIP BAY						3,S,10			
LITTLE R	109	PORT PHILLIP BAY									2,S,16
MOORABOOL R	H09	MOORABOOL R						2,S,10			2,R,16
MOORABOOL R	H09	MOORABOOL R									4,S,16
MOORABOOL R	H09	MOORABOOL R									1,N,16
MOORABOOL R EAST	H09	MOORABOOL R									WCH/S,22
BRANCH											
MOORABOOL R EAST	H09	MOORABOOL R									WCH/F,22
BRANCH											
MOORABOOL R WEST	H09	MOORABOOL R									WCH/S,22
BRANCH											
STONY CK	H09	LITTLE R									2,R,16

### BASIN 33

BARWON R	G09	BASS STRAIT	P,23	P,23	4,R,20				D,23	C,23	6,S,16	WP/A,22
BARWON R	G09	BASS STRAIT									2,N,16	
BARWON R	G09	BASS STRAIT						1,N,11			4,R,16	
LEIGH R	G09	BARWON R									3,S,16	
LEIGH R	G09	BARWON R									2,R,16	
MUDDY WATER HOLES CK	H09	BRUCE CK									1,S,16	
WAURN PONDS CK	H10	BARWON R									1,R,16	
YARROWEE R	H10	BARWON R									1,S,16	WP/A,22
YARROWEE R												WP/T,22

Stream basin	Grid no.	Tributary of	Angling Intro.	Angling Native	Canoe	Car camp	Flora	Fauna	Geo./ geom.	Fish div.	Fish stat.	Cult. herit.	Scenic value
<b>BASIN 34</b>													
LITTLE WOODY YALOAK	G09	WOODY YALOAK R										1,S,16	
SPRINGDALLAH CK	G09	WOODY YALOAK CK										1,S,16	
WOODY YALOAK R	G10	LAKE CORANGAMITE				P						1,R,16	WCH/A,22
WOODY YALOAK R	G10	LAKE CORANGAMITE										1,S,16	
<b>BASIN 35</b>													
AIRE R	F11	LAKE HORDERN		P,23					3,S,11		C,23		SU/S,22
AIRE R	F11	SOUTHERN OCEAN											SU/A,22
ANGLESEA R	H10	BASS STRAIT		P,23									
BARHAM R EAST BR	G11	BARHAM R		P,23						D,23	C,23		SU/A,22
BARHAM R WEST BR	G11	BARHAM R		P,23					1,S,11	D,23			
CARLISLE R	F11	GELLIBRAND R							1,S,11				
CARISBROOK CK	G11	BASS STRAIT									C,23		
CHAPPLE CK	F11	GELLIBRAND R							1,S,11				
CHARLIES CK	G11	GELLIBRAND R										2,X,2	
CUMBERLAND R	G11	BASS STRAIT									C,23		SU/N,22
CURDIES R	E11	SOUTHERN OCEAN	P,23	P,23						D,23		1,S,16	
ELLIOT R	G11	BASS STRAIT							1,S,11				
ERSKINE R	G11	BASS STRAIT								D,23	C,23	1,R,16	SU/N,22
GELLIBRAND R	F11	SOUTHERN OCEAN	P,23	P,23					2,S,11	D,23			SU/F,22
GELLIBRAND R	F11	SOUTHERN OCEAN											SU/A,22
JOHANNA R	F11	BASS STRAIT										2,X,2	
KENNET R	G11	BASS STRAIT									C,23		
PAINKALAC CK	H10	BASS STRAIT	P,23							D,23			
SKENES CK	G11	BASS STRAIT									C,23		
THOMPSON CK	H10	BASS STRAIT		P,23									
WILD DOG CK	G11	BASS STRAIT									C,23		
WYE R	G11	BASS STRAIT									C,23		
<b>BASIN 36</b>													
BILLY BILLY CK	F08	FIERY CK											1,R,16
BROKEN CK	F09	MOUNT EMU CK											1,S,16
BURCHETT CK	E09	MUSTON CK											1,S,16
FIERY CK	E09	HOPKINS CK											1,R,16
GOOD MORNING BILL CK	E08	LAKE BUNINJON											1,R,16
HOPKINS R	E10	SOUTHERN OCEAN	P,23	P,23						D,23	C,23	5,S,16	WP/A,22
HOPKINS R	E10	SOUTHERN OCEAN										2,R,16	WCH/A,22
HOPKINS R	E10	SOUTHERN OCEAN										1,N,16	
HOPKINS R	E10	SOUTHERN OCEAN					5,R,20						
LUBRA CK	D09	MUSTON CK										1,S,16	
MERRI R	D10	SOUTHERN OCEAN	P,23	P,23						D,23		1,S,16	
MT EMU CK	E10	HOPKINS R				2,R,20				D,23		4,S,16	WP/A,22
MT EMU CK	E10	HOPKINS R											WCH/A,22
SALT CK	E10	HOPKINS R										1,S,16	
TRAWALLA CK	E08	MOUNT EMU CK										1,R,16	
YOUL CK	D10	SPRING CK										1,S,16	
<b>BASIN 37</b>													
DARLOT CK	C10	FITZROY R		P,23			3,S,21			D,23		1,R,16	WP/F,22

DARLOT CK	C10	FITZROY R				2,L,21	1,S,12			1,S,16	WP/T,22
EUMERALLA R	D10	LAKE YAMBUK				1,S,21		D,23		1,R,16	
EUMERALLA R	D10	LAKE YAMBUK				2,L,21					
FITZROY R	C10	PORTLAND BAY					1,N,12	D,23		1,R,16	
JOHNSTONE CK	B10	DISCOVERY BAY					1,S,12				
MOYNE R	D10	BELFAST LOUGH								1,S,16	C/T,22
MOYNE R	D10	BELFAST LOUGH								1,R,16	
SCOTTS CK	E10	CURDIES R								1,R,16	

### BASIN 38

BOONAWAH CK	D09	LAKE LINLITHGOW				1,S,21					
CRAWFORD R	B09	GLENELG R					1,S,12		C,23	1,S,16	
GLENELG R	B10	SOUTHERN OCEAN	P,23	P,23							
GLENELG R	B10	SOUTHERN OCEAN				1,S,21		D,23		3,S,16	GR/N,22
GLENELG R	B10	SOUTHERN OCEAN			1,N,20	1,R,21	1,S,12				GR/A,22
GRANGE BURN	C09	WANNON R			1,R,20						WP/1,22
GREEN CK	D08	DWYER CK			1,R,20		1,N,12			1,X,1	WP/T,22
MOLESIDE CK	B10	CRAWFORD R				1,R,21					
MOSQUITO CK	A08	GLENELG R				1,S,21					
MUDDY CK	D09	GRANGE BURN									
WANNON R	B09	GLENELG R					1,N,12				
WANNON R	B09	GLENELG R				P	1,X,18	1,R,21	D,23	C,23	1,S,16
YARRAMYLJIP CK	C08	GLENELG R						1,S,21			GR/S,22
											WP/A,22

### BASIN 39

MOSQUITO CK	A08	BOOL LAGOON (SA)				1,S,21					
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**Notes:**

The entry codes are as follows:

The last number (numbers 1 to 27) identifies the source of information. These are listed below.

For recreational angling, car-based camping, fish diversity and fish conservation status, an entry indicates that it meets the following criteria:

**Angling**

Introduced species (P) high level of significance  
Native species (P) high or average level of significance

Car-based camping (P) presence of popular camping spots, in terms of size or numbers of sites

Fish diversity (D) at least 7 native freshwater species

Fish conservation status (C) presence of native species with an 'endangered' or 'vulnerable' status

**Scenic landscapes**

The river/landscape setting of each high scenic value reach is listed prior to the source number (22). The first letters describe the landscape character type. The letter following the '/' describes the river-setting category.

**Landscape character type**

MBP - Murray Basin Rivers  
WP - Western Plains  
SL - Southern Lowlands  
WCH - West Central Hills  
FH - Foothills  
EH - Eastern Highlands  
G - Grampians  
SU - Southern Uplands  
C - Coastline

**River setting category**

N - Natural  
S - Semi-natural  
F - Farm--forest  
A - Agricultural  
T - Small town--suburban

For canoeing, nature conservation values (flora, fauna, and geological/geomorphological sites of significance) and cultural heritage values (post-contact sites) the leading number indicates the number of sites or reaches with the particular level of significance, and the middle letter indicates the level of significance, as follows:

I - International  
N - National  
S - State  
R - Regional  
O - Outstanding  
H - High  
X - Significance level not formally assessed but is at least of regional significance  
A - Extremely rare species present  
B - Species present that are endangered or localised in occurrence.

## Information Sources

1. Royal Historical Society of Victoria.  
Rivers and Streams - First submission number 37.
2. Gellibrand River System Committee.  
Rivers and Streams - First submission number 40.
3. Mornington Peninsula and District Water Board.  
Rivers and Streams - First submission number 48.
4. Department of Sport and Recreation.  
Rivers and Streams - First submission number 60.
5. Briggs, L.  
Rivers and Streams - First submission number 70.
6. McRae-Williams, M.S., Rosengren, N.J., and Kraemers, S.M. (1981).  
Sites of geological and geomorphological significance in East Gippsland. Ministry for Conservation - Environmental studies series report No 320.
7. Rosengren, N.J. (1984).  
Sites of geological and geomorphological significance in the Gippsland Lakes catchment. Department of Conservation, Forests and Lands - Environmental studies series report No 402.
8. Rosengren, N.J. (1984).  
Sites of geological and geomorphological significance in the Western Port Bay catchment. Ministry for Conservation - Environmental studies series report No 401.
9. Rosengren, N.J., Frood, D.I. and Lowe, K. (1983).  
Sites of environmental significance in the floodplain of the upper Yarra River. Upper Yarra Valley and Dandenong Ranges Authority: Melbourne.
10. Rosengren, N.J. (1984).  
Sites of geological and geomorphological significance in the western region of Melbourne. Department of Conservation and Environment and the Melbourne Western Region Commission Incorporated.
11. Rosengren, N.J. (1984).  
Sites of geological and geomorphological significance in the Shire of Otway. Ministry for Conservation - Environmental studies series report No 399.
12. Rosengren, N.J., Mallen, J., and Shepherd, T. (1981).  
An assessment of the geological/geomorphological significance of private land in the Shire of Portland. Ministry for Conservation - Environmental studies series report No 364.
13. Forbes, S.J., Gullan, P.K., and Walshe, N.G. (1981).  
Sites of botanical significance in East Gippsland. Ministry for Conservation - Environmental studies series report No 322.
14. Gullan, P.K., Earl, G.E., Forbes, S.J., Barley, R.H., and Walsh, N.G. (1984).  
Sites of botanical significance in Central Gippsland. Department of Conservation, Forests and Lands - Environmental studies series No 400.
15. Opie, A.M., Gullan, P.K., Van Berkel, S.C., and Van Rees, H. (1984).  
Sites of botanical significance in the Western Port region. Ministry for Conservation - Environment studies series report No 328.
16. Clark, I.D. (1989).  
Themes relating to the past 150 years of Victorian rivers, streams, and water systems. Report to the Land Conservation Council.
17. Victorian National Parks Association Inc.  
Rivers and Streams - First submission number 44.
18. Bird, R.  
Rivers and Streams - First submission number 52.
19. Kunert, C. and Macmillan, L. (1988).  
Conservation value and status of Victorian streams - Part III. The Wimmera and its catchment. Royal Melbourne Institute of Technology: Melbourne.
20. Victorian Amateur Canoe Association Inc.  
Rivers and Streams - First submission number 34.
21. Biosis Research Pty Ltd and Ecological Horticulture Pty Ltd (1988).  
Report on the ecological values of Victorian rivers and streams. Report to the Land Conservation Council.
22. Anson, Y., Sweatman, C., and Sandford, M. (1987).  
A scenic assessment of Victoria's streams. Report to the Land Conservation Council.
23. Tunbridge, B.R., and Glenane, T.J.  
Fisheries value and classification of fresh and estuarine waters in Victoria and addenda (1990). Arthur Rylah Institute, Department of Conservation and Environment.
24. Department of Conservation and Environment (1989).  
European history of the Melbourne Area, District 2. A report to the Land Conservation Council by the Historic Places Section.
25. Biosis Research Pty Ltd and Scenic Spectrums Pty Ltd (1989).  
Conservation, scenic and resource values of selected rivers and streams in Victoria. A report to the Land Conservation Council.
26. Joyce, E.D., and King, R.L. (1980).  
Geological features of the national estate in Victoria. Victorian Division, Geological Society of Australia Incorporated: Melbourne.
27. Cameron, D.  
(Department of Conservation and Environment, pers.comm.).
28. Scotts, D., and Seebach, J.H. (1989). See references.

## PROPOSED RECOMMENDATIONS

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### HERITAGE RIVERS

### MAPS 2 - 28

A1 - A15

Recommendation numbers



Heritage River Corridors



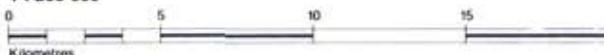
P.L.W.F. Public land water frontage reserves.

Notes: 1. Scales are either 1:100 000 or 1:250 000, as marked.

1 : 100 000



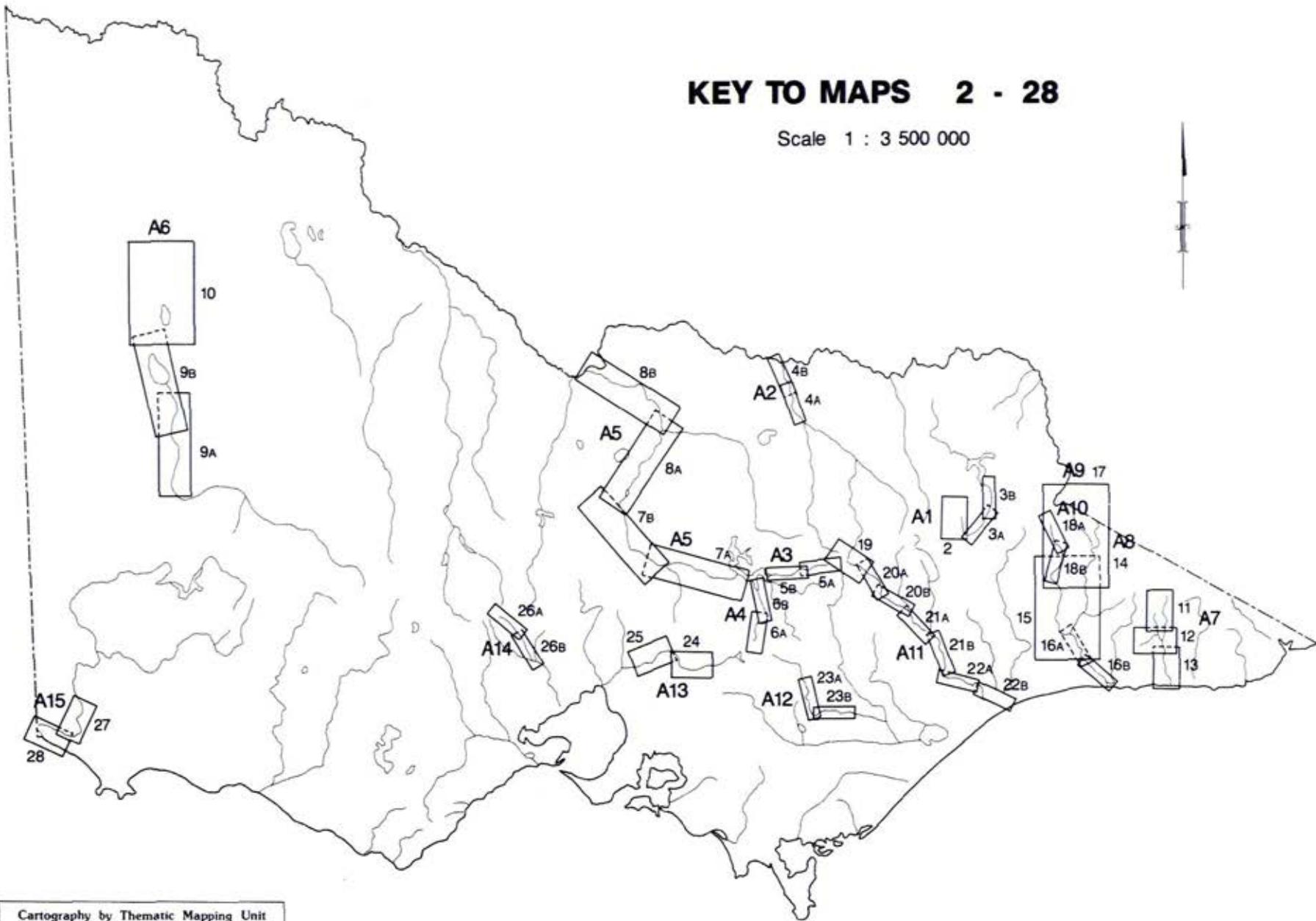
1 : 250 000



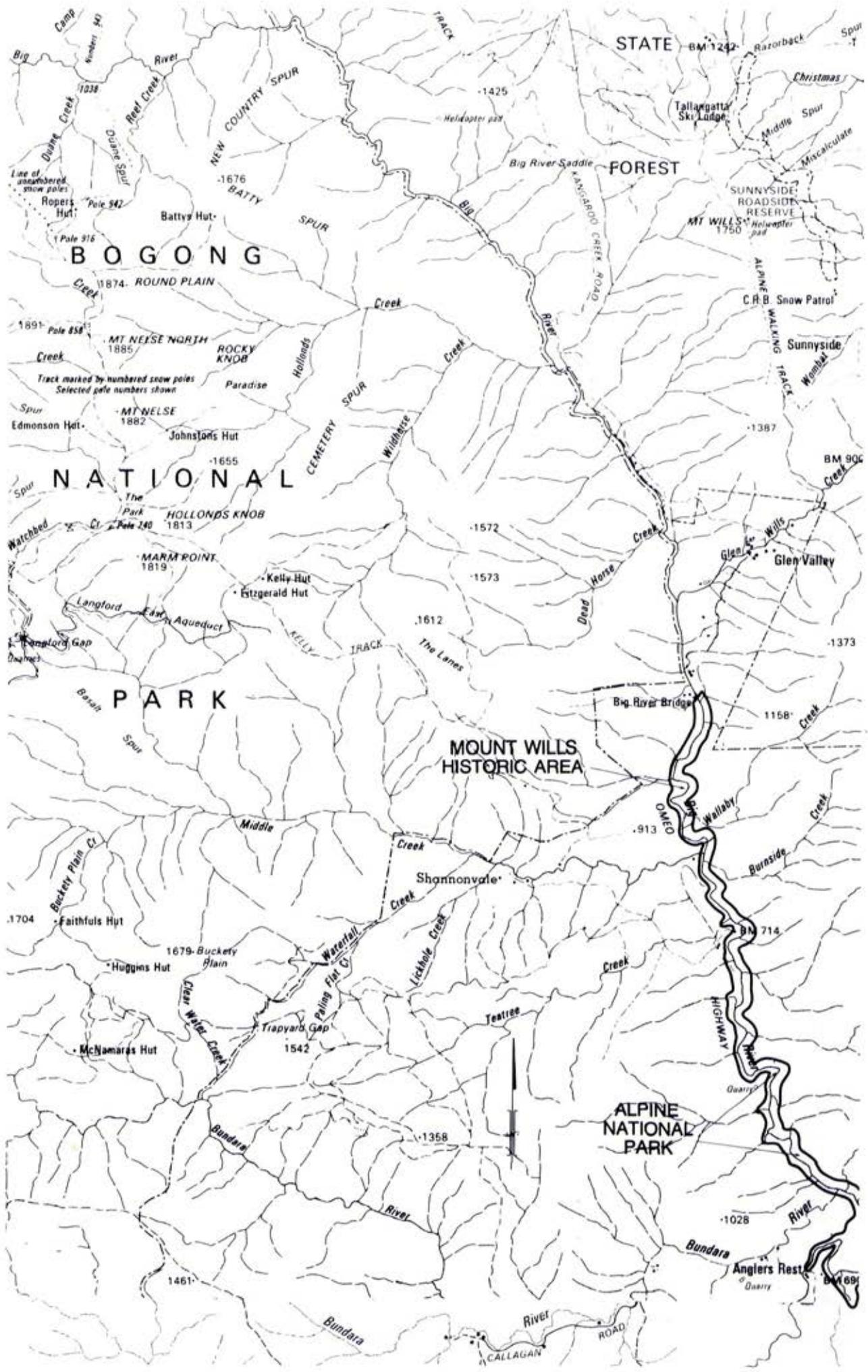
2. Orientation of maps on the page varies - note the north points.
  3. River corridors are generally 200m wide on each side of the rivers, except as follows:
    - (a) where the corridor comprises a Public Land Water Frontage Reserve (narrower than 200m);
    - (b) in gorges, for example on the Snowy, Mitchell and Lerderberg Rivers, where the corridor is the river's immediate catchment (wider than 200m);
    - (c) where the corridor follows a Natural Features Zone specified in previous recommendations, for example, Bemm, Goolengook and Errinundra Rivers (width increases downstream).
-

# KEY TO MAPS 2 - 28

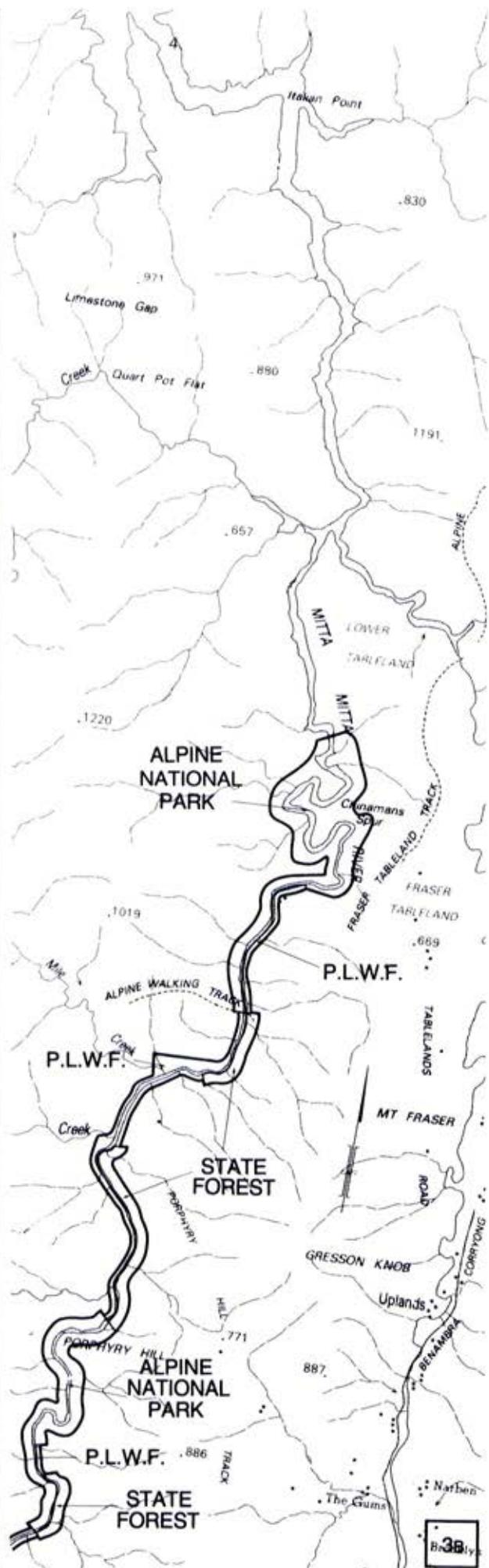
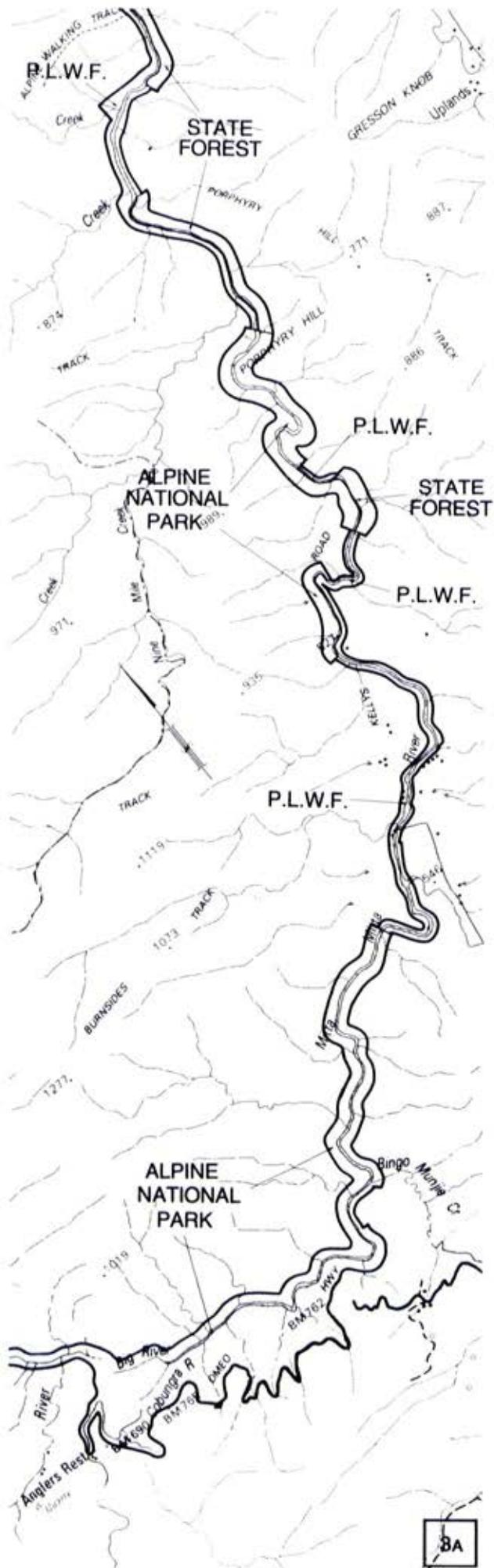
Scale 1 : 3 500 000



Cartography by Thematic Mapping Unit  
Survey & Mapping Victoria  
Department of Property & Services

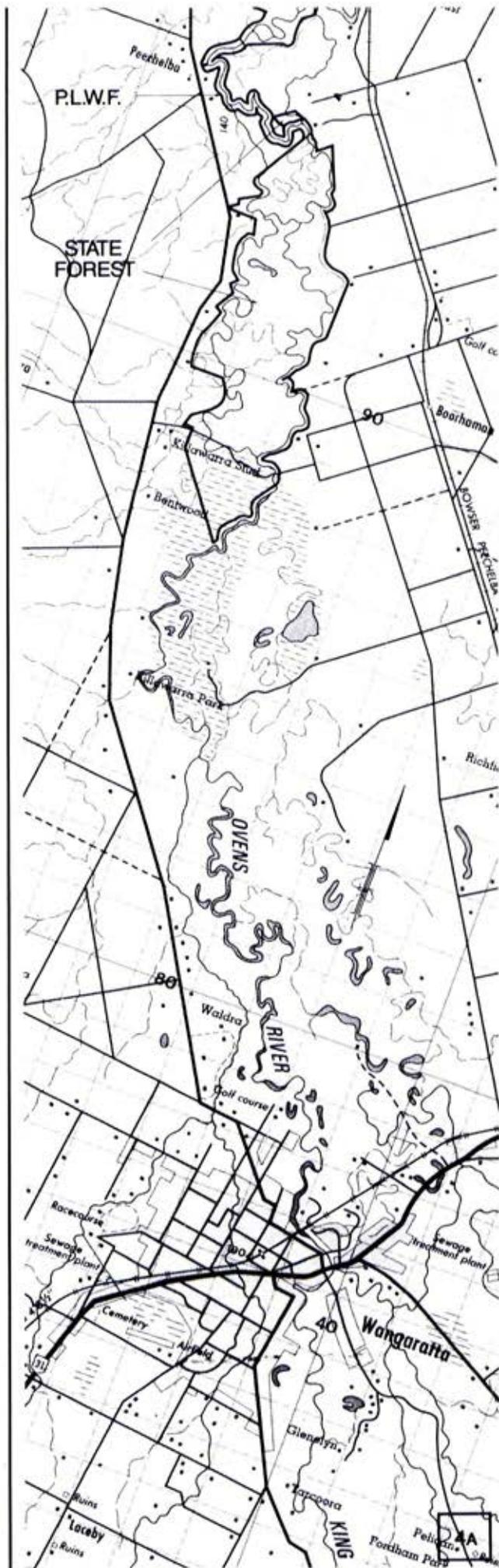
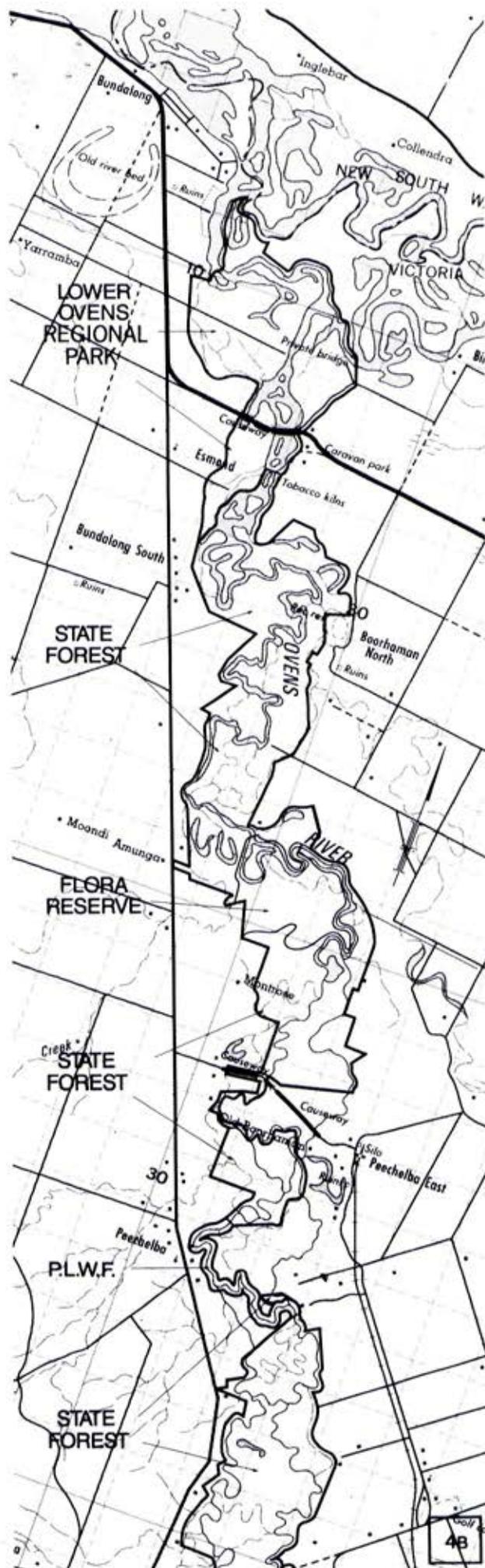


A1 - MITTA MITTA RIVER Sheet 1  
Scale 1:100 000

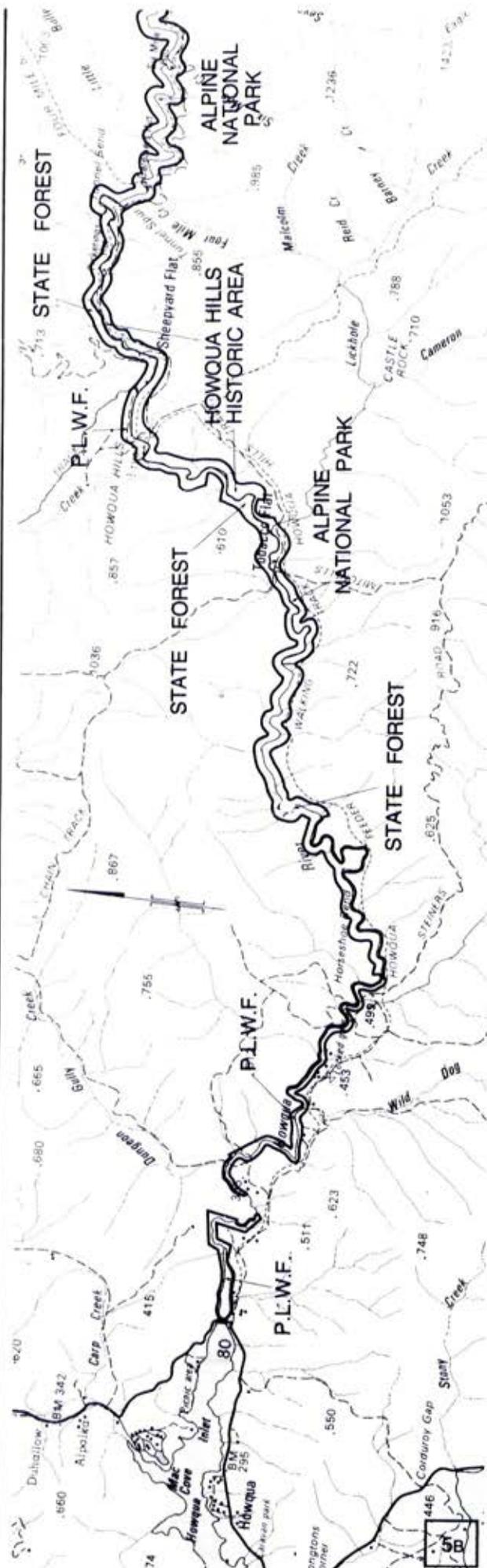
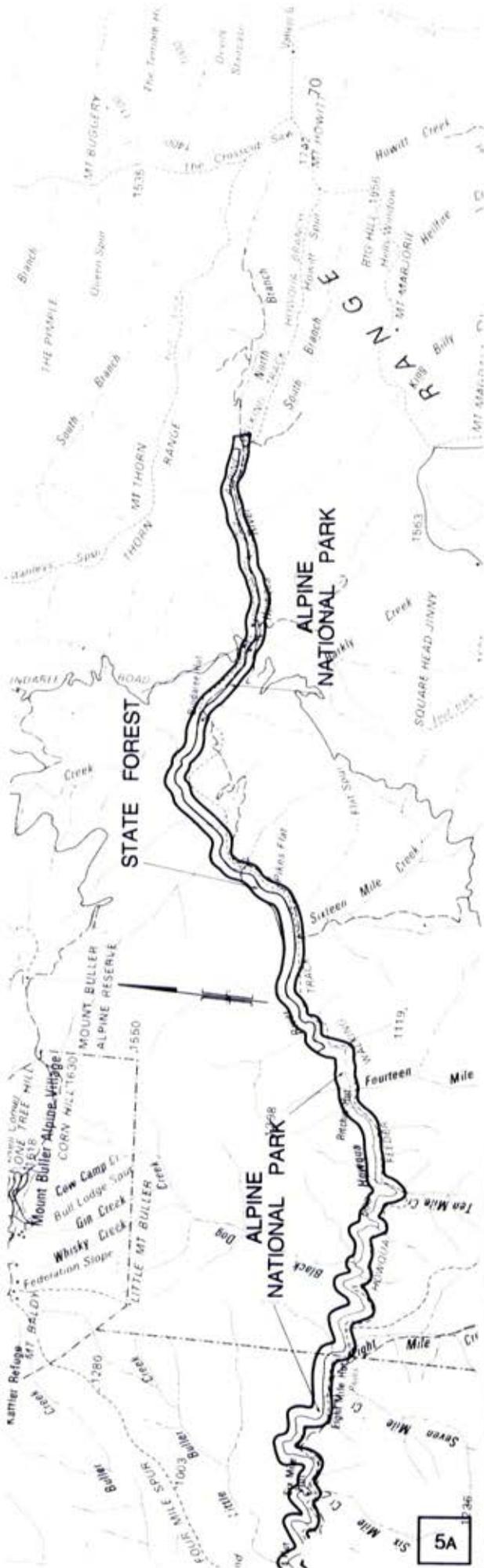


A1 - MITTA MITTA RIVER Sheet 2

Scale 1:100 000



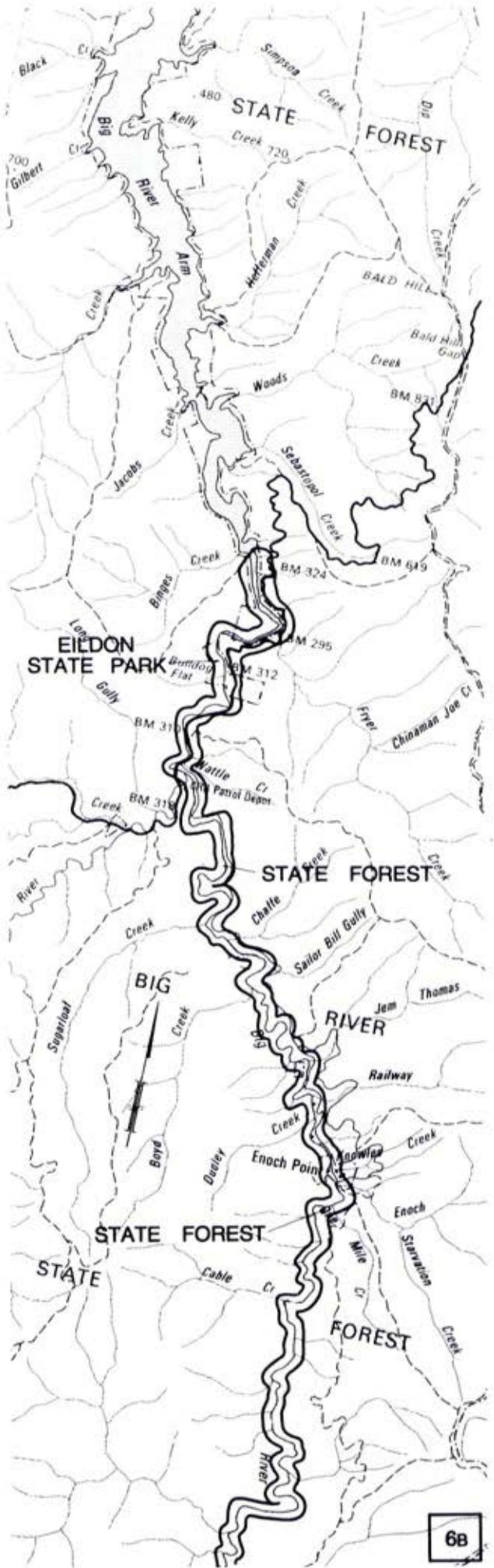
A2 - OVENS RIVER  
Scale 1:100 000



A3 - HOWQUA RIVER  
Scale 1:100 000

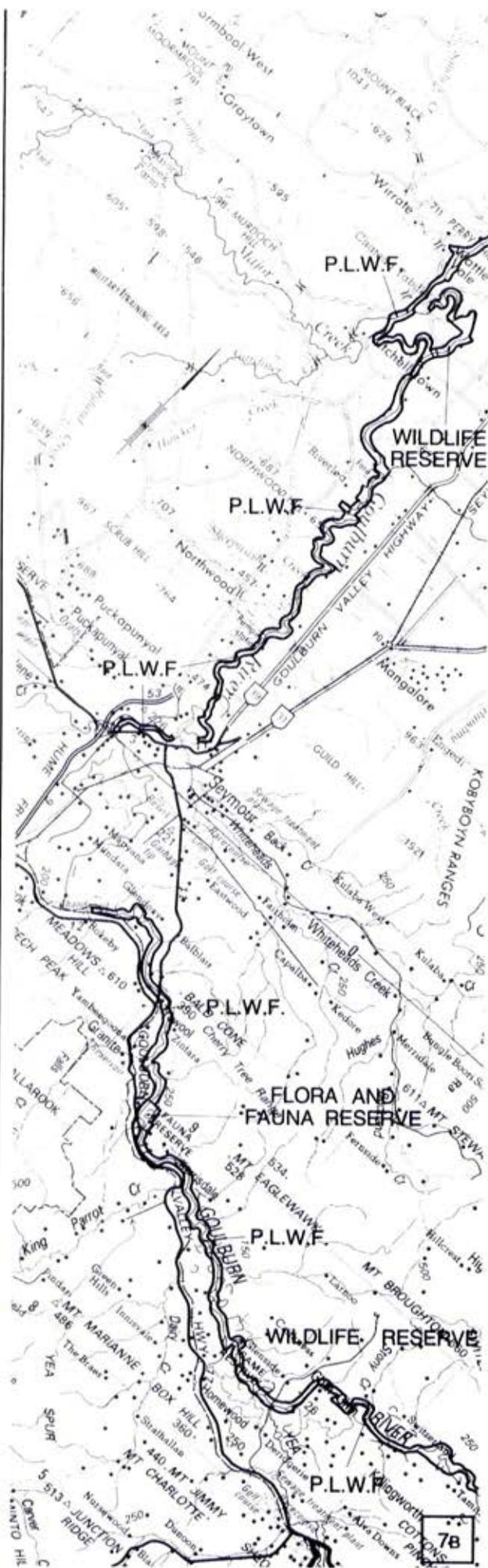
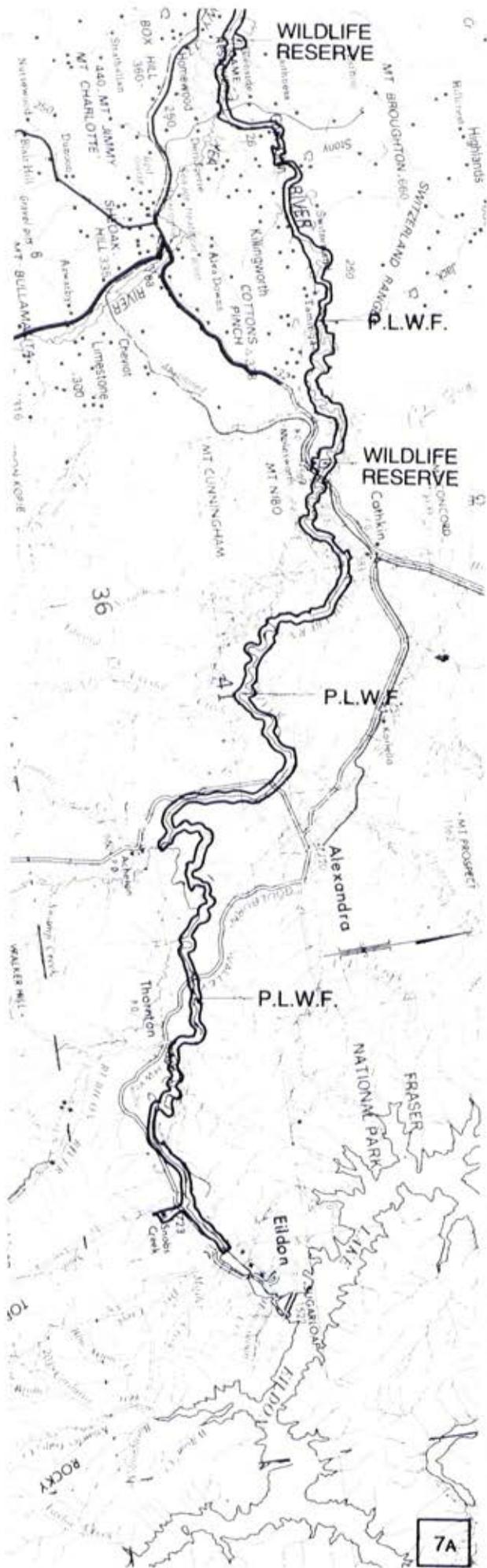


6A



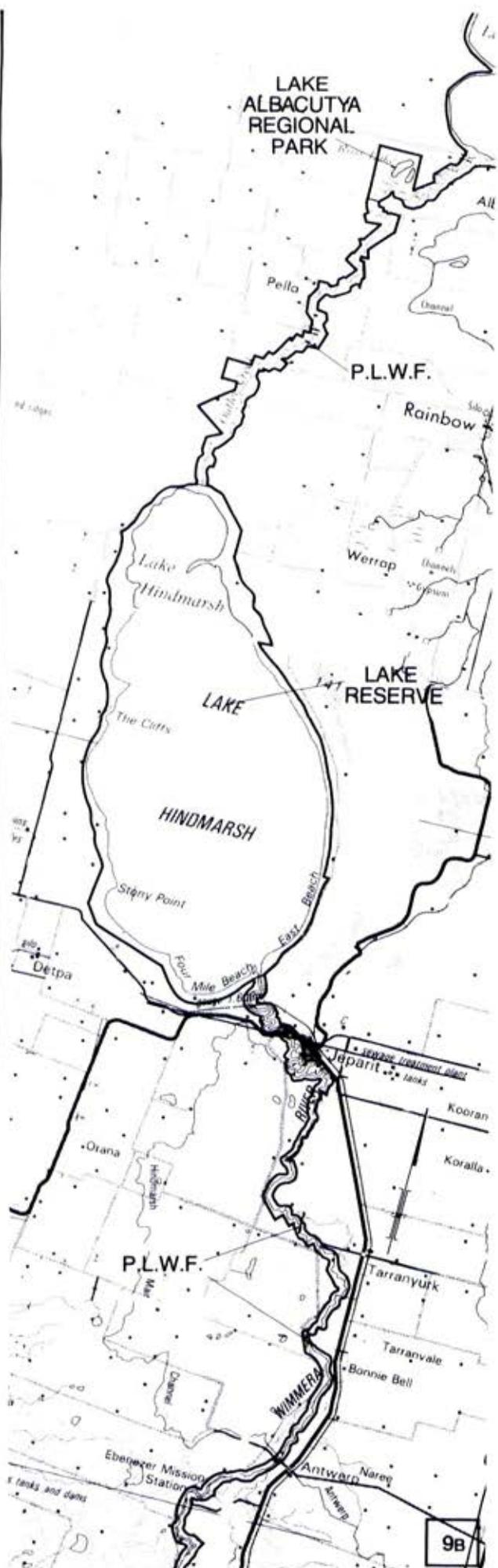
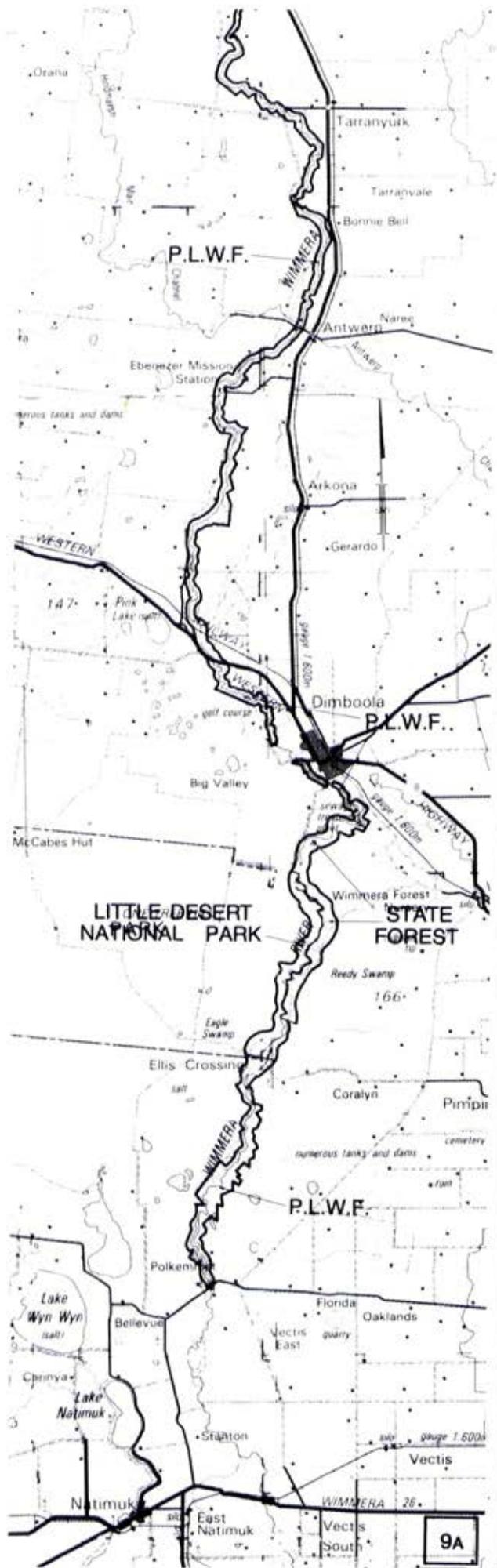
6B

A4 - BIG RIVER  
Scale 1:100 000



A5 - GOULBURN RIVER Sheet 1  
Scale 1:250 000

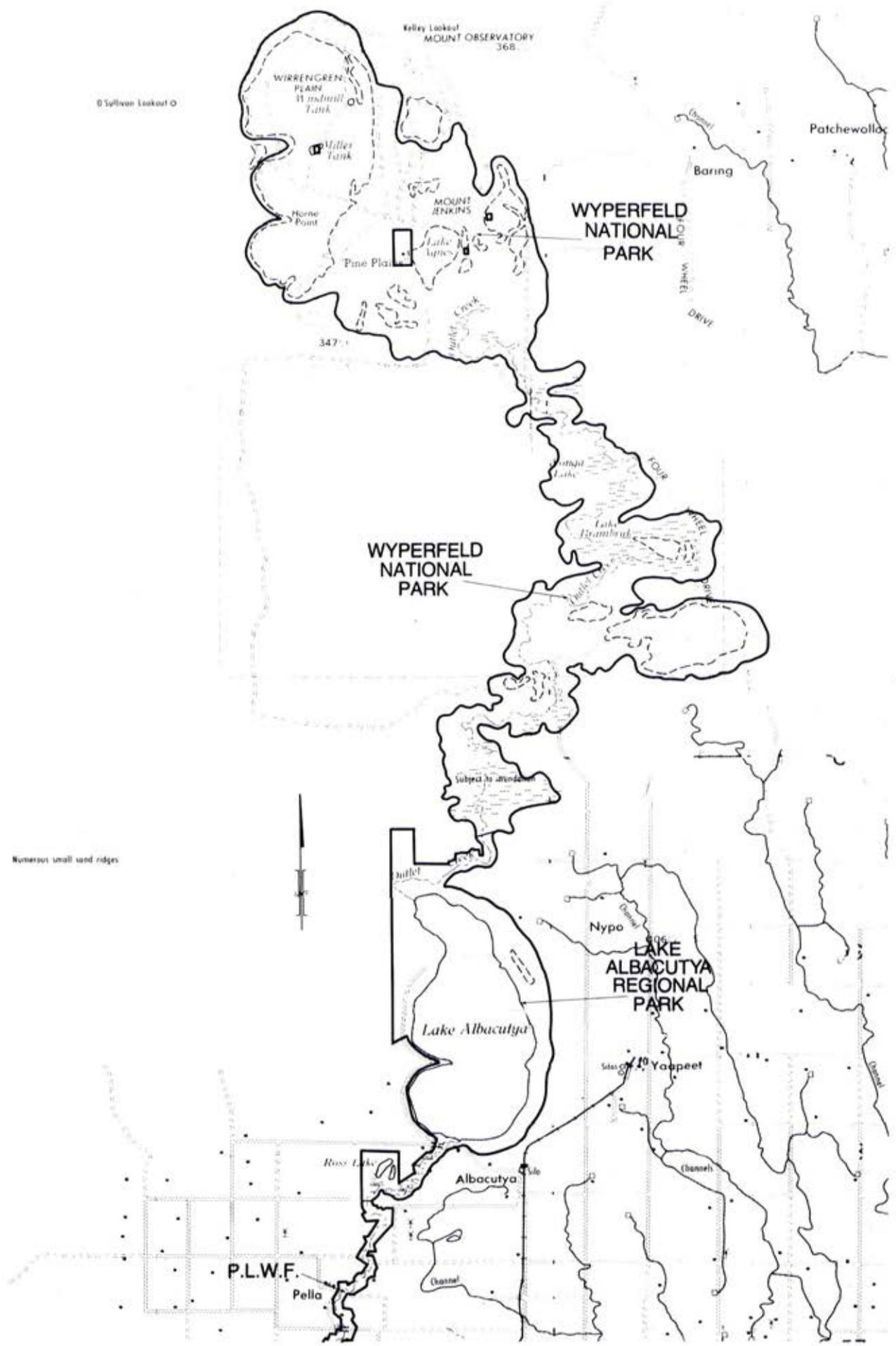




A6 - WIMMERA RIVER Sheet 1

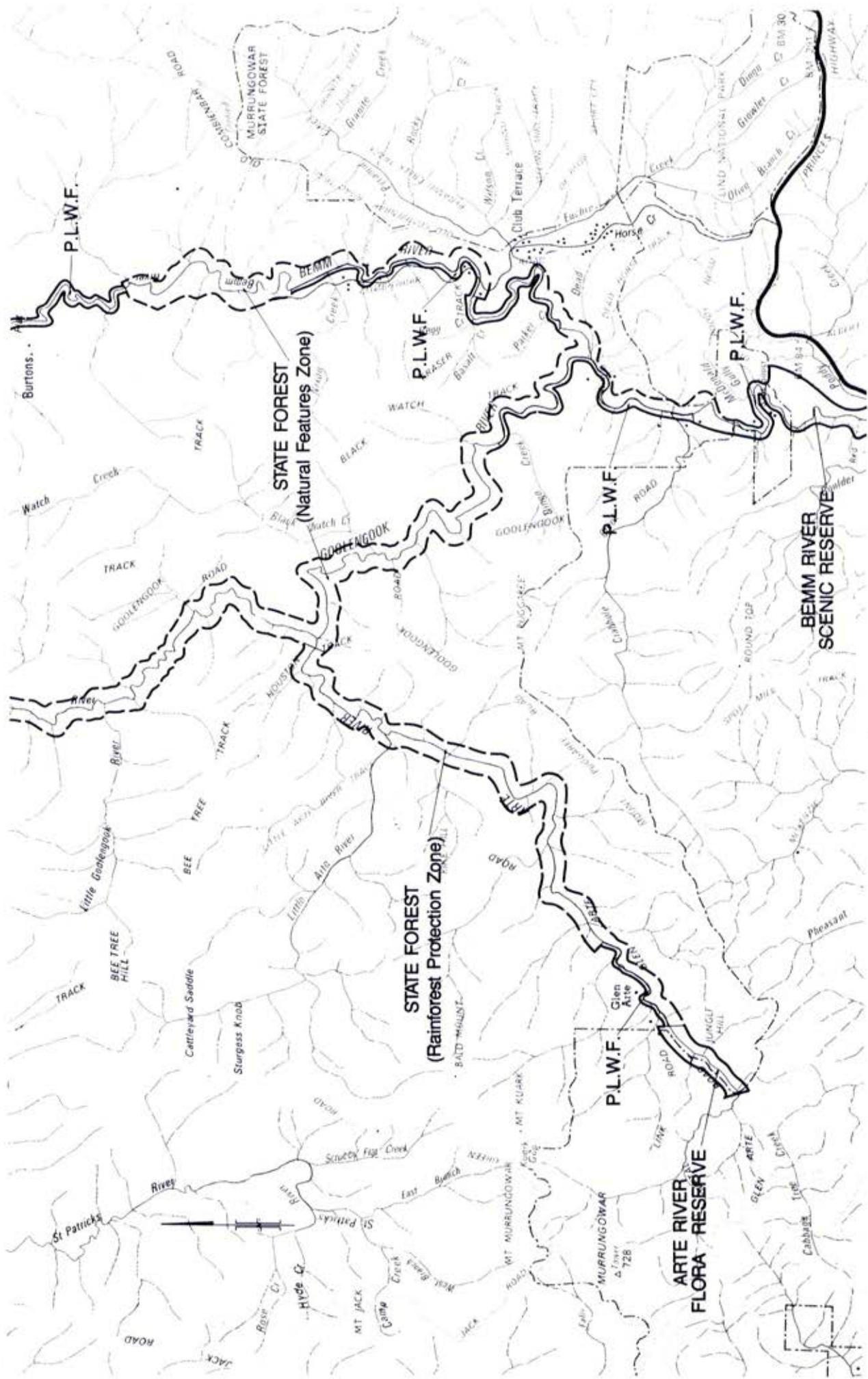
Scale 1:250 000

MAP 9

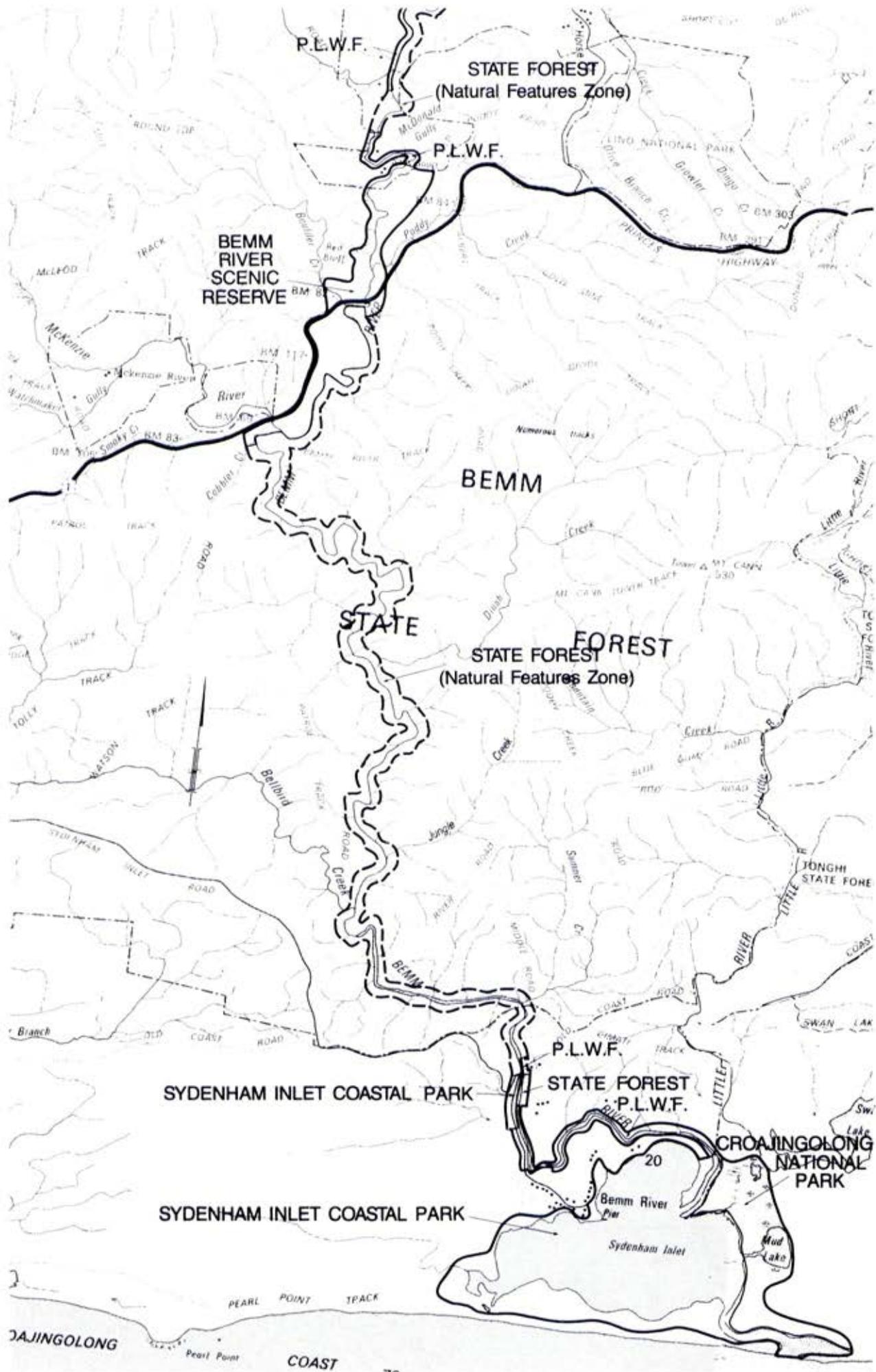


A6 - WIMMERA RIVER Sheet 2  
 Scale 1:250 000



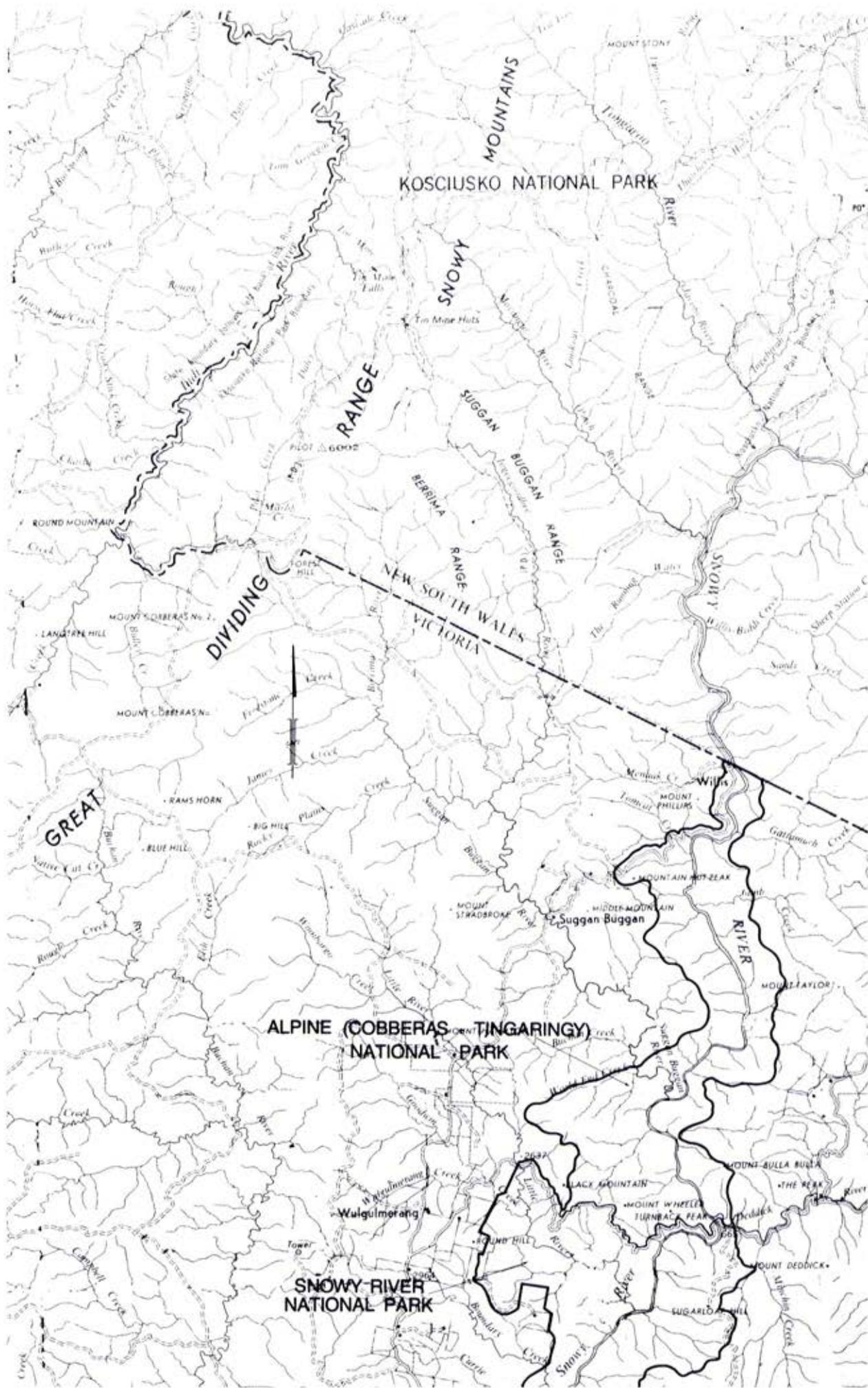


A7 - BEMM RIVER Sheet 2  
 Scale 1:100 000



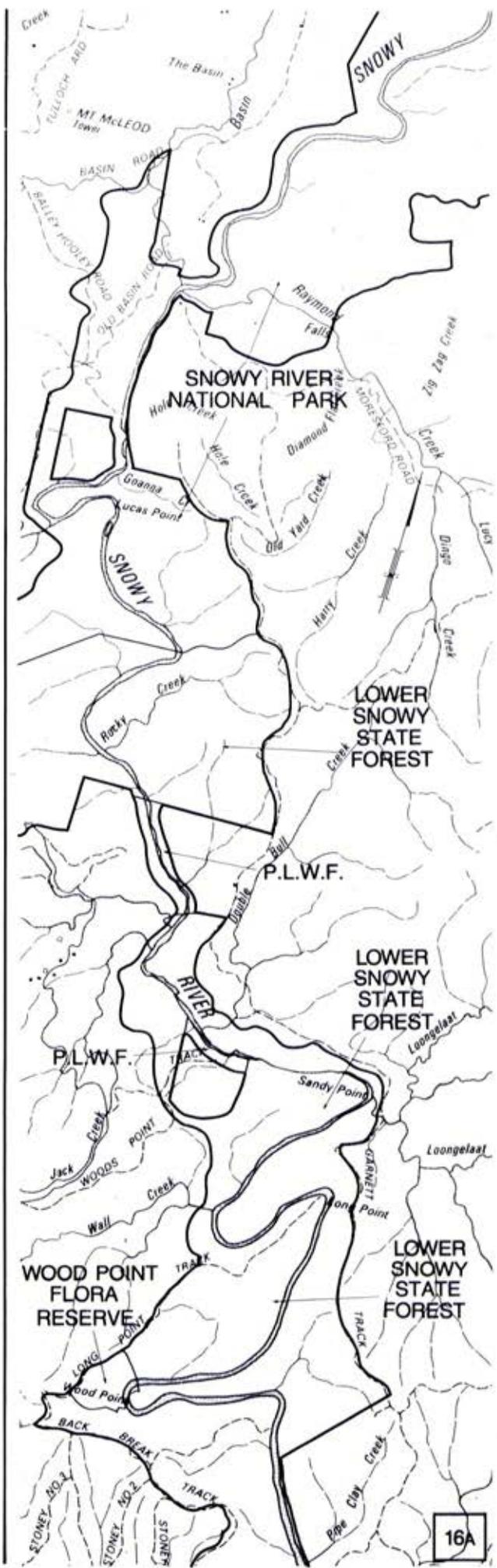
A7 - BEMM RIVER Sheet 3

Scale 1:100 000

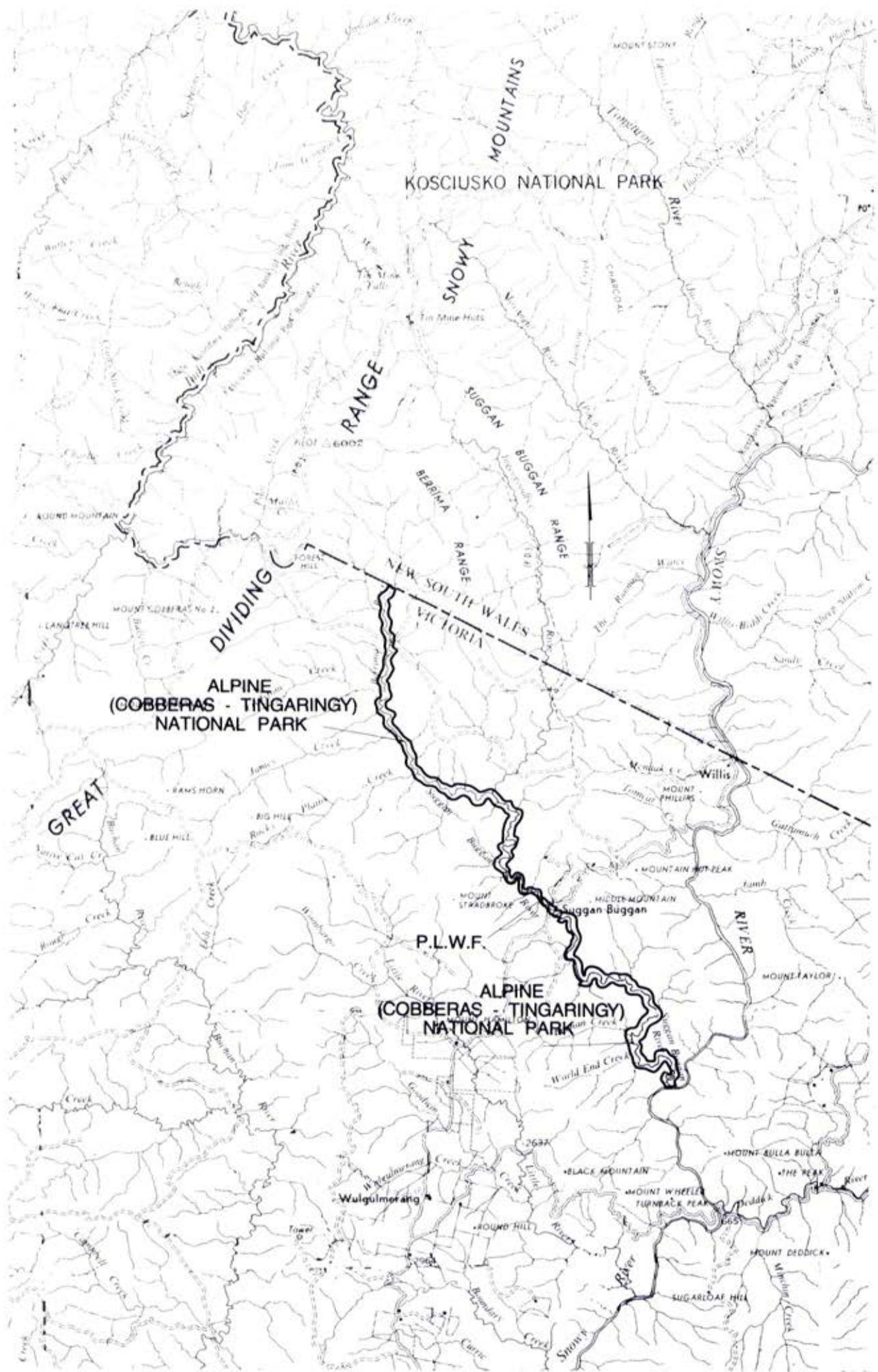


A8 - SNOWY RIVER Sheet 1  
 Scale 1:250 000





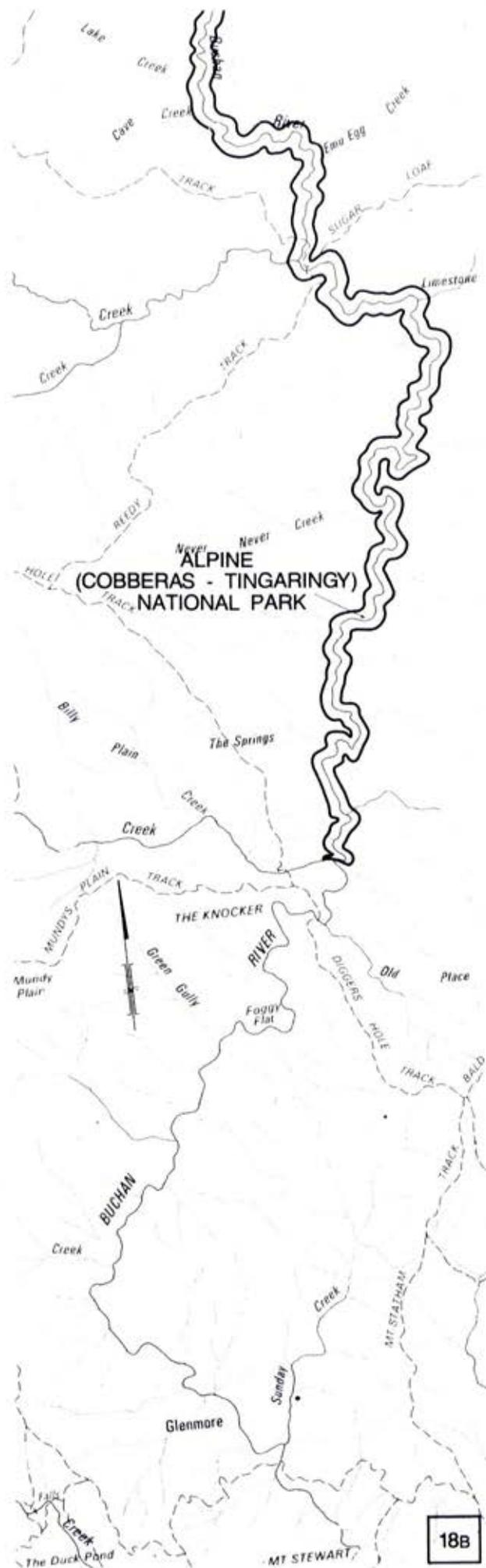
A8 - SNOWY RIVER Sheet 3  
Scale 1:100 000



**A9 - SUGGAN BUGGAN AND BERRIMA RIVERS**

Scale 1:250 000

**MAP 17**

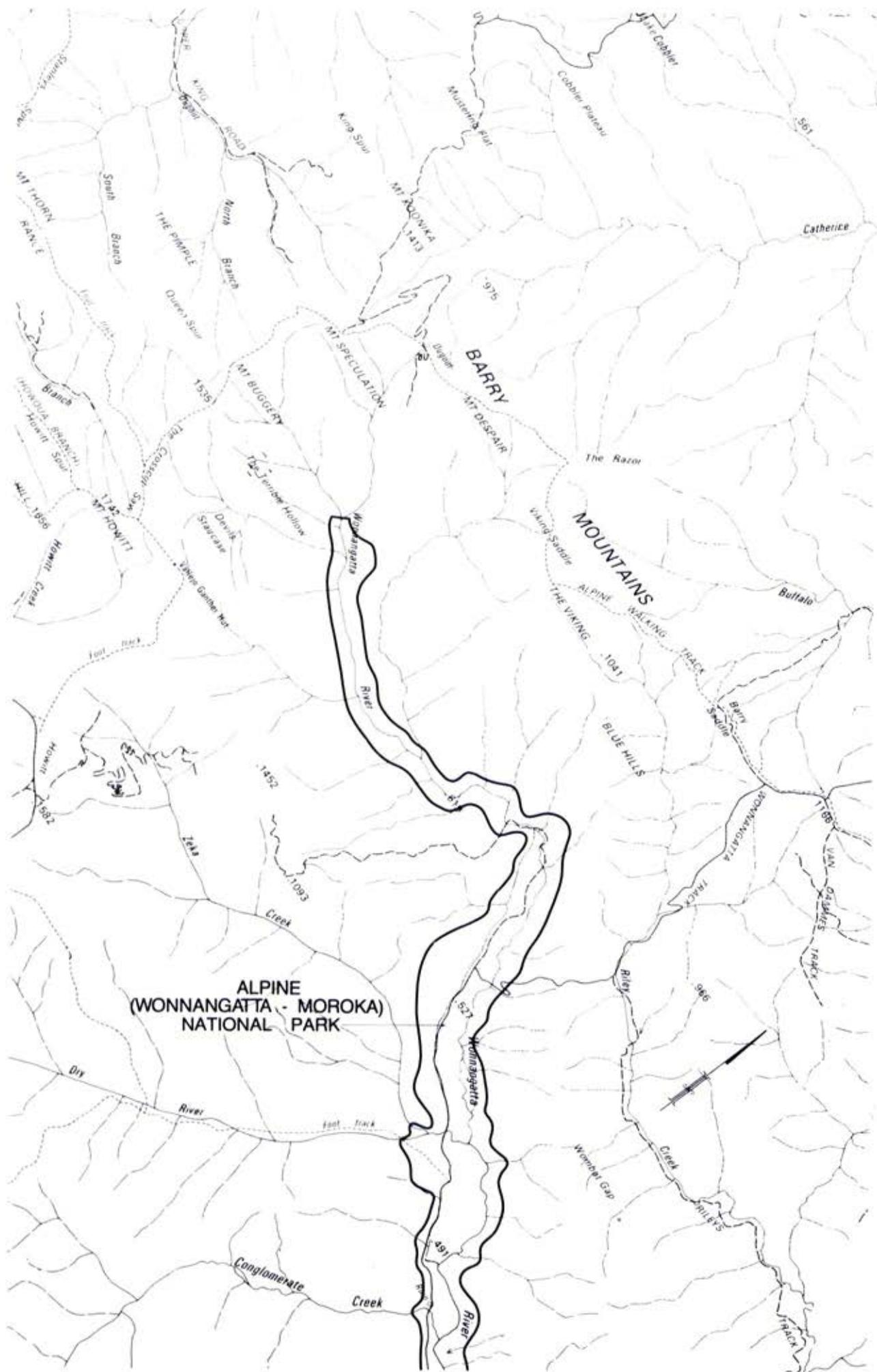


18B



18A

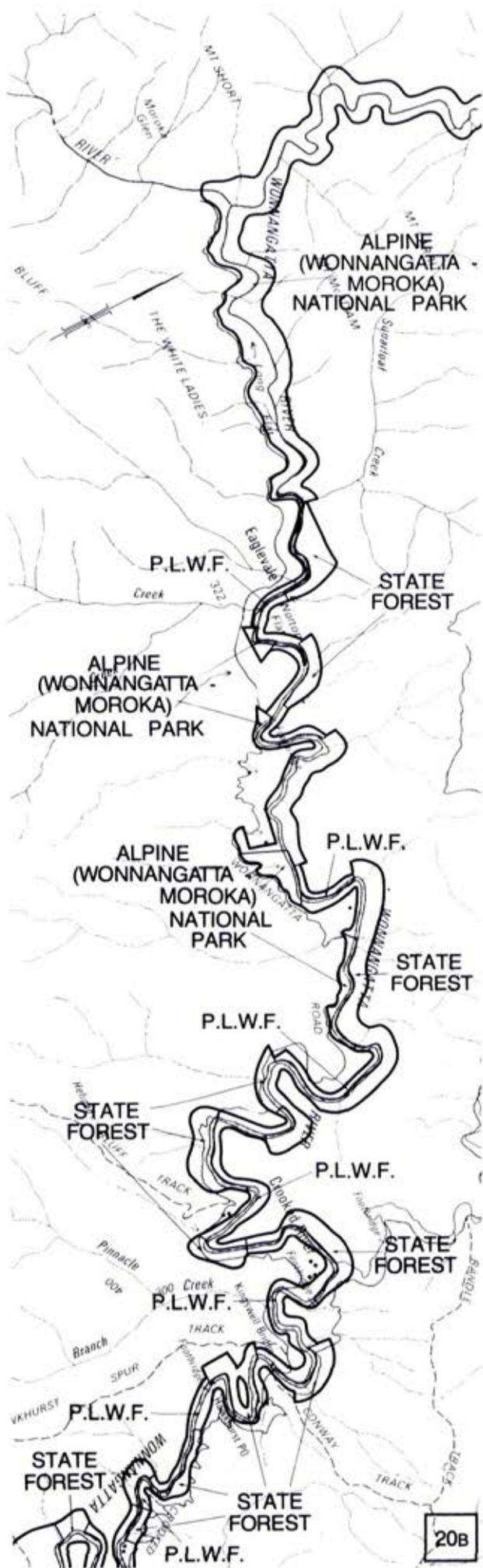
A10 - UPPER BUCHANAN RIVER  
Scale 1:100 000

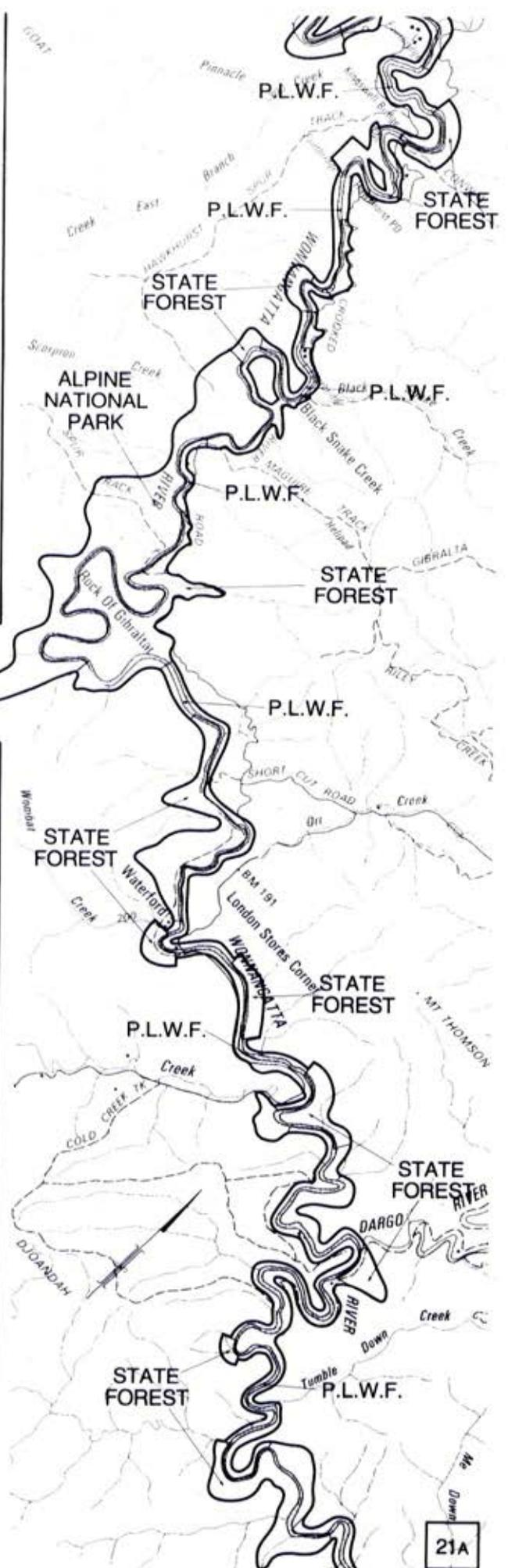
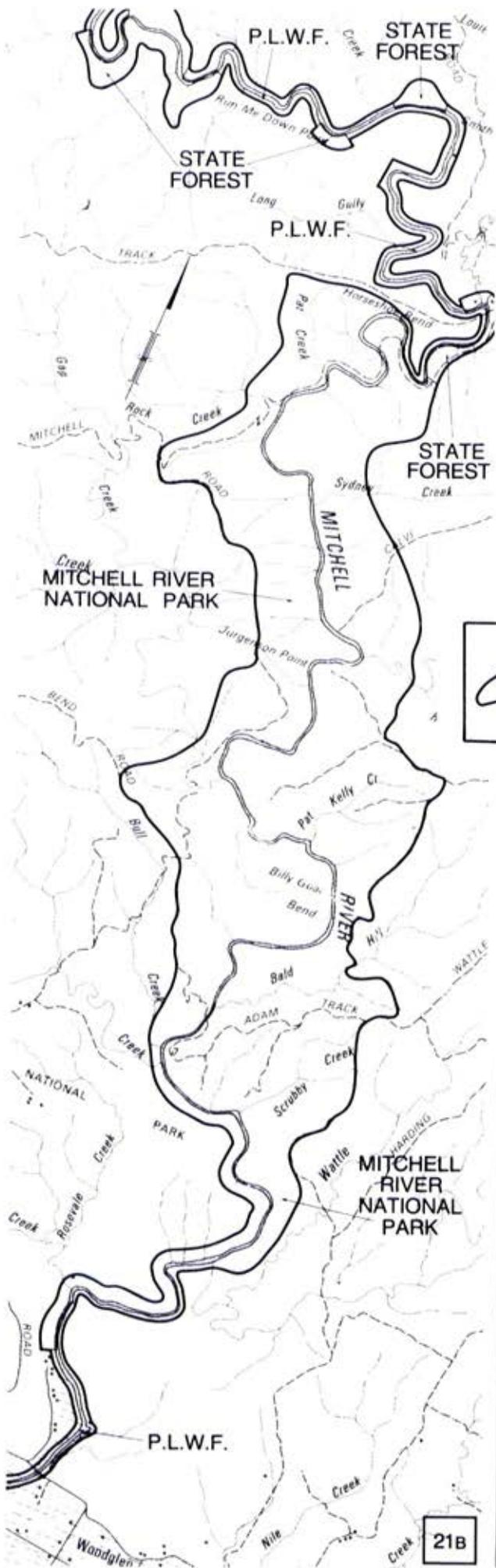


A11 - MITCHELL AND WONNANGATTA RIVERS Sheet 1

Scale 1:100 000

MAP 19

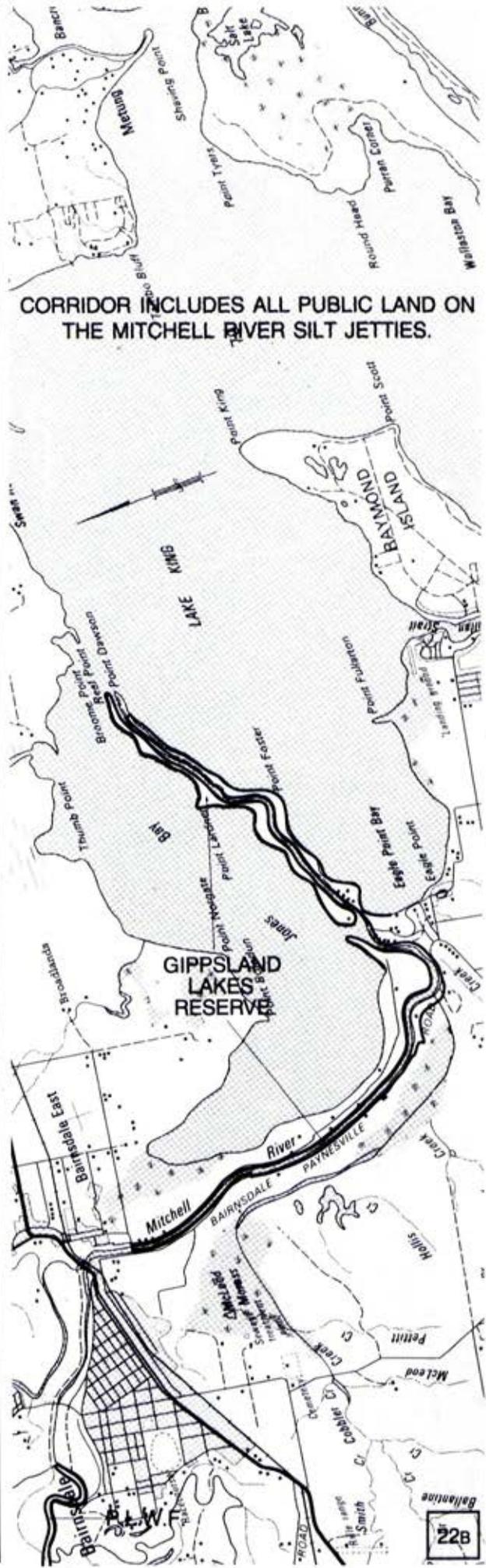




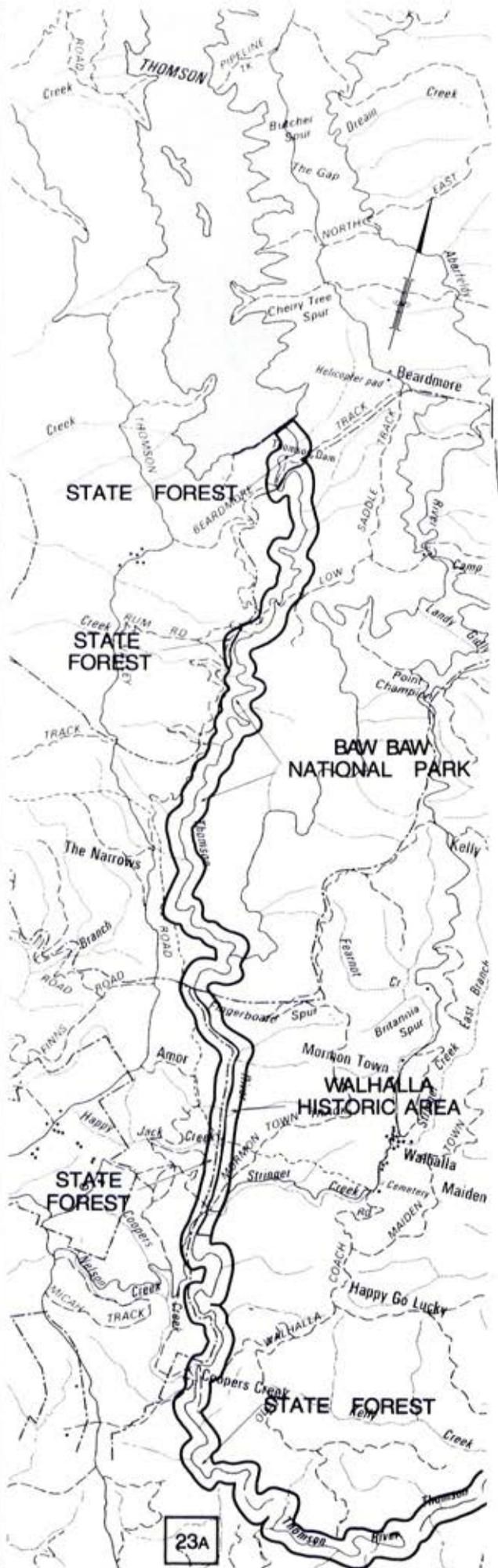
A11 - MITCHELL AND WONNANGATTA RIVERS Sheet 3

Scale 1:100 000

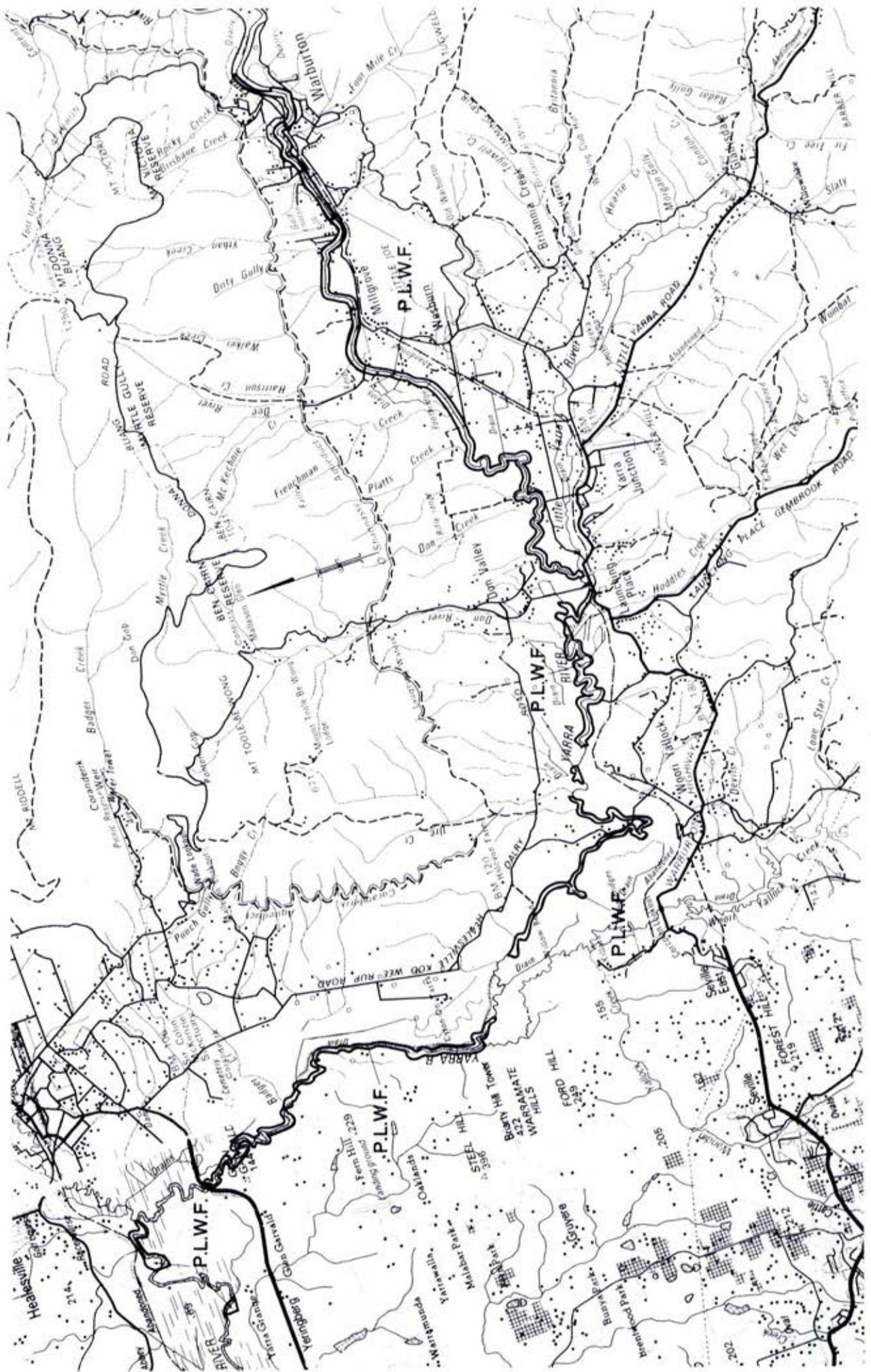
MAP 21



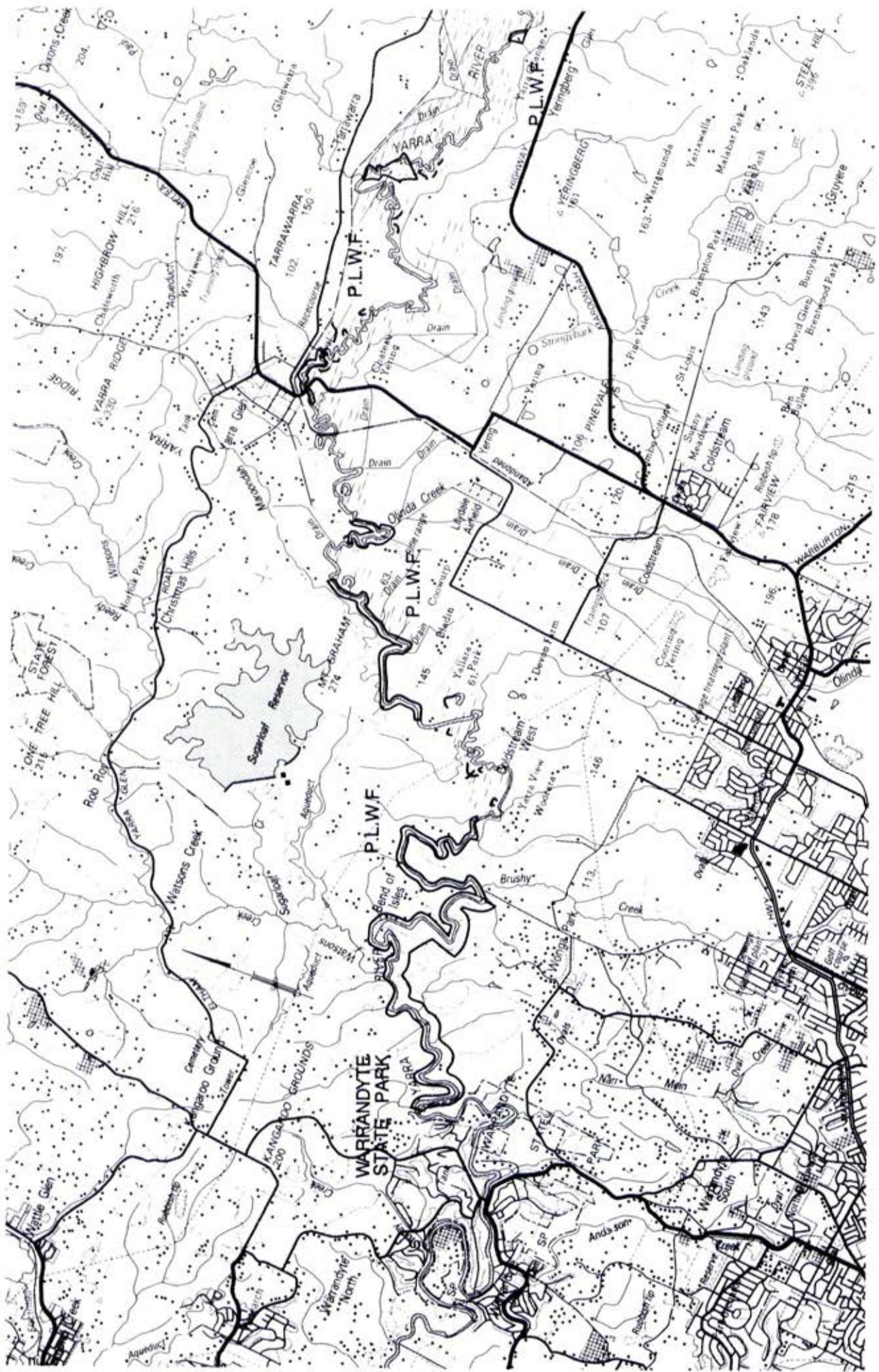
CORRIDOR INCLUDES ALL PUBLIC LAND ON THE MITCHELL RIVER SILT JETTIES.



**A12 - THOMSON RIVER**  
 Scale 1:100 000

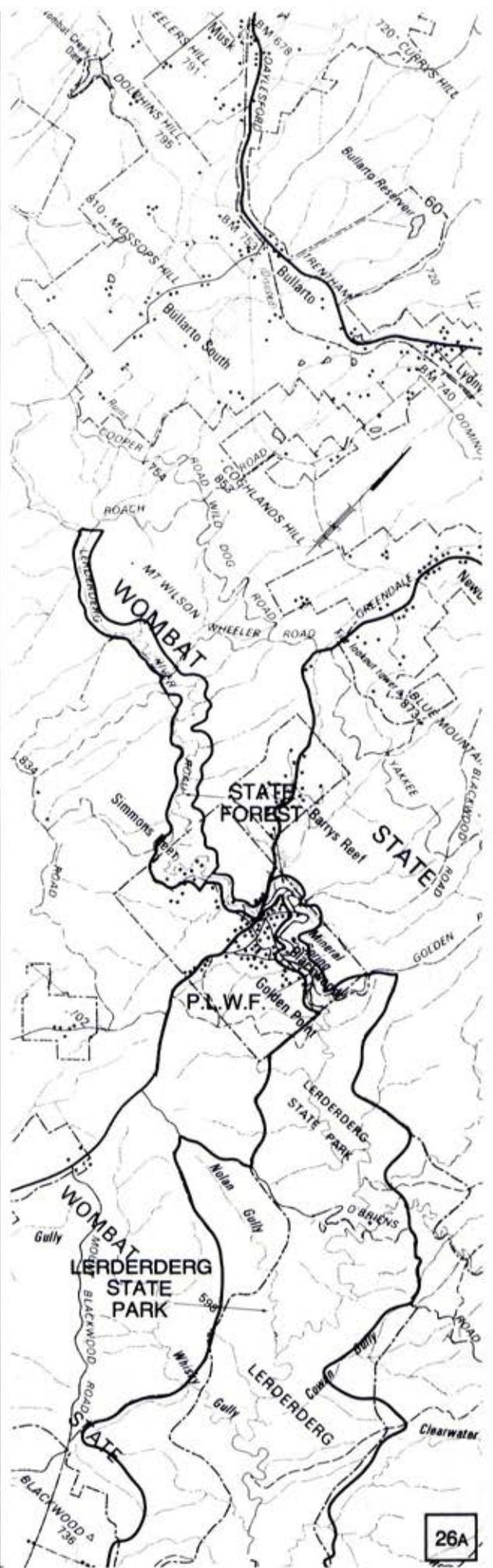


A13 - YARRA RIVER Sheet 1  
 Scale 1:100 000

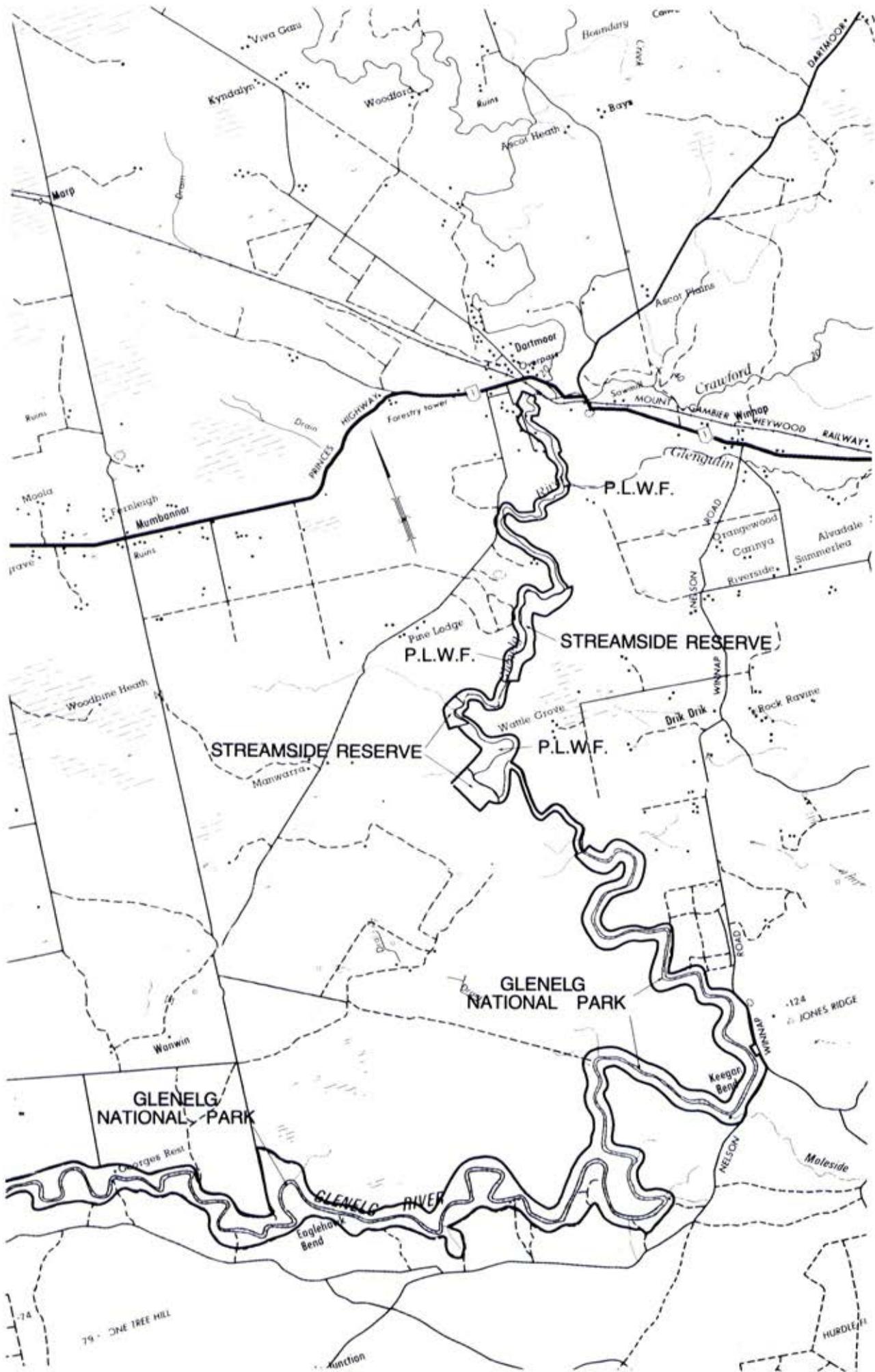


A13 - YARRA RIVER Sheet 2

Scale 1:100 000



A14 - LERDERDERG RIVER  
Scale 1:100 000



A15 - GLENELG RIVER Sheet 1  
 Scale 1:100 000





LEGEND	
<b>HERITAGE RIVERS</b> 	<p><b>A1</b> Mitta Mitta River; Glen Valley to Lake Dartmouth (Maps 2, 3)</p> <p><b>A2</b> Ovens River; Kilawarra to Lake Mulwala (Map 4)</p> <p><b>A3</b> Howqua River; junction of north and south branches to Lake Eldon (Map 5)</p> <p><b>A4</b> Big River; junction of Spring and Oaks Creeks to the junction of Fryer Creek and Big River Arm, Lake Eldon (Map 6)</p> <p><b>A5</b> Goulburn River; Lake Eldon to Murray River (Maps 7, 8)</p> <p><b>A6</b> Wimmera River; Polemmet Bridge to Warriglen Plain (Maps 9, 10)</p> <p><b>A7</b> Berrim River; Goolengook River (from headwaters), Arco River (from Glen Arco Road) and Errindundra River (from headwaters of East Branch); upper reaches to the sea (Maps 11, 12, 13)</p>
<b>ESSENTIALLY NATURAL CATCHMENTS</b> 	<p><b>B1</b> Red and Benedore Rivers, Shipwreck, Seal and Easty Creeks</p> <p><b>B2</b> Rodger River and Mountain Creek</p> <p><b>B3</b> Avon, Turton and Dolodrook Rivers, Ben Cruachan Creek</p> <p><b>B4</b> O'Shannassy River</p> <p><b>B5</b> Log Bridge Creek - East Branch</p> <p><b>B6</b> Front Creek</p> <p><b>B7</b> Mount Tabor Creek</p> <p><b>B8</b> Banimboola Creek</p> <p><b>B9</b> Devils Creek - Middle Branch</p> <p><b>B10</b> Warrumbula Creek</p> <p><b>B11</b> Long Jack Creek</p> <p><b>B12</b> South Bulter Creek</p> <p><b>B13</b> Williams Creek</p> <p><b>B14</b> Double Creek</p> <p><b>B15</b> Unnamed Inlet to Genoa River</p> <p><b>B16</b> Winrol Creek</p> <p><b>B17</b> Errindundra River - East Branch</p> <p><b>B18</b> Gattamurh Creek</p> <p><b>B19</b> Swamp Creek</p> <p><b>B20</b> Wallaby Creek</p> <p><b>B21</b> Mount Gelarney Creek</p> <p><b>B22</b> Cawender Creek</p> <p><b>B23</b> Musk Creek</p> <p><b>B24</b> Brodribb River headwaters</p> <p><b>B25</b> Stony Creek</p> <p><b>B26</b> Warrungarra River headwaters</p> <p><b>B27</b> Blue Flag Creek</p> <p><b>B28</b> Pinnacle Creek - East Branch</p> <p><b>B29</b> Funcher Creek</p> <p><b>B30</b> Mount Vreker Creek</p>
<b>REPRESENTATIVE RIVERS</b> 	<p><b>C1</b> Upper Big River (above Glen Valley)</p> <p><b>C2</b> Snowy Creek</p> <p><b>C3</b> Dargo River</p> <p><b>C4</b> Macalister River (Glencam)</p> <p><b>C5</b> Buchan River (above Mellick Munjick Creek)</p> <p><b>C6</b> Thurra River</p> <p><b>C7</b> Nicholson River</p> <p><b>C8</b> Cornella Creek</p> <p><b>C9</b> Acca River (Acca)</p> <p><b>C10</b> Lerderberg River (O'Briens Crossing)</p> <p><b>C11</b> McCullum Creek</p> <p><b>C12</b> Callalander River (Carlisle River)</p> <p><b>C13</b> Tarras River (Yarram)</p> <p><b>C14</b> Kennedy Creek</p> <p><b>C15</b> Dardak Creek</p> <p><b>C16</b> Moorabool River (Morrison)</p>

## PROPOSED RECOMMENDATIONS

### Rivers and Streams Special Investigation

1 : 1 000 000

- Notes :**
- Detailed plans of the Essentially Natural Catchments B1 - B30 are available on request from the Land Conservation Council.
  - Category E — Public Land Water Frontage Reserves — are not shown on this map. Refer to Map 5 in the Rivers and Streams Resources Report (September 1989) or the detailed plans in each of the Council's past final recommendations.