


RIVERS AND STREAMS

SPECIAL INVESTIGATION

FINAL RECOMMENDATIONS



 LAND CONSERVATION COUNCIL

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JUNE 1991

LAND CONSERVATION COUNCIL

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Cover Photograph

*The Snowy - a recommended Victorian heritage river,
from the Bonang--Gelantipy Road.*

Photograph provided by Doug Hooley

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CONTENTS

		Page
Introduction ..		1
A.	Victorian heritage rivers ..	21
A1	Mitta Mitta River ..	34
A2	Ovens River ..	36
A3	Howqua River ..	39
A4	Big River ..	41
A5	Goulburn River ..	45
A6	Wimmera River ..	49
A7	Genoa River ..	55
A8	Bemm, Goolengook, Arte and Errinundra Rivers ..	57
A9	Snowy River ..	60
A10	Suggan Buggan and Berrima Rivers ..	65
A11	Upper Buchan River ..	67
A12	Mitchell and Wonnangatta Rivers ..	69
A13	Thomson River ..	76
A14	Yarra River ..	79
A15	Lerderderg River ..	82
A16	Aire River ..	85
A17	Glenelg River ..	88
A18	Murray River ..	91
B.	Essentially natural catchments ..	93
B1	Red and Benedore Rivers, Shipwreck, Seal and Easby Creeks catchment ..	98
B2	Rodger River and Mountain Creek catchment ..	99
B3	Avon, Turton and Dolodrook Rivers, Ben Cruachan Creek catchment ..	101
B4	O'Shannassy River catchment ..	102
B5-B26	Isolated catchments ..	103
C.	Representative rivers ..	105
D.	Other river uses and values ..	111
E.	River frontages, bed and banks ..	114
F.	Management guidelines and policy recommendations ..	123
F1	Recreation ..	123
F2	Nature conservation ..	129

F3	Cultural heritage	..	..	..	..	..	..	..	..	..	..	135
F4	Visual resources	..	..	..	..	..	..	..	..	..	..	138
F5	Flow regulation	..	..	..	..	..	..	..	..	..	..	141
F6	Environmental and recreational water requirements	..	..	..	..	..	..	..	..	..	..	144
F7	Water use efficiency	..	..	..	..	..	..	..	..	..	..	146
F8	Environmental quality	..	..	..	..	..	..	..	..	..	..	148
F9	Waterway management	..	..	..	..	..	..	..	..	..	..	156
F10	Utilities and survey	..	..	..	..	..	..	..	..	..	..	162
F11	Mineral and stone production	..	..	..	..	..	..	..	..	..	..	165
Glossary of terms	..	..	..	..	..	..	..	..	..	..	..	173
References	..	..	..	..	..	..	..	..	..	..	..	177
Appendices	..	..	..	..	..	..	..	..	..	..	..	181
I	List of Submissions	..	..	..	..	..	..	..	..	..	..	181
II	Extract from the social and economic appraisal	..	..	..	..	..	..	..	..	..	..	184
III	Recommendations for essentially natural third-order catchments	..	..	..	..	..	..	..	..	..	..	195
IV	Representative rivers	..	..	..	..	..	..	..	..	..	..	197
V	River and stream values	..	..	..	..	..	..	..	..	..	..	200
VI	Conservation status of native fresh-water fish species	..	..	..	..	..	..	..	..	..	..	208
Maps												
1	Final recommendations	..	..	..	..	..	..	..	..	..	..	back pocket
A1-A17	Victorian heritage rivers	..	..	..	..	..	..	..	..	..	..	follow text

INTRODUCTION

The Land Conservation Council, Victoria - established by the *Land Conservation Act 1970* - carries out investigations and makes recommendations to the Minister for Conservation and Environment 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 water use, the harvesting of forest produce and mineral extraction. Under its *Act* the Council is required to take into account the social and economic effects of its recommendations, and that has been done for this Investigation.

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.

The Council then formulated its Proposed Recommendations, and published them in November 1990 to provide a basis for public comment. Copies were distributed to all who made submissions on the Resources Report. A further submission period followed, and a list of those who made submissions is provided in Appendix I. Council's response to submissions is given below.

These Final Recommendations are the next stage of the process followed by the Council in accordance with the *Land Conservation Act 1970*. They will be presented to the Minister for Conservation and Environment for consideration by the government.

Recommendations approved by the government will be implemented by the relevant land and water managers. The Council's role is public land use planning; it does not have a role in ongoing management, beyond proposing broad management guidelines that are intended to clarify recommendations for the use of land.

Availability of submissions

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

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, 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 off-stream 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, ecological and cultural heritage 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. The availability of water, which with minimal treatment is suitable for drinking, is becoming a pressing issue around the world.

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 determining appropriate water and associated land use.

Increases in population and leisure time are likely to place greater 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. The Council has identified two major objects:

- * To identify streams with outstanding values and to seek to protect them, bearing in mind any social and economic implications
- * To highlight the values of all streams in Victoria and to encourage their restoration and management with the involvement of local communities, in the context of a whole catchment approach

These recommendations should not be viewed as a comprehensive plan for dealing with every issue relating to Victorian Rivers. They are only part of a larger set of initiatives and strategies relating to the use of water and the protection and management of streams, catchments and water resources.



Goulburn Weir - significant cultural heritage feature

In relation to this, the Council strongly supports the concept of a whole catchment approach in addressing river and catchment management and restoration issues. The *Water Act 1989* also sets this as one of several planning aims. However, while supporting this approach, the Council can only make recommendations about public land within catchments and associated with streams and therefore these recommendations can only be part of an overall strategy dealing with streams and catchments.

The Council is not a land managing body; its primary function is to make recommendations to the Victorian Government on the use of public land in order to provide for the balanced use of land in Victoria. It is up to the Government as to whether it will accept these recommendations.

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 recommendations embrace water as an important resource whose quality, quantity, and environmental

condition is directly related to the management of land.

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 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

For this investigation, 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 if the same information base and procedures were 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.

The Council has made no recommendations for private land. The recommendations for public land, including rivers and streams and river frontage reserves within the Council's responsibilities, 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.

Other Studies

Various relevant studies are being carried out by other agencies. National and other park management plans, catchment management plans and forest management plans being prepared by the Department of Conservation and Environment, include

the South-western Region Water Management Strategy (now completed), and the Department's Gippsland Water Strategy are of particular relevance. Numerous localised studies are in progress, and these are referred to where relevant in the following recommendations.

The Council has used information collected for these studies, where relevant, and vice versa. There has been coordination of external studies to ensure duplication did not occur.

In relation to the relative timing of completion of studies, there has been some concern about overlapping study timetables, especially for those studies in Gippsland. It should be noted that from the outset the Gippsland (previously the South-east Region) Water Strategy specified that identification of heritage rivers was one of the necessary inputs to its Task Force considerations. Ultimately, decision on these various studies are made by the government, and where appropriate, parliament.

Information sources

In formulating its 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 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-west and Gippsland Water Management Strategies; and 'Water Victoria: an Environmental Handbook', and 'Water Victoria: a Resource Handbook', both prepared by that Department.

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 Housing Library, Ground Floor, 477 Collins Street, Melbourne, and purchased from the bookshop at the same address. 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 in the Report showing the values, use as a base the Australian Water Resources Council (AWRC) river basins (see glossary). The recommendations for Victorian heritage rivers, essentially natural catchments and other stream values in Appendix V are listed in river basin order.

Social and Economic Assessment

To assist in assessing the implications of its recommendations, Council commissioned a study by consultants: Read Sturgess 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 recommendations.

Extracts from the appraisal are provided in this volume for each Victorian 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 inter-library loan from the Department of Planning and Housing Library, or can be inspected at the Council's offices.

The Council is aware that there is ongoing community debate regarding the usefulness of the contingent valuation method to assign monetary values to non-market goods and services. The values obtained from the methodology are perceived by some as unrealistic and the techniques used to derive the figures are seen as open to various forms of bias. The consultants recognised these limitations in their report and discussed in detail the assumptions, qualifications and sources of bias in this approach.

The Council therefore recognises that the dollar estimates for environmental attributes derived by the consultants should be used with caution and bearing in mind the assumptions made. This is why the Council avoided a direct comparison of the dollar values for resource implications and environmental attributes but has only used the consultants' data to identify those rivers and catchments where a more detailed evaluation of the range of values and issues was needed, to assist in forming a judgement about its land-use recommendations.

It should not be assumed that the Council necessarily endorses contingent valuation as the most appropriate method, but it is relevant to note that no-one has suggested a better technique to the Council for quantifying environmental values.

The question might be asked as to why the Council should be attempting to obtain a dollar value for environmental attributes? First, the *Land Conservation Act 1970* requires the Council to take social and economic factors into account; and secondly, for too long, land use decisions have been made without any information on the monetary values of environmental attributes being considered.

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 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 rivers, these recommendations have no implications for resource use beyond the existing approved recommendations applying to frontage reserves.

These recommendations specify that the provision of environmental and recreational water requirements 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 Victorian

heritage rivers conform with the existing Council policy. Under this policy (see section F11), unless specifically excluded (reference areas, 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 recommended 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 Victorian heritage river the consultants interviewed relevant departmental officers and representatives from companies involved in large proposals. The results indicated 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 off-stream storage. The Gippsland route for the Very Fast Train, then under consideration, would have crossed the Mitchell and Snowy river corridors.

Council's Response to Submissions

During the public consultation period following the publication of the Resources Report, Council received 75 submissions on the future use of rivers and streams in Victoria, and over 30 subsequent letters that provided further information, opinions, and comment.

Following publication of the Proposed Recommendations the Council received a further 132 submissions up to the closure of the consultation period and some 45 subsequent letters (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 various river values and potential uses and conflicts.

During the submission periods Council met with representatives from many organisations across the State with an interest in rivers in general, and in this Investigation. The interest of these organisations and their time, in discussing the Proposed Recommendations, is also acknowledged.

The Resources Report provided a description of the State's rivers and streams, their special values and uses. It also introduced the philosophy of heritage rivers and described other methods of protecting rivers and streams. That report did not include any recommendations.

The Proposed Recommendations report identified certain rivers and streams in the State worthy of protection. Particular categories were proposed, and policies and guidelines for the management of rivers and streams generally outlined. The Proposed Recommendations enabled those wishing to make submissions to focus their comments and to interpret the possible implications of the Council's proposals for particular issues and streams.

The inclusion of issues in the following outline does not necessarily imply Council endorsement or rejection of the opinions expressed. Council is also aware that statements made in submissions may be factually incorrect.

Submissions revealed a widespread concern for the protection of rivers and their associated values. Indeed, many of them suggested additional streams for inclusion in the various categories proposed, principally to afford them and their catchments a greater

level of protection and management than they receive at present.

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. Others provided specific information which assisted Council to clarify its recommendations and guidelines.

In most cases, those that expressed opposition to the association of a stream with a specific category, were principally concerned about the potential impact that its classification might have on a particular form of present or future use.

These Final Recommendations make specific provision for the protection of outstanding



Woolshed Falls, Beechworth - a scenic feature

river corridors and essentially natural catchments. They also seek to improve the quality, condition and protection of values of streams and their frontages across the State and, through the various categories, to indicate priorities for management.

The Council 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 and it has been suggested that the best approach to management of a stream involves the adjacent landholders.

Council acknowledges the role of catchment co-ordinating 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 the Council's charter. These recommendations for public land should therefore be viewed as only part of a range of government and community strategies for rivers and catchments.

Water Supply Catchment protection

In this Investigation, several water authorities have referred in submissions to: catchment protection by essentially natural catchment designation (see Chapter B); the effects of representative river proposals (see Chapter C) on new storage construction; and general comments relating to protection of catchments with a range of land uses. Six Victorian heritage rivers are used for urban water supply, and seven Victorian heritage rivers and 16 essentially natural catchments are within proclaimed water supply catchments. These recommendations will assist in the protection of these water supply catchments.

Three water boards requested additional protection for their respective water supply catchments. Land-use determinations exist for two of these catchments, while the third is proclaimed. The boards' comments have been drawn to the attention of the Department of Conservation and Environment, as implementing their requests is not within the ambit of this Investigation. The recommendations

for representative rivers have been revised in response to comments from several water authorities.

Heritage rivers

A number of groups and submissions discussed the term 'heritage rivers'. Some expressed concern about its possible link with World Heritage listing and the Australian Heritage Commission; others expressed the view that it is the most appropriate term to describe the values that the Council is proposing to protect. The Council believes that it should retain the word 'heritage' but use the term 'Victorian heritage rivers' to clearly indicate that these rivers are to be managed and controlled by Victorians under State legislation. Further discussion on this issue can be found in Chapter A of these recommendations.

Many submissions provided additional information about the values of particular rivers across the State, some of which they considered to be of heritage river status. 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 - Victorian heritage rivers. The detailed descriptions of the recommended heritage rivers also include such information.

While a number of the rivers suggested in submissions have not been recommended as Victorian heritage rivers, the Council has provided for the protection of their identified values (along with those of other streams) in the balance of these recommendations, in particular, in Chapter D. Council agrees with suggestions that all rivers are of value and should be managed as assets of the State. It believes, however, that the degree and form of protection should vary according to the significance of the values and their sensitivity to change, and that such protection can be achieved in many cases without compromising sustainable land and water use.

The question was asked why recommend additional protection for river corridors within existing national parks? Rivers are often an important feature of national parks. The recognition of outstanding rivers in this

Investigation, whatever the surrounding public land use, emphasizes the approach taken by the Council - the systematic assessment of values - rather than reacting to proposed land or resource use changes.

Submissions variously opposed or supported separate legislation for heritage rivers. Some suggested *other methods of protection* or that existing provisions were adequate. Chapter A outlines alternatives for the protection of Victorian heritage rivers and describes Council's preferred option, which is protection under new legislation.

Essentially natural catchments

Information provided in submissions and field inspections has reduced the number of catchments that fall within this category, from those described in the Resources Report. Nevertheless, there is general appreciation of the need to protect those few remaining catchments that retain a very high degree of naturalness.

Many of the catchments are located within existing national parks or the Avon Wilderness Area (see Appendix III). There is also some overlap between the areas identified in these recommendations and the Council's Proposed Recommendations for the Wilderness Special Investigation, in that areas with high wilderness quality in eastern Victoria often contain essentially natural catchments.

The principal concern expressed in submissions about this category is that timber and mineral resources could become unavailable, if land currently within State forest is set aside to protect catchment values. The implications of the recommendations in relation to the government's legislated guarantee to supply timber at sustainable levels was cited as the major obstacle to the protection of some of these catchments.

These recommendations identify catchments of special value because of their natural condition - as required by government for this Investigation. After being advised of all the implications, the government must decide what compromises may be needed to achieve its various objectives.

Appendix III indicates the distribution of the recommended essentially natural catchments within parks and State forest and Table 1 lists the timber resources involved.

Representative rivers

The set of rivers, selected by the Council as representatives of the range of river-catchment types identified from geomorphic units and hydrological regions in the State, was also generally favourably received in the submissions. There were some suggestions for additional river catchment types and their representative streams to be added to the list. For example, those forming distributary systems in the west of the State, short high gradient coastal streams (such as those in the Otways), and alpine bog drainage systems. Some concern was expressed that such classification might inhibit future regulation of the recommended streams. These matters are discussed in Chapter C.

Rivers and their 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 such reserves) 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 emphasizes that the recommendations in Chapter E are based largely on its existing recommendations for such reserves, dating back to 1977. However concerns raised in submissions are acknowledged by Council and it has considered them in the light of other matters and concerns raised during discussions. Adjoining landowners have had problems with litter, damage to stock and property, and fire arising from careless use of frontages by some members of the public. Further, the government, if it were to assume sole responsibility for vermin and weed control, fencing, and other management activities, would incur significant additional costs. These recommendations emphasise

that degraded frontages should be restored co-operatively, and that access for appropriate forms of recreation be provided.

Several submissions suggested rationalization of frontages where the stream was no longer situated within its original cadastral boundary. This matter is addressed in the recommendations.

Other important issues raised were that frontage restoration will require appropriate funding and co-ordination of works. Matters relating to who should pay for such works, and who the responsible body to oversee and plan such works should be, are addressed in the recommendations (see General Recommendations and Chapter E).

Balancing resource use and value protection

Some submissions, while not opposing the need to protect river values, considered that in relation to the water sector, 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, domestic and agricultural 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.

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

As it is impossible to predict with 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 future water resource developments in particular should be excluded from such rivers. 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, and others emphasised that water supply security is important for future agricultural and township development in the region. The view was put 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 foregone) costs. However, Council believes that, in future, any analysis of a new proposal should include an assessment of all costs and benefits.

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, water can continue to be provided for industry, water resource development, and other activities 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 legal recreational activities conducted along or on rivers is an important aspect of Victorian culture and, in general, should continue. Council has not sought to identify every individual activity because of the exceptionally wide variety that exists. Many of the recommended Victorian heritage rivers are of outstanding significance for one or more such activities.

Concern was expressed that the absence of reference to an activity from the recommendations for a particular river may mean it was intended to prevent that activity. That is not the case, and unless specified, permitted activities can continue where land status permits, subject to normal management. In relation to fishing, 'bag limits' and a 'closed season' were proposed in submissions. The Council discussed these, and decided that these were also matters for the land and resource managers. Other views on recreation were also provided.

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.

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 or where control is difficult to achieve; enhance access to areas with high recreation values; and 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.



Fishing - a popular activity

Access to rivers, including recommended Victorian 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.

A number of submissions raised issues relating to how land- and water-management activities affect river values. In relation to river management, views were that too many agencies are involved and responsibilities are divided. Other issues raised include: flow regulation, environmental and recreational flows; aquatic flora and fauna matters, such as problems associated with fish passage throughout the river system, possible conflicts between native fish and introduced fish, and the need for more research and information about 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 addressed 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 the adequacy of logging prescriptions and supervision of timber-harvesting operations. Council has made specific recommendations on this issue in previous studies, but in this report has also provided guidelines concerning timber harvesting in river red gum forests. Opportunities for community input regarding timber-harvesting were also provided during the development of the Code of Forest Practices by the Department of Conservation and Environment.

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 only for third-order catchments (see glossary) or larger, and not to assess estuaries or wetlands 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 recorded as occurring in the associated third-order catchment. The essentially natural catchment recommendations apply only to third-order or larger catchments. 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 greatly increased the data-collection task. The estuaries of several rivers have been included where relevant, however, in recommendations in Chapters A and B.

Wetlands similarly have been included where they are located within river corridors being considered. They would require separate, detailed study however, to adequately address their range of values and uses.

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 water and groundwater sources. Options for increased future water supply can also widen with 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 then Department, now integrated with 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 Department considers that, in accordance with the general principles laid down by the *Water Act 1989*, 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 assessments of the economic and financial position 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 Department'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 Department 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 beneficiaries.

Public participation in resource development and allocation decisions is an important social consideration. The water resource strategies for South-west and Gippsland 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.

Final Recommendations

Having considered submissions arising from the publication of both the Resources Report and Proposed Recommendations, and all other available information, including that

derived from discussions with numerous individuals, representatives of municipalities, river management and water boards and interest groups, both in Melbourne and

country Victoria, and having inspected some Victorian streams with a range of values and potential conflicts, Council has formulated these Final Recommendations.

Council recommends the protection of rivers with outstanding values and characteristics, and has also recognised the importance of other places along rivers for community use. These recommendations do not replace Council's existing land use recommendations except where explicitly stated. In other words, within the Victorian heritage river corridors, the underlying tenure continues, whether national or State park, State forest, etc (and whether implemented, or approved recommendations awaiting implementation). These recommendations, however, require additional protection for river values.

The recommendations can be divided into general, specific, or policy.

1. General recommendations set the context and qualify the specific recommendations in the body of this report.
2. Specific recommendations relate to particular 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.

* Victorian heritage rivers

Recommendations for heritage rivers are described in Chapter A. Council has identified 17 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 45 catchments considered to be in an essentially natural condition. Some 33 occur in existing national parks, wilderness or protected catchment, while the remaining 12 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. With one exception, 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 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

The existing government-approved recommendations of Council provide a framework in which some land use activities are

permitted and others excluded, according to the public land category.

Several of the following recommendations specify land use activities that, while generally appropriate in many existing public

land use categories such as State forest, are currently excluded from particular areas. The means of exclusion are:

- * legislation, including the *National Parks Act 1975* (as amended) and exclusions under the *Crown Land (Reserves) Act 1978*
- * specific categories in 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, particularly in relation to timber harvesting, exploration and mining, and grazing
- * government decisions that vary recommendations of Council, or that are unrelated to recommendations
- * zoning or other provisions in 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.

Management of Public Land along Rivers and in Catchments

Various agencies have statutory responsibilities for catchment management, frontage management, waterway management, water allocation, water supply, and water quality monitoring and protection. These were discussed in the Resources Report.

Comments frequently made in the past, and in submissions for this Investigation, are that: too many agencies are involved in river and catchment management; it is difficult to find the one responsible for a specific matter; the division of responsibility dilutes the resources available for, and the effectiveness of, programs to improve river and catchment condition; and that there should be a central unit of government that co-ordinates river management matters.

In relation to public land, the Department of Conservation and Environment has the primary management responsibility for

catchment land, and river frontages. In most cases stream beds and banks are Crown land, and the Department has various roles there, including the approval of sand and gravel extraction proposals, and in-stream and bank flora and fauna responsibilities. The Department has developed substantial expertise in its management of parks, forests, other Crown land and its research into soil conservation, pest plant and animal control, protection of flora and fauna (including fish) and forests.

The Rural Water Commission has responsibility for major water storage and distribution systems. Under delegation, the Commission has responsibility for licensing of diversions for agricultural uses, for issuing licences to carry out works in a waterway, and providing engineering advice. Along with the Department of Conservation and Environment the Commission provides financial assistance for



Platypus

in-stream works outside river management authority districts. The Commission has extensive experience in hydrology and water engineering, including flood protection and river management.

Water supply, and often waste-water treatment and disposal, are the responsibilities of the Board of Works (for Melbourne and adjoining areas), the Rural Water Commission (for Bendigo and the Warrnambool--Otway system), or particular water boards. In relation to water supply, these bodies are primarily interested in water quality and quantity, and the condition of the catchment supplying the water.

Local government also has important, related roles, as responsible planning authorities, through representation on waterway management authorities and water boards, and as representatives of the community. Shire Councils may also be designated as *committees of management under the Crown Land (Reserves) Act 1978* for relevant areas of public land, including parcels of river frontage.

In the past agencies with 'river management' or 'river improvement' roles focussed on bed and bank stability, and maintaining channel capacity. Under the *Water Act 1989* however, waterway management authorities have changed and broadened functions (see section F9 - Waterway management). They must also perform their functions 'in an environmentally sound way', and 'must participate... in forming and consulting with catchment co-ordination groups...'

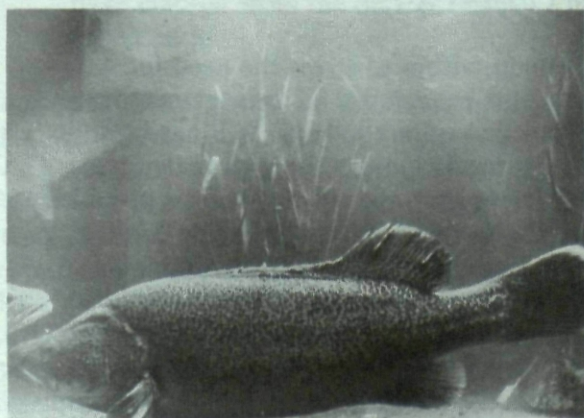
Waterway management authorities (River Management Boards, River Improvement Trusts, Drainage Trusts) involve some 27 agencies across the State, including several with responsibilities other than river management.

Water quality protection is an object of the Environment Protection Authority, through licensing of point-source discharges and development of State Environment Protection Policies. Control over land use (including public land use) can be exercised in proclaimed water supply catchments under the *Soil Conservation and Land Utilization Act 1958*, implemented by the Department of Conservation and Environment. The *Health Act 1958* contains provisions relating to the pollution of rivers and streams. The Department of Agriculture has some regulatory roles regarding registration of agricultural chemicals and aerial spraying.

Recommended managers

The managers of public land along rivers and in catchments, recommended to implement these recommendations, must have access to the relevant agencies providing expertise and research at a State level, as outlined above. It would be expensive, and pointless, to establish new agencies with all those roles 'in house' for each stream or river basin. The appropriate manager varies according to the circumstances.

In the past an arbitrary line was drawn between those responsibilities that are primarily 'land management' (carried out by



Murray cod

the Department of Conservation and Environment) and those seen as 'river management' (Rural Water Commission or river management authority responsibilities). The dividing line was often between the river catchment and frontage on one hand, and beds and banks on the other hand.

This division sometimes worked against effective management of river systems. This matter is taken up in more detail in Chapter E (river frontages, beds and banks), but there are clear needs for a whole-catchment perspective to be taken by river managers, and for effective co-ordination of the continuing roles of various agencies. Catchment co-ordination groups could assist in this regard.

Waterway management authorities, acting in accordance with the *Water Act 1989*, appear to be best placed to improve the effectiveness of river management. They would need to continue liaison with relevant agencies providing expert advice at a State level, and with community groups and individuals at a local level. The existing Standing Committee on Rivers and Catchments presently co-ordinates the State level advice. Given that various of the Committee's objectives have been met, it may be timely to re-examine its role, objectives and structure, and replace or reconstitute the committee.

If waterway authorities are to be given additional responsibilities, for water frontage

management through to more comprehensive catchment management they will need to demonstrate:

1. that they are seeking appropriate advice and acting in accordance with environmental guidelines, both in general for their river management, and for the protection of a wide range of river values, and
2. that they are acting in ways that benefit the community, rather than groups or individuals with narrowly focussed interests.

The following recommendations identify managers to implement them. In several

cases these are the Department of Conservation and Environment, in conjunction with a particular waterway authority, and/or other land or water managers where relevant. In other areas, although community organisations may exist that have an interest in particular streams, they do not have the authority to operate effectively on a whole catchment basis. For many rivers, no waterway authority or other relevant local organisation exists, and accordingly the Department of Conservation and Environment (or relevant existing land manager) in conjunction with the Rural Water Commission (as appropriate) are specified as managers.

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 pest plants and animals (including aquatic species) pose problems in the management of public land associated with rivers and streams. Blackberry in particular restricts access to

many areas. 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 relating to land and resources 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.

Recommendations III to VI concern the implementation of recommendations.

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, identified values could be affected or 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.

III That, until the formal procedures for the implementation of those recommendations approved by government are completed, the present legal status and management responsibilities continue, except that the land be managed in accordance with the approved recommendations.

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, the development of newly discovered mineral resources, alternative industrial uses of known resources, or other values - Council believes that it would be appropriate to review its recommendations in order to take account of changed circumstances and community demands. A review after a short period would, in the Council's view reduce stability and increase uncertainty in public land planning and management. To suggest a fixed review period may mean that a review occurs when it is not justified by changes in either information, or community demands.

VII That, where the government considers there have been sufficient changes in information, new data on environmental and other values, 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, to require a review of the recommendations in this report, the Land Conservation Council be requested to carry out such a review, provided at least seven years have elapsed from the date of their acceptance.

In several areas relevant to this Investigation, the information base is far from complete. Various research needs are identified in the following recommendations, but these cover many aspects, including: flora and fauna surveys (particularly in-stream), either in more detail or in geographical areas not previously surveyed; further ecological studies of the needs of particular communities, the processes occurring in them, and the effects of land use and management practices; further studies of recreation needs and management;

surveys and protection of cultural heritage sites and areas of high scenic landscape value; and on the resources side, the results of mineral exploration, further information on timber resources and water needs, and other development. The following recommendation proposes establishment of an interdepartmental group to collect such information, concentrating specifically on rivers and streams.

VIII That a research group with members from relevant agencies be established to continue the collection of data relating to rivers and frontages, to carry out or oversee necessary studies, where possible to complete the information base on river and stream values and uses, prior to any review of these recommendations, and to assist in determining the need for a review.

River management

The Council recognises a need to clarify the roles of the many organisations involved in waterway management, as reflected in the views expressed in submissions and discussions that existing expertise is not fully used, and that some improvements in co-ordination and efficiency are apparently required.

IX That the respective roles of departments, authorities and organisations involved in various aspects of management of rivers and streams be reviewed and clarified, to make full use of existing expertise and to improve co-ordination and efficiency in the use and allocation of available resources.

A. VICTORIAN 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 'shorelines 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 11 500 km. The protected segments are corridors, not whole catchments. Many individual states also enacted their own legislation. By 1983, 30 had done so, affording various levels of protection to about 22 000 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 eco-system 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 recommends that the most outstanding streams or reaches in the State be designated as Victorian 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', do not convey the intention to protect ecological and cultural values. Other terms considered were 'rivers of special significance', and 'significant rivers', while 'great Victorian rivers' was proposed in a submission.

The Council chose the term Victorian heritage river recognising that the Canadian system uses a similar title. Council's process is not linked with either the Australian Heritage Commission's Register of the National Estate, or 'World Heritage' listing as has been suggested. The Council's recommendations favour the establishment of new Victorian legislation to protect the identified values in each heritage river corridor.

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 conservation reserves, it is appropriate that rivers with outstanding values be similarly identified for permanent protection. That is not to say that other rivers, and river catchments outside Victorian heritage river corridors, should be ignored or degraded. The remainder of these recommendations addresses these wider concerns.

A Victorian 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 Victorian heritage river outline the main reasons for protection and appropriate uses, and will guide planners, managers, and users.

Some people expressed concern in submissions about the emphasis in these recommendations on protection of river values other than those related to the utilisation of water. It is important to note, however, that most of our Victorian rivers have been modified in the past to supply the needs of a growing community.

The next few years probably represents the last opportunity to protect the most outstanding examples of our remaining river systems. In this context it is relevant that the Council's recommendations for Victorian heritage rivers comprise only 17 corridors with a total length of 1950 km, that is just over 3% of the total length of named streams in Victoria (56 000 km). The remaining streams and water resources in the State will continue to be available for consideration to meet community needs.

Protection of these rivers accommodates 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 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 the movement of aquatic fauna along streams, or any appreciable diversion of flow out of the watercourse, may conflict with a component of the Victorian heritage river concept. That is, that some rivers should be set aside to protect natural values, including their naturally varying flow regime, which responds to daily, seasonal, and longer-term climatic conditions, and to which the natural stream biota are adapted.

A 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.

Victorian heritage river values

When considering a river or stream for Victorian 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 zoological or botanical 'sites of 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 zoological or botanical 'sites of significance'
- * streams - identified as 'essentially natural' mainstreams - that are in very good condition because their immediate catchments adjacent to the corridors have undergone little modification by modern technological society
- * features that are outstanding examples of geological history or geomorphological processes, or other natural phenomena; these include 'sites of geological or

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 Victorian Heritage Rivers

The development of the recommendations in this category has involved the six steps detailed below.

Step 1 - Collect data

The Resources Report outlined the range of information that was available at the time of publication. New information, from submissions and other sources, included: results of unpublished work; recent survey data; newly identified high-value areas; and new approaches. As a result, changes 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 were 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 (car-based camping occurs where a car is used to carry camping equipment to the site, and where the period of camping is short term)
- * canoe-touring or white-water canoeing

Given the diversity of the values and their expression, the Council did not believe that a numerical weighting system was appropriate or desirable. Rather it used the following

points to judge and rank the total values of rivers, and determine the upper and lower boundaries. Each point is of equal importance.

- * 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 distribution and extent of overlap of values
- * the combination of particular values that enhanced 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 Victorian 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 Victorian 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 recommends 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

Victorian heritage river. In some cases, the width of the corridor has been increased to reflect the topography of narrow valleys or gorges or the distribution of adjacent areas with significant values: there it follows the valley or gorge rim, or a larger unit of public land, where practical for management.

Where the corridor consists of only a public land water frontage reserve, its width adjacent to the stream narrows, usually to about 30 m.

Step 3 - Identify conflicting uses or activities

The process of river corridor protection began with the identification of land uses or activities that would place its values at risk. The extent of risk depended on the characteristics of the value, the nature of the activity, how this would be undertaken, and its frequency and duration.

In developing recommendations for Victorian 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

The development of recommendations that balanced the protection of values with utilisation of commercial resources, and also separated conflicting uses, involved four components. These were: 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 then the development of proposed recommendations by the Council for public comment.

Potential resources found along Victorian heritage rivers included:

- * 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 land status or 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 were known), and modifications to the way the resource could 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' Victorian heritage 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 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 Victorian heritage rivers.

Step 5 - Publish Proposed Recommendations for comment

The Proposed Recommendations were published in November 1990 and were open for public comment until 15 April 1991. In this period - just under five months - there was extensive consultation by the Chairman and Council officers with representatives of municipalities, river management boards, water boards, other interested groups, agencies and individuals. Comments received in the 177 submissions and letters are summarised in the previous chapter, but many referred to the Victorian heritage rivers in general, to particular rivers or to specific

recommended uses. These have been read and considered by the Council in the formulation of these recommendations.

Step 6 - Propose administrative mechanisms to protect Victorian heritage rivers

An administrative mechanism is required to ensure that 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 recommended river corridors.

Victorian 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 '*Victorian Heritage Rivers Act*' would give a firm and long-term commitment to protecting the values that led to this status. It would also provide a focal point for protecting rivers so declared, and could specify appropriate land use and broad management requirements in accordance with the Council's approved recommendations.

Legislation 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 Victorian 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, so that secure protection is provided. However, 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, survey and re-reservation, a substantial disadvantage of this alternative.

Planning and Environment Act 1987

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 Housing. 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 that it cannot be used to alter existing land uses.

Codes of practice

A code of practice document stipulates detailed requirements concerning the management practices that relate 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. Under the *Mineral Resources Development Act 1990*, codes of practice may be developed and adopted. Such a code is in preparation for exploration activities, and the rehabilitation of exploration sites.

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, roadworks, recreation, exploration and 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 1970

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, once recommendations have been 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.

The recommended Victorian heritage rivers

Condition

The rivers recommended have been selected on the basis of the presence of certain environmental and recreational values, as previously discussed. The values are at a high level (generally of State significance or greater) and have been recorded in relatively recent studies or surveys. This does not necessarily mean that the present condition of the Victorian heritage rivers is ideal, particularly in relation to water quality, bed and bank stability, frontage vegetation, and environmental water requirements. The report 'Environmental Condition of Victoria's Streams' (Mitchell, 1990) assesses these characteristics, particularly in relation to in-stream and riparian habitat condition.

These recommendations specify that such issues be addressed for all rivers, but that Victorian heritage rivers be given priority in relevant programs, in particular for the provision of environmental water requirements, revegetation of degraded areas, and programs to evaluate and improve water quality. However there is some concern that, if the condition of some reaches of Victorian heritage rivers deteriorates, the values that have led to the heritage river recommendation will be put at risk. Matters relating to loss of river values would need to be addressed in future reviews.

A whole-catchment approach will be necessary to implement programs to improve river condition. It is expected that catchment co-ordinating groups would play an important

part here. The policy recommendations in Chapter F provide a framework for the management and protection of rivers and their catchments, aiming to improve their condition.

Management

The recommended corridors include public land with a variety of land tenure - national and State parks, other reserves, State forest and so on. As mentioned below, it is not proposed that the corridors be re-reserved, but that they be recognised by an overlay form of protection. In major public land planning projects, such as forest management plans, recommended Victorian heritage rivers should be depicted on all relevant maps, and the appropriate uses specified.

Where a substantial length of a corridor flows through a park for which a management plan is in preparation or being reviewed, it is not proposed that the corridor need have a new, specific management plan. Instead, it should be recognised and its boundaries shown on all relevant maps, and appropriate zoning provided, in new plans, or as existing plans are reviewed.

Where a Victorian heritage river exists largely outside parks and conservation reserves, it would require a specific management plan to be prepared.

The recommended manager of these river corridors varies according to the circumstances. They are recommended to be

managed by the Department of Conservation and Environment in conjunction with the relevant waterway authority, and in conjunction with the Rural Water Commission where a Victorian heritage river is part of a major water supply system. Where no waterway authority has been constituted they should be managed by the Department in conjunction with the Commission. Several of the corridors are entirely within national parks, and in these cases they are to be managed by the Department, in consultation with the Commission or relevant authority on waterway management matters.

Currently, seven of the recommended Victorian heritage rivers are within a constituted waterway management authority district. It is expected that a further five will be within a few years.

Impairment of Values

In a number of the following recommendations, in relation to the impact of new water diversions on identified values, Council has used the phrase - that such diversions 'not significantly impair' the values specified. It is recognised that this is imprecise, but this is intentional. The degree of likely effect on, or impairment of values will depend on each specific proposal for water diversion.

Alternative techniques or designs of structures, and timing and volumes of diversions, may result in there being no significant impact on river values. Although the general principles of the impact of land use activities on river and stream values have been established, the impact of a diversion depends on its particular details, and the circumstances of the river.

The object of the recommendations is for the values to be sustained into the distant future. Where values are particularly sensitive to artificial changes in flow regime, it may not be possible to divert water. Where the values are robust, a minor level of change would be acceptable. Attention must also be paid to the cumulative effects of previous diversions (or other changes), using natural conditions as the baseline (where appropriate).

The River Corridor

As noted above the corridor includes the river and adjacent narrow ribbon of public land (where present). Where the river channel is confined by rock it is likely that the corridor location will remain as shown on the accompanying maps into the distant future. The course of a river across its floodplain is however, naturally dynamic in human timescales, and it is possible that the course of some Victorian heritage rivers will change in the future. In these cases the corridor will continue to be defined by the actual position of the river and any adjacent public land water frontage reserve. However, the geographic location of the corridor will, by necessity, change. Values present along the old course will require continuing protection.

The designation of a Victorian heritage river does not mean that specific actions have to be undertaken to ensure that its course (and corridor) stay in their current location. Decisions or actions in response to changes in the river's location are to be based on geomorphic principles, and the values and uses of the river and its surrounds. Chapter F provides guidance for such matters.

River values

The recommendations for Victorian heritage rivers specifically emphasise the protection of the values whose level of significance made the river stand out among all others. These rivers are likely to have other important values which may be significant at a regional level or less, or may be highly significant but of only local occurrence. Although these values are not specifically highlighted, their protection is, nevertheless, important, and is to be reflected in management actions.

Using recreational values as an example, at least 16 water-based and water-enhanced activities are possible within the corridors, as listed below. Often there are practical constraints on an activity, where there would be, in principle, no objection to it being carried out. The river may be too low or too small for canoeing, it may have few fish for fishing, no gold for panning, or game or vermin for hunting. Consequently within

Water-based and water-enhanced recreation activities

Water-based

Angling	shore and water-based
Canoeing and rafting	flat, white water and touring
Power boating	cruising, waterskiing and racing
Rowing (includes sprint canoeing)	
Sailboarding	
Sailing	dinghy, keel boat and trailer sailer
Swimming	

Water-enhanced

Camping	car-based and lightweight
Trail activity	cycling, walking and horseriding
Fossicking	gold, precious and semi-precious gems
Hunting	waterfowl, deer, and vermin
Nature appreciation	flora and fauna
Photography and painting	
Picnicking	
Pleasure driving and sightseeing	four-wheel-drive, trail bike, and two-wheel-drive

these corridors, if the recreational activity is permitted under the relevant land status or tenure, then subject to the discretion of the manager and in accordance with the principles in section F1, the activity would be permitted.

In these recommendations, Council has highlighted those recreational activities whose significance contributed to a river's heritage status. Other recreational activities are recommended to be permitted in accordance with the land status (refer to Introduction).

In-stream barriers

Artificial barriers on streams serve a number of important utilisation functions. They store water, they can raise the head of water for off-stream diversion, and they can impound a river producing an expanse of flat water. Other structures that in practice can form a barrier to movement of in-stream fauna include culverts, fords, drop-structures, flow gauge weirs, and hydro-electricity scheme installations. As described in the Resources Report, barriers potentially have major environmental impacts - fragmenting in-stream and riparian habitat, and disrupting the natural downstream movement of organic debris needed to maintain the aquatic foodchain and sediment.

There is some interest in the construction of new barriers or the enhancement of existing barriers for recreational and scenic amenity purposes. In many instances a perceived need for these works is driven by the poor environmental condition of the river and surrounding area.

The desired improvement may be achieved by non-interventionist means - such as attention to pest plant and animal control, bank and bed stability and plantings of indigenous vegetation. Not only will these actions serve to also restore the river, but in the longer term, lower maintenance costs are likely.

Victorian heritage river recommendations

The following recommendations identify 17 Victorian heritage river corridors. Several other river corridors were considered as candidates during the development of the recommendations, and information about the costs and benefits of protecting them is included in the social and economic appraisal. However, the King (below Lake William Hovell), Loddon, and Tyers Rivers were not considered further, as more recent information and field inspections led to reassessment of their values. The Council

resolved against recommending the Bunyip River for Victorian heritage river status after comparison with other candidates, considering the values and resources present, and recognising that a river-based corridor would not protect the full extent of the cool temperate rainforest present, one of the key values.

In submissions and at briefings, several other rivers were suggested for consideration. These included the Aberfeldy, Acheron, Aire, Avon, Brodribb, Buckland, Campaspe, Delatite, Gellibrand, Genoa, King (above Lake William Hovell), Mackenzie, Murray, Mueller, Rocky, Taggerty, Tambo, Taponga, Thurra, and Wannon Rivers. There were proposals that extended reaches of the Glenelg, Mitta Mitta, Ovens, and Wimmera Rivers be recommended. All these proposals were considered by Council in the light of their known values and the criteria described above, and the Aire and Genoa Rivers have been added to those recommended.

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 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 Victorian heritage river corridors. These are followed by a description, discussion of resource implications, and specific recommendations for each river corridor. Those values that led to the river being recommended as a Victorian heritage river are listed under recommendation A1--A17(n) for each river; other important values requiring specific protection where present,

are listed under the clause following, commonly (o).

Map 1 shows the 17 Victorian heritage river corridors diagrammatically. Maps A1 to A17 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. The recommendations for each corridor are provided in two parts:

- * Those recommendations that apply to all corridors - recommendations A1--A17(a) to (l).
- * Those recommendations that apply specifically to each river - A1, A2, A3 (etc) to A17(m) on. These are listed following a description of each river and any resource implications.

Recommended Victorian Heritage Rivers

Recommendation and map number	River corridor name
A1	Mitta Mitta River
A2	Ovens River
A3	Howqua River
A4	Big River
A5	Goulburn River
A6	Wimmera River
A7	Genoa River
A8	Bemm, Goolengook Arte, and Errinundra Rivers
A9	Snowy River
A10	Suggan Buggan and Berrima Rivers
A11	Upper Buchan River
A12	Mitchell and Wonnangatta Rivers
A13	Thomson River
A14	Yarra River
A15	Lerderderg River
A16	Aire River
A17	Glenelg River

VICTORIAN HERITAGE RIVERS

Recommendations

A1-A17 *That the river corridors shown on Maps A1 to A17 and described below be designated Victorian heritage rivers, and be used:*

- (a) to protect natural, scenic, cultural heritage, and recreational values, with particular attention 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 for a range of recreation opportunities as permitted in accordance with land status, unless otherwise specified in these recommendations*
- (d) in accordance with the policy recommendations in Chapter F*

that

- (e) where indicated below, the river corridors be retained free from impoundments, artificial barriers, or structures that impede the passage of in-stream fauna*
- (f) (i) any new water diversions from the mainstream or tributaries upstream of the lowest point on each Victorian heritage river not significantly impair 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 Victorian heritage rivers have not been undertaken, these investigations should be completed in any review of water allocations in existing regulated systems*
 - (iv) Victorian heritage rivers be given priority in investigations undertaken to establish appropriate environmental water requirements in existing regulated systems*
- (g) existing water quality be maintained, or where degraded be progressively improved - where opportunities allow - in accordance with the protection of the values and uses specified*
- (h) timber-harvesting not be permitted in Victorian heritage river corridors, except where specified for particular rivers below*
- (i) (i) where currently permitted, and at the discretion of the corridor managers, public land within the Victorian 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, degradation of water quality, or damage sites of cultural significance*

(continued)

A1-A17 - Victorian Heritage Rivers (continued)

- (ii) *priorities for revegetation be developed in accordance with the process 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 important plant or animal communities that would be significantly impaired by continued grazing*
- (j) (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*
- (k) (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*
- (l) *exploration and mining be permitted in Victorian heritage river corridors, except where land status excludes these activities, and subject to:*
 - (i) *existing Council policy (see section F11) 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 Victorian Heritage Rivers Act, and managed as specified for each river.

Notes:

1. *Maps A1 to A17 show the corridors based on the present stream location. Should the river course change markedly, the following applies:*
 - * *the new course becomes part of the corridor, on the basis of streamflow continuity. Where this course bisects freehold allotments, the bed and banks are not Crown land (that is, in most cases, public land). Where the course forms the boundary of a freehold allotment, the bed and banks are public land. In all cases, the use, flow, and control of all water is the right of the Crown.*
 - * *the old course retains its existing tenure, and all values present require protection.*
2. *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 syled on the existing Reference Areas Act 1978.*
3. *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 Genoa, Bemm, Snowy, Suggan Buggan, Buchan, Mitchell, and Thomson Rivers, and other rivers in Gippsland, are included in the Strategy.*

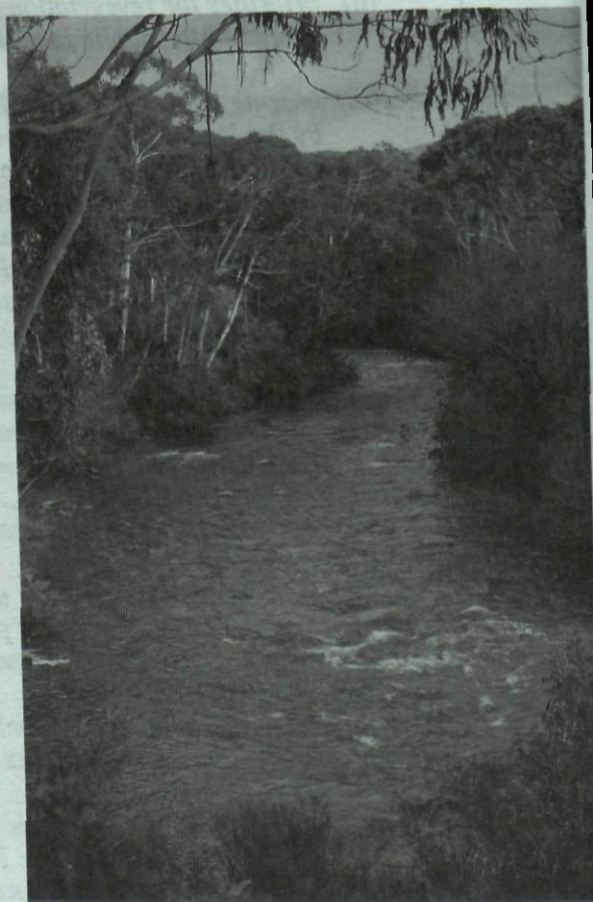
MITTA MITTA RIVER

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 geological processes 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 Victorian heritage river corridor extends 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,



Mitta Mitta River near Dartmouth Reservoir

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 contains riparian closed scrub of *Leptospermum brevipes* and *L. phyllioides* beneath an overstorey of narrow-leaf peppermint (*Eucalyptus radiata*) and manna gum (*E. viminalis*), of State botanical significance. The endangered spotted tree frog (*Litoria spenceri*) has also been recorded in the Mitta Mitta River upstream from Anglers Rest.

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 (*Macquaria australasica*) spawns in the lower reaches of the river corridor and 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 valleys of the Big and Mitta Mitta Rivers. 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
	<u>2335</u>	<u>60</u>

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 where the corridor consists of the public land water frontage reserve.

Resources

Code of Forest Practices constraints, combined with a generally unmerchantable timber resource, mean that effectively the Victorian heritage river corridor contains no available or harvestable timber resource in the State forest section. A possible future hydro-electricity 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 indicate 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 60 km river corridor from Glen Valley to the tailwaters of Lake Dartmouth shown on Map A1 be used in accordance with general recommendations A1--A17 (a) to (l) above

that

(m) (i) the corridor be retained free from impoundments, artificial barriers, or structures that impede the 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, or reduce scenic landscape value

that

(n) the following significant values be protected

(continued)

AI - Mitta Mitta River (continued)

- (i) scenic landscapes from the Bundara River confluence to Taylors Crossing
- (ii) riparian closed scrub of narrow-leaf peppermint with *Leptospermum brevipes* and *L. phyllicoides* - Livingstone Creek to Lake Dartmouth
- (iii) canoeing - Glen Valley to Hinnomunjie Bridge
- (iv) Macquarie perch spawning site - Mitta Mitta River and tailwaters of Dartmouth Dam
- (o) other recreation activities continue where permitted in accordance with land status

and that the corridor be managed by the Department of Conservation and Environment, in conjunction with the Rural Water Commission in relation to waterway management.

OVENS RIVER

The Victorian 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 (*E. 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 Victorian heritage river corridor includes riparian communities of river red gum with a shrub layer of silver wattle (*Acacia dealbata*) and grassy understorey, which are similarly of State significance. River bottlebrush (*Callistemon palludosus*) 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 (*Myotis adversus*), a bat with 'indeterminate' conservation status. Normally cave-dwelling, it has been recorded in the Ovens River forests roosting in mature river red gums. The three species of tortoise occurring in Victoria have also been recorded in the corridor; the status of one, the broad-shelled tortoise (*Chelodina expansa*), may be threatened. 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.

In comparison with other north-flowing rivers, such as the Goulburn or Loddon, the Ovens reflects, to a greater degree, natural variations in its flow. In-stream values are also important.

Murray cod (*Maccullochella peeli*) are found in the reach and, while their conservation status is vulnerable, it is considered that



Ovens River red gum forest

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 (*Craterocephalus stercusmuscarus*) and crimson-spotted rainbow fish (*Melanotaenia splendida*), and has a diverse native fish fauna, including golden perch (*Macquaria ambigua*), flat-headed galaxias (*Galaxias rostratus*), western carp gudgeon (*Hypseleotris klunzingeri*), and Australian smelt (*Retropinna semoni*) as well as the above species.

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
	3750	52

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 section 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 52 km river corridor from Killawarra to Lake Mulwala shown on Map A2 be used in accordance with general recommendations A1--A17 (a) to (l) above

(continued)

A2 - Ovens River (continued)

that

- (m) (i) *the corridor be retained free from further impoundments, artificial barriers, or structures that impede the passage of in-stream fauna*
- (ii) *any new diversions of water only be permitted if their volumes, timing, and offtake do not significantly 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 be permitted, subject to the discretion of the land manager, but that in areas where surveys identify a risk of degradation through the loss of biological values or bank instability, licences be reviewed (Note: Grazing is not permitted in the Flora Reserve in this corridor)*
- (v) *the impact of firewood harvesting on flora and fauna be assessed, and subject to this assessment, be permitted at the discretion of the manager*

that

- (n) *the following significant 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 (see Note)*
 - (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) *native fish diversity and Murray cod habitat by providing conditions conducive to seasonal spawning*
- (o) *the following additional values be protected*
 - (i) *habitat for the three Victorian species of tortoise*
 - (ii) *wetlands and waterbird habitat*
- (p) *other recreation activities continue where permitted in accordance with land status and that the corridor be managed by the Department of Conservation and Environment, in conjunction with the Rural Water Commission (in relation to river flows) and the Ovens River Management Board (in relation to waterway management).*

(continued)

A2 - Ovens River (continued)

Note:

Consultants employed by the Council expressed the view that some areas with riverine open forests/woodlands were of State botanical significance, for the following reasons:

- the communities were formerly widespread but are now uncommon or rare*
- excellent examples of the communities occur, in terms of size, lack of disturbance, diversity, botanical 'intactness', or presence of significant species*
- the communities are inadequately represented in 'biological reserves'*
- species of State significance are present (in some areas)*

They also comment that there are deficiencies in our knowledge of the floristics of such areas, and that there is an urgent need for biological surveys that address vegetation management issues, particularly in the Ovens River basin (among others). Accordingly, further studies will be necessary to identify the areas requiring protection for their botanical significance.

HOWQUA RIVER

The Victorian 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 has widened slightly and a narrow floodplain has developed, such as at Sheeppark Flat, Fry's 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 their 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 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



Howqua River near Pikes Flat

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 Sheepland Flat and Fry's Hut areas were also the focus for the Howqua grazing run, taken up in 1845. Around Fry's 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.

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 Sheepland Flat is very popular.

Sheepland 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. A survey of macro-invertebrates revealed that the river supports a rich and diverse fauna. The endangered spotted tree frog has also been recorded here.

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
	1520	60

The Victorian 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, 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 60 km river corridor from the junction of the North and South Branches to Lake Eildon shown on Map A3 be used in accordance with general recommendations A1-A17 (a) to (l) above

that

- (m) (i) the corridor be retained free from impoundments, artificial barriers, or structures that impede the passage of in-stream fauna*
- (ii) any new diversions of water only be permitted if their volumes, timing, and offtake do not significantly 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

- (n) the following significant values be protected*
 - (i) canoeing - Eight Mile Creek to Frys Hut, and the Sheeppyard 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 spotted tree frog*
 - (o) other recreation activities continue where permitted in accordance with land status*
- and that the corridor be managed by the Department of Conservation and Environment, in conjunction with the Rural Water Commission in relation to waterway management.*

BIG RIVER

The Victorian 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, agricul-

tural, or industrial discharges. The aquatic habitat is of great interest. Above the confluence with the Taponga River, the endangered spotted tree frog has been recently 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 head-water tributaries, following disturbance of the mainstream 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 Enoch Point, but the middle reaches flow through a magnificent V-shaped valley. This section



Big River

of the river can be viewed from the Big River four-wheel-drive track that runs south from Enoch 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 Enoch 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 the 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 Victorian heritage river corridor comprises a strip 200 m wide along each side of the river.

Resources

With the possible exception of the use by residents at Enoch Point, there is no current off-stream use of Big River water within the corridor. The water flowing through the corridor does, however, contribute to storage in Lake Eildon which is allocated for off-stream use in the Goulburn River system.

The Board of Works considers the Big River is an important prospective water source. The Board's preferred 30-year planning schedule for the augmentation of Melbourne's water supply is as follows:

1. Diversion of approximately 100 000 ML per year from the Big River to Upper Yarra Dam, providing 5 to 7 years augmentation of supply (commissioning date 2005/6)
2. Diversion of approximately 80 000 ML per year from the Black River to Thomson Dam providing 4 to 5 years augmentation of supply (commissioning date 2011/12)
3. The 'combined scheme': a series of incremental augmentation works from catchments including the Acheron River, Cement Creek and Aberfeldy River, and upgrading the Yarra River pumps at Yering. Approximately 90 000 ML per year would be diverted, providing 5 to 6 years of supply (commissioning date 2016/17).

The schedule is based on increasing capital and operating costs alone. Implications that may arise from environmental impacts have yet to be assessed, and are not reflected in this preferred schedule. Strategies for Melbourne's water supply are currently being reviewed by the Melbourne Water Resources Review Panel.

Restrictions on access to Big River water to augment Melbourne's water supply would mean that the next preferred option (currently, the diversion of the Black River to Thomson Dam) would be brought forward. The consultants concluded that, in those circumstances, the difference in the cost between the Big River and the Black/Goulburn Rivers as the 'next best' option for augmenting Melbourne's water supply, would be likely to exceed the Big River's environmental values. However, the recommendations below do not preclude the diversion of water from the Big River corridor or its catchment.

When a specific proposal is put forward, the need to develop this particular resource, details of site design, and the timing and volume of withdrawals can be considered and determined in the assessment of an environmental effects statement for the proposal. However, technical solutions which allow water diversion and continuity of passage for in-stream fauna have been identified, as follows.

- (i) A small diversion structure could be constructed in one of the river banks that allows the diversion of water into a 'sump' feeding a tunnel. The sill height of such a diversion structure could be set to allow diversion only when flows reach a certain depth.
- (ii) An artificial 'riffle' section could be constructed within the river providing an upstream pool from which water is taken, through a permanently underwater offtake structure, into a tunnel. This could consist of either carefully placed rocks or a low, underwater weir across the stream.

Detailed site studies may reveal other options consistent with these recommendations. It

should therefore be possible for an appropriately constructed diversion to be established within the Victorian heritage river corridor.

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.

Recommendation

A4 Big River

That the 51 km river corridor from the junction of Spring and Oaks Creeks to Lake Eildon shown on Map A4 be used in accordance with general recommendations A1–A17 (a) to (l) above

that

- (m) (i) any new diversion of water only be permitted if its volume and timing, and the design of the offtake structure, do not significantly impair in-stream habitat conditions, the passage of in-stream fauna, or reduce scenic landscape value*
- (ii) the volume and timing of any new diversion be such as to not significantly impair canoeing quality, but that if such impairment is likely, an economic assessment of the relative social benefits and costs be carried out*
- (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 not be upgraded, in order to limit use and maintain the current range of recreational opportunities*
- (v) if possible, the shallow quarries along the Jamieson Road be relocated and the sites reclaimed*

that

- (n) the following significant values be protected*
 - (i) habitat for the spotted tree frog*
 - (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*
- (o) other recreation activities continue where permitted in accordance with land status*

(continued)

A4 - Big River (continued)

and that the corridor be managed by the Department of Conservation and Environment, in conjunction with the Rural Water Commission in relation to waterway management.

Notes:

1. *In any review of these recommendations, the need to divert water from within the corridor to augment Melbourne's water supply should be considered.*
2. *The Goulburn system of which the Big River is a tributary is at present fully committed. Council is concerned that the diversion of water from the Big River may limit options for the future provision of an environmental water requirement for the Goulburn.*
3. *As part of the State Water Resources Plan, preliminary studies of potential diversion sites on the upper reaches of the Big, Black, and Upper Goulburn Rivers have been initiated by the Department of Conservation and Environment. They cover archaeology, mining heritage, fauna, landscape assessment, and fish-flow requirements. At the time of publishing these recommendations, preliminary reports on the archaeology, and mining heritage (Reports 57 and 56 respectively of the Water Resource Management Report Series - Department of Conservation and Environment) had been published.*

GOULBURN RIVER

The Victorian 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, near Eildon, 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, south-east of Seymour. Today, pleasure drivers can take in these views from the Goulburn Valley Highway, and the informal lookouts dotted along the valley.



Goulburn River near Trawool

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. The remains of an 1882 town water supply pump at Murchison are of State significance.

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 have been assessed as being of State significance, being excellent examples of

these communities, which are inadequately represented in reserves. The understoreys are commonly a mosaic of grasses with rushes and sedges, although some areas have a shrubby or heathy under-storey. On the margins, small areas of mixed woodland/open forests occur, with red gum, grey box (*E. microcarpa*), and yellow box (*E. melliodora*). In particular, areas with an intact under-storey are significant. The Goulburn River marks a boundary where the drier river red gum associations found to the west meet the wetter associations more usual to the east.

These open forests are also particularly important habitat for a number of fauna species, including the squirrel glider (*Petaurus norfolcensis*), brush-tailed phascogale (*Phascogale tapoatafa*), and arking owl (*Ninox connivens*) - all rare species in Victoria. The corridor below Shepparton is considered to be of national significance as habitat for squirrel gliders which 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 barking march 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 the river 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
	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 both for an irrigation storage, and for the lower dam in a hydro-electric pumped storage scheme.

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 430 km river corridor from below Lake Eildon to the Murray River shown on Map A5 be used in accordance with general recommendations A1-A17 (a) to (l) above

that

- (m) (i) the corridor be retained free from further impoundments, artificial barriers, or structures that impede the passage of in-stream fauna (see Note 1)*

(continued)

A5 - Goulburn River (continued)

- (ii) *any new diversions of water only be permitted if their volumes, timing, and offtake do not significantly impair wetland, riverine forest, or native fish habitat conditions, or reduce scenic landscape value (see Note 2)*
- (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, subject to the discretion of the land manager, but that in areas where surveys identify a risk of degradation through loss of biological values or bank instability, licences be reviewed (see Notes 3 and 4)*
- (v) *the impact of firewood harvesting on flora and fauna values be assessed, and subject to the assessment be permitted at the discretion of the manager*

that

(n) *the following significant values be protected*

- (i) *areas with an intact understorey in river red gum open forest/woodland, and yellow box and grey box woodland/open forest communities (see Note 5)*
- (ii) *areas of habitat significance for vulnerable or threatened wildlife including squirrel gliders, large-footed myotis, barking march frogs, barking owls, and brush-tailed phascogales*
- (iii) *native fish diversity and Murray cod habitat below Goulburn Weir by providing water conditions conducive to seasonal spawning (see Note 6)*
- (iv) *Macquarie perch habitat above Goulburn Weir*
- (v) *fishing opportunities - especially for trout from Eildon to Yea River, and native species below Goulburn Weir*
- (vi) *canoeing - Eildon to Goulburn Weir*
- (vii) *cultural heritage sites listed above*
- (viii) *scenic landscapes - from Molesworth to above Seymour, and from below Seymour to Echuca*

(o) *other recreation activities continue where permitted in accordance with land status*

and that the corridor be managed by the Department of Conservation and Environment in conjunction with the Rural Water Commission, the Mid-Goulburn River Management Board and other relevant waterway authorities in relation to waterway management.

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.*

(continued)

A5 - Goulburn River (continued)

2. *The flow regimes of the Goulburn River in two sections (Eildon to Nagambie, and Nagambie to the Murray River) are modified, and the present system is fully committed. Council is concerned that re-allocation of water within and from the Goulburn River basin for off-stream use could preclude the provision of an environmental water requirement for the Goulburn.*
3. *The Benalla Region of the Department of Conservation and Environment is currently reviewing grazing management along the Goulburn River in keeping with the Wetlands Conservation Program.*
4. *Some limited areas of the public land water frontage are cultivated or used for horticulture. While these are considered inappropriate uses of frontages, they may be continued at the discretion of the corridor managers, but should be subject to review.*
5. *For the reach from Murchison to the Murray River, consultants employed by the Council expressed the view that some areas with riverine open forests/woodlands were of State botanical significance, for the following reasons:*
 - *the communities were formerly widespread but are now uncommon or rare*
 - *excellent examples of the communities occur, in terms of size, lack of disturbance, diversity, botanical 'intactness', or presence of significant species*
 - *the communities are inadequately represented in 'biological reserves'*
 - *species of State significance are present (in some areas)**They also comment that there are deficiencies in our knowledge of the floristics of such areas, and that there is an urgent need for biological surveys that address vegetation management issues, particularly in the Goulburn River basin (among others). Accordingly, further studies will be necessary to identify the areas requiring protection for their botanical significance.*
6. *In accordance with recommendations A1-A17(f)(iii) and (iv), a review of water allocations in the Goulburn system should include consideration of the environmental water requirements of Murray cod and the diverse community of other native fish, the riverine forests and adjoining wetlands, and the ability of the Rural Water Commission to provide appropriate water conditions.*
7. *Salinity management plans in this area may result in the discharge of saline and nutrient-rich waste water to the Goulburn River. Council is concerned that urban, industrial, and agricultural discharges may affect river values and uses and has provided appropriate recommendations in section F8.*
8. *Submissions identified bank instability as a problem associated with rapid river falls at the completion of a flow release. This issue is described in section F9.*
9. *Council is aware of a proposal to construct a hydro-electric scheme at the Eildon Pondage Weir. These recommendations would not prevent this.*

WIMMERA RIVER

The Victorian 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 - Albcutyta 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. This system began in the 1880s when a scheme was established to distribute water to the Mallee from the Wimmera and Richardson Rivers, and Yarriambiack and Dunmunkle Creeks through a network of channels. The supply system now consists of 16 000 km of channels, covering 28 500 sq.km, and claimed to be the largest in the world.

The flow regime through the Wimmera river corridor has been considerably modified, 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 2 to the following recommendations). 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-black box (*E. largiflorens*) association is of particular significance, as it 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



Wimmera River at Big Bend

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 shrub-lands of tangled lignum (*Muehlenbeckia cunninghamii*). To the south-west of the lake, impressive woodlands of yellow gum (*E. leucoxydon*) and slender cypress pine (*Callitris preissii*) occur. An excellent stand of the depleted salt paperbark (*Melaleuca halmaturorum*) grows to the immediate north-east of the Wimmera River mouth. The endangered dwarf flat sedge (*Cyperus rigidellus*) and vulnerable plant species jerry-jerry (*Ammannia multiflora*), water-fire (*Bergia ammannioides*), six-point arrowgrass (*Triglochin hexagona*) and three-nerve wattle (*Acacia trineura*) have been recorded at Lake Hindmarsh, as have large populations of other significant plants, including short rat-tail grass (*Sporobolus mitchellii*) and *Atriplex australasica*.

In-stream habitat of the perennial sections also provides refuge for Murray cod - introduced to this river - and considered vulnerable as a result of habitat changes in its natural range.

Its lake system is a key feature of the river. When full, Lake Hindmarsh is the largest natural 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. Both species are considered 'restricted' in Victoria. 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 significance.

The Wimmera River terminal lake system has outstanding 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. More generally, it is the largest internal drainage system in the State.

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. 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. Today on the Wimmera River the remains of Ebenezer Mission, established in 1858 to redress the effects of that period, 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
	56 020	229

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 distributary 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 Wimmera-Mallee region has been extensively explored for mineral sands and an arcuate province of commercial mineralisa-

tion has been identified that lies to the south and east of the corridor. To date five significant deposits have been identified or inferred within this province, the best known being WIM 150. When current extraction and metallurgical problems associated with their development are resolved, these areas are considered to contain many years of reserves. No deposits of commercial interest have yet been identified within the corridor, however.

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

Council has previously identified in recommendations for its Wimmera Area Investigation (1986) and Mallee Area Review (1989), issues relating to water quality and changes in the natural flow regime (as a result of diversion of river flows), that require specific attention.

The supply of water to the Wimmera-Mallee Stock and Domestic Supply system is over-committed. The efficiency of the supply and storage system is such that, of the water released from its headwaters, only 17% is finally used. The losses occur through seepage and evaporation from the open and unlined supply system (65% of that released) and from town and farm storages (50% of the volume supplied).

Greater efficiency can be achieved by piping the channel system. This means that water previously lost to evaporation or leakage to groundwater may be available for other uses. It is estimated that 60 000 ML of water could be saved and made available in this way each year.

The Rural Water Commission has developed a policy which allows consumers wanting new supplies to fund public works such as piping, and receive a new water allocation through the resultant savings. The Commission has described this as the 'sale of savings' policy.

There is concern that the sale of such savings for off-stream use may preclude the future provision of environmental water to the Wimmera River system. However, the

Commission estimates that the long-term private demand for additional water is small, compared with the total additional water volume that could be made available by piping. Consequently there is considerable water potentially available to meet an environmental water requirement for the Wimmera River System.

Council is concerned that in the absence of water being specifically provided as an environmental requirement, some of the aquatic and riparian values of the river corridor may be lost or seriously degraded. Currently, several of these values are under pressure.

Recommendation

A6 Wimmera River

That the 229 km river corridor from Polkemmet to Wirrengren Plain shown on Map A6 be used in accordance with general recommendations A1–A17 (a) to (l) above

that

- (m) (i) *transfers between existing water users take place where appropriate, but that no additional diversion of surface water be made in the Wimmera Basin*
- (ii) *increased allocations only be made where they can be achieved from water savings through schemes that improve water distribution efficiency, such as the piping of parts of the Wimmera–Mallee Stock and Domestic Supply System*
- (iii) *the government ensure that an adequate proportion of such water savings is allocated to environmental water requirements for the Wimmera River upstream of Lake Hindmarsh (see Note 1)*
- (iv) *on completion of studies of the means of providing environmental water requirements along the Wimmera River and Outlet Creek to the terminal lakes (see Note 2), the government ensure that an adequate proportion of water savings is allocated to these requirements*
- (v) *the corridor be retained free from further impoundments, artificial barriers, or structures that impede the passage of in-stream fauna, except in special circumstances (see Note 4)*
- (vi) *the land managers review the location of river roads away from sensitive river banks and Aboriginal sites*
- (vii) *areas currently available for firewood collection, with the land manager's approval, continue to be available (see Note 5) and that other alternatives for supply of fire wood for domestic or commercial purposes be investigated*

that

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

(continued)

A6 Wimmera River

- (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 geomorphological features of the lake surrounds
- (v) scenic landscapes along the Wimmera River from Polkemmet to near Dimboola
- (vi) fishing opportunities, especially for golden perch, yabbies, and redfin (see Note 6)

(o) other recreation activities continue where permitted in accordance with land status

and that the corridor be managed by the Department of Conservation and Environment, in conjunction with the Rural Water Commission and in consultation with the Wimmera Catchment Coordinating Group.

Notes:

1. Detailed studies into environmental flows, focussing on fish, have been carried out in this reach. Further investigations may be required to determine the environmental water requirements for riparian vegetation here. Provision of flows or other treatments in this reach should not be such as to adversely affect riparian values.
2. 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.
3. Council is aware that the Wimmera Catchment Co-ordinating Group is currently developing the Wimmera River Integrated Catchment Management Strategy. As well as meeting its other aims, this Strategy will provide an important means of achieving the on-ground implementation of these final recommendations in a manner that involves, through community input, an appreciation of the values and uses of the Wimmera River.
4. The condition where such impoundments, barriers or structures may be built is where they would prevent a rise in river salinity resulting from the inflow of saline groundwater. However, such an approach to the maintenance of water quality addresses only a symptom of salinity, and Council is concerned that it could direct resources away from treatment of the causes. In addition, such structures are likely to further fragment in-stream habitat. If they can be shown to be a reasonable solution to the long-term maintenance of water quality, these recommendations would not prevent such structures. Prior approval by the Department of Conservation and Environment would be necessary for their construction, and this should be based on the recommendations for the corridor and the above issues.
5. Lake Hindmarsh surrounds are not available for licensed firewood-harvesting, because of the particularly high natural values present.
6. Council is aware of the professional fishing operations on Lake Hindmarsh.

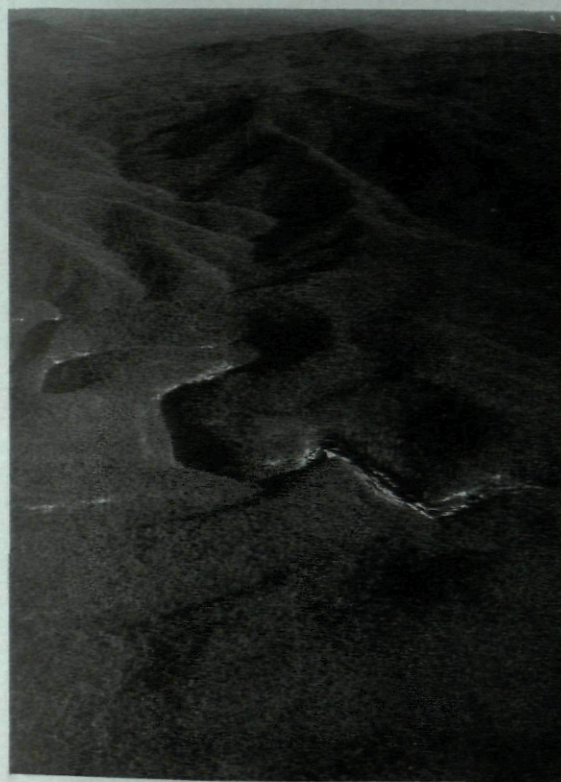
(continued)

A6 - Wimmera River (continued)

7. Submissions have identified issues related to the use of speed boats within this corridor. These include the impact of the wake on bank stability, and the compatibility of this activity with other water-related or water-enhanced recreational activities in the corridor. Council considers that the corridor managers should resolve these issues.

GENOA RIVER

The Victorian heritage river corridor along the Genoa extends 27 km from the Victoria/New South Wales border to just upstream of Wangarabell. The corridor lies wholly within the Coopracambra National Park. The river rises in south-east New South Wales, and in Victoria, drains east to Mallacoota Inlet.



Genoa River gorge

The corridor forms part of a magnificent rock-bound gorge of national geomorphic significance. The river has formed a sequence of deeply entrenched meanders displaying various scales of channel and valley development. These meanders, cut through sedimentary rocks which are now

gently dipping, gives the Genoa a character different from other rivers in eastern Victoria. The sedimentary rocks exposed in the gorge contain a number of important fish and plant fossil horizons.

In 1971, fossil footprints of a prehistoric amphibian were discovered in the gorge. Footprint impressions of any kind are rare in the geological record and these in the gorge are of international significance, being the oldest known footprint trackway of a four-legged animal in the world. They were found in the upper Devonian 'red beds', some 350 million years old. Other fossil-bearing rock strata in the corridor are also of palaeontological interest.

Set within the forested gorge, the large pools, sandy beaches, rock bars, boulder fields and striking colour of some of the rock layers give the corridor a scenic grandeur which unfolds at each turn of the river.

The scenery and remoteness of the corridor from roads and other reminders of contemporary life make the area a source of enjoyment and high recreation value for river walkers and naturalists.

The river-side vegetation is in excellent condition, free of many uses likely to affect its naturalness. It is of floristic significance, and a number of tree and shrub species restricted in Victoria to the river-sides of East Gippsland are recorded here. These include the tall, white trunked river peppermint (*E. elata*), *Callistemon subulatus*, and the showy *Kunzea ambigua*. The gorge and the immediately surrounding area also provide an understanding of the taxonomy and biogeography of the genus *Pomaderris* in Australia.

Tenure			uniformly 200 m wide along each streambank.
Public land tenure	Area (ha)	Length (km)	Resources
Coopracambra National Park	1300	27	Owing to the existing national park status of the corridor, there are no resource implications of these recommendations.

Along its entire length, the corridor is

Recommendation

A7 Genoa River

That the 27 km river corridor from the New South Wales/Victoria border to Wangarabell shown on Map A7, be used in accordance with general recommendations A1–A17(a) to (l) above

that

- (m) (i) the corridor be retained free from impoundments, artificial barriers, or structures that impede the passage of in-stream fauna*
- (ii) no new diversion from within the corridor be permitted*
- (iii) no new roading be constructed in the corridor*

that

- (n) the following significant values be protected*
 - (i) sites of geological and geomorphological significance as outlined above*
 - (ii) scenic landscape values within the corridor*
 - (iii) sites of botanical significance*
 - (iv) relatively natural mainstream condition (see Note 2)*
- (o) the remote recreational setting be protected*
- (p) other recreation activities continue where permitted in accordance with land status*
- (q) the corridor managers liaise with agencies in New South Wales to enhance the protection of corridor values*

and that the corridor be managed by the Department of Conservation and Environment, in consultation with the East Gippsland Rivers Management Board in relation to waterway management.

(continued)

A7 Genoa River (continued)**Note:**

1. *This area is in an area of high wilderness quality being considered in the Council's current Wilderness Special Investigation*
2. *Council is aware that pest plants, willows in particular, are colonising parts of the corridor. It is appropriate that action be taken to address this issue.*

BEMM RIVER AND ITS TRIBUTARIES, GOOLENGOOK, ARTE, AND ERRINUNDRA RIVERS

This Victorian 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 about halfway between the towns of Orbost on the Snowy River, 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 essentially undisturbed aquatic environments, from sub-alpine 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 steep headwaters of the Goolengook River, developed on granitic parent material, open to a relatively broad flat valley tract, providing 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 elevation to close to sea level.

Cool temperate rainforest occurs in the highland areas and down to elevations of 600 m. Southern sassafras (*Atherosperma moschatum*) is dominant, with black oliveberry (*Elaeocarpus holopetalus*) frequently co-dominating the canopy. Other common associated trees or shrubs include forest wattle (*A. frigescens*), Gippsland waratah (*Telopea oreades*), mountain pepper (*Tasmania lanceolata*), privet mock olive (*Notelaea ligustrina*), and banyalla (*Pittosporum bicolor*). 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 700 m down to sea level. Depending on the susceptibility to flooding, kanooka (*Tristania laurina*) or lillypilly (*Acmena smithii*) 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 rare white supplejack (*Ripogonum album*), 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



Cool temperate rainforest - Errinundra Plateau

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 oliveberry, 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 occurrence of rainforest intergrades on the Arte River has been well documented and these sites are 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 (*Potorous longipes*), 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. These sites tend to be clustered rather than evenly distributed. Two predator scat records containing potoroo remains have been located in the Bemm River corridor.

The aquatic habitat too is significant. The vulnerable Australian grayling (*Prototroctes maraena*) occurs in the Bemm River. The lower reaches of the river and its estuary, Sydenham Inlet, are also important for conserving the diverse range of fish species present.

The estuary contains several geomorphic features that reflect changes in the location of the mouth of the Bemm, the 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 highly regarded by anglers for species such as black bream (*Acanthopagrus butcheri*), estuary perch (*Macquaria colonorum*), and Australian bass (*Macquaria novemaculeata*). Fishing from both shore and boats is 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 adjacent to the Princes Highway has been 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 Victorian heritage river corridor, the land managers currently apply protective measures for rainforest, and the natural features zone is not available for timber production. The management aims of this zone are described in Council's East Gippsland Area Review Final Recommendations. The boundaries of the natural features zone have not been defined in a forest management plan to date, so the corridor through State forest shown on Map A8 is diagrammatic and the area figures are provisional.

A protective buffer of 20 to 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

A8 Bemm River and its tributaries, Goolengook, Arte, and Errinundra Rivers

That the 148 km river corridor including the Bemm River and sections of its tributaries shown on Map A8 be used in accordance with general recommendations A1--A17 (a) to (l) above

(continued)

A8 - Bemm River and its tributaries, Goolengook, Arte, and Errinundra Rivers (continued)

that

- (m) (i) the corridor be retained free from impoundments, artificial barriers or structures that impede the passage of in-stream fauna*
- (ii) any new diversions of water only be permitted if their volumes, timing, and offtake do not significantly impair native fish habitat conditions, adversely affect rainforest and its continuity, or reduce scenic landscape value*

that

- (n) the following significant values be protected*
 - (i) rainforest occurrences*
 - (ii) long-footed potoroo habitat (see Note 2)*
 - (iii) Australian grayling habitat, by retaining free passage for migration, and maintaining water quality, flow, and in-stream habitat conditions (see Note 3)*
 - (iv) native fish diversity in the lower reaches and Sydenham Inlet*
 - (v) Sydenham Inlet, an estuary of geomorphological significance*
- (o) other recreation activities continue where permitted in accordance with land status*

and that the corridor be managed by the Department of Conservation and Environment, in conjunction with the East Gippsland Rivers Management Board in relation to waterway management.

Notes:

- 1. Recent instances of reduced river water quality as a result of turbidity following rain have been reported. The causes should be identified and remedial action taken.*
- 2. A recent report (Scotts and Seebeck, 1989) highlights the need for extra studies to clarify the requirements of the long-footed potoroo.*
- 3. The mouth of the Bemm has an irregular cycle of opening and subsequent closure, under natural conditions. These recommendations do not suggest that a permanent opening be maintained.*

SNOWY RIVER

The Victorian 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 Bonang--Gelantipy 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, downstream of McKillop Bridge, the 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 variations in valley morphology controlled by differences in bedrock geology; 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 reflects broad-scale changes in rainfall and relief. They include rain-shadow woodland; dry sclerophyll, lowland sclerophyll, and 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 river beard heath (*Leucopogon riparius*), rock guinea flower (*Hibbertia spathulata*) - both rare in Victoria and Australia - and Snowy River wattle (*A. boormanii*). Snowy River daisy (*Brachycome riparia*) and broad-leaf hop bush (*Dodonaea rhombifolia*) were described here and are rarely encountered outside the Victorian section of the river and are both also rare in this State and nationally. Disjunct western species that occur in the gorge include fringed heath-myrtle (*Micro-myrtus ciliata*), violet kunzea (*Kunzea parvifolia*), and glandular phebalium (*Phebalium glandulosum*) - rare in Victoria.

The lower Snowy is also of floristic significance, particularly between Long Point



The Snowy River from McKillops Bridge

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 the endangered buff hazelwood (*Symplocos thwaitesii*) and the rare yellow milk-vine (*Marsdenia flavescens*).

Further north, from the border to Currie Creek, the riparian woodland and forest provide habitat for many birds. The caves along the river are key components of the habitat for the 'restricted' common bent-wing bat (*Miniopterus schreibersii*) and eastern horseshoe bat (*Rhinolophus megaphyllus*).

In the steep and rocky Little River gorge, several colonies of brush-tailed rock-wallabies (*Petrogale penicillata*) 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.

This spectacular valley with its rugged slopes and gorges, the pattern of vegetation communities, including the rain-shadow woodlands dominated by native pine, and the rapids, pools, and sandy beaches along the river, create a setting of outstanding scenic beauty. Notable vantage points occur along the Bonang-Gelantipy 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 impressive valley views from the Turnback to McKillop Bridge section of the Bonang Road as it winds 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 long still pools, camping on sandy beaches, and enjoying the 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, 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 trestle-supported timber girder bridge, now disused, still crosses the floodplain, and is the longest such rail or road bridge in the State.

Crossings in the valley sections required a different approach, recognizing 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 wood decked, steel girder bridge, supported by four reinforced concrete pylons.

Such a substantial bridge, on the narrow and winding Bonang-Gelantipy Road, is a permanent reminder of the power of rivers in shaping human settlement patterns. It is one of only three bridges to cross the Snowy River in Victoria, the other two being the rail bridge, and the long Princes Highway bridge and causeway at Orbost.

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, in particular increased saltwater incursion. Consequently, Council has endorsed current initiatives to investigate the possibility of providing an environmental water requirement.

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
	46 690	175

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 adjacent to private land.

Resources

Over the years there has been discussion about the possible siting of a pulp mill at Orbost. Such a mill may have implications for flows and values in the proposed Victorian heritage river corridor. However,

the water requirements of such a mill could be met by an off-stream storage, should it be necessary. These recommendations do not preclude diversion from the Snowy River provided it does not significantly impair fish passage and habitat, canoe value, or increase 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.

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

In 1979 as part of the Alpine Area Investigation Council identified a site of approximately 20 ha south of McKillop Bridge as potentially suitable for the development of a resort. This site is located at the bottom of the Snowy River valley, and access roads are steep, winding and unsealed. The site also occurs in a rainshadow and its soils are susceptible to compaction and erosion. There are a number of localities in the region - some of which have already been privately developed - that are more centrally located, provide better access to a range of recreation resources, and where site conditions are more suited to resort development. Consequently Council considers that the temporary reservation previously recommended should be rescinded and the site included in the Snowy River National Park.

Recommendation

A9 Snowy River

That the 175 km river corridor from the New South Wales/Victoria border, to the sea, shown on Map A9 be used in accordance with general recommendations A1-A17 (a) to (l) above

(continued)

A9 - Snowy River (continued)

that

- (m) (i) the corridor be retained free from further impoundments, artificial barriers, or structures that impede the passage of in-stream fauna (see Note 3)*
- (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, 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

- (n) the following significant 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 for migration, and maintaining water quality, flow, and in-stream habitat conditions*
 - (iv) native fish diversity in the estuary*
 - (v) geological and geomorphological sites of significance*
 - (vi) cultural heritage sites of Pleistocene occupation, at New Guinea, Aboriginal archaeological sites, river crossings and other features on the Orbost floodplain*
 - (vii) outstanding botanical values*
 - (viii) fauna habitat values of the Snowy River valley, especially those associated with riparian vegetation, caves, and the brush-tailed rock-wallaby habitat of the Little River Gorge*
- (o) other recreation activities continue where permitted in accordance with land status.*
- (p) the area previously covered by recommendation T5 for the Alpine Area be included in the Snowy River National Park*
- (q) 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) (see Note 2)*

(continued)

A9 - Snowy River (continued)

(r) *the corridor managers liaise with agencies in New South Wales to enhance the protection of corridor values*

and that the corridor be managed by the Department of Conservation and Environment in conjunction with the Rural Water Commission and the Snowy River Improvement Trust (in its district), in relation to waterway management, and where appropriate the Port of Melbourne Authority in relation to navigable waters.

Notes:

1. *The upper reaches of this river are in an area of high wilderness quality being considered in the Council's current Wilderness Special Investigation.*
2. *Possible technical solutions to the problems of providing an environmental water requirement for the Snowy River should be identified first, then the social and economic implications should be assessed, particularly as they relate to the transfer of water allocations and any reduction in hydro-electricity generating capacity occurring as a result of their implementation. The SECV has prepared a preliminary estimate - \$14 million per annum - of the value of lost capacity, and the capital cost of replacing it.*
3. *It has been proposed that a saltwater barrier be constructed on the lower Snowy. This could prevent fish passage, limit the distribution of estuary and migratory species, and stop all but the smallest boats. Investigations into the need for such a barrier, alternative sources of freshwater (eg groundwater) if that is the primary concern, and possible sites, should be completed before a decision is made on this proposal. The matter could be included in a future review of these recommendations.*

SUGGAN BUGGAN AND BERRIMA RIVERS

The Suggan Buggan--Berrima 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 in elevation 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 passes through montane sclerophyll woodland communities, but for most of its length the corridor comprises riparian forest communities in sharp contrast with the adjoining rain-shadow woodland.



Suggan Buggan R. - towards the Snowy R.

A site of State botanical significance surrounds the corridor. The dry rain-shadow woodland dominated by white cypress pine (*Callitris collumellaris*) and white box (*E. albens*) and rocky outcrop open-scrubland communities are of outstanding botanical value. 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 vulnerable hairy anchor plant (*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 vulnerable Australian grayling and supports a diverse native fish population.

The visual character of the corridor has been assessed as having high scenic value. Some see the rain-shadow 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

A10 Suggan Buggan and Berrima Rivers

That the 56 km river corridor from the New South Wales/Victoria border to the Snowy River shown on Map A10 be used in accordance with general recommendations A1-A17 (a) to (l) above

that

- (m) (i) the corridor be retained free from impoundments, artificial barriers, or structures that impede the 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

- (n) the following significant values be protected*
 - (i) sites of botanical significance*

(continued)

A10 - Suggan Buggan and Berrima Rivers (continued)

- (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 (via Snowy River) for migration, and maintaining water quality, flow, and in-stream habitat conditions
- (iv) native fish diversity
- (v) the essentially natural condition of the Suggan Buggan and Berrima mainstreams
- (o) other recreation activities continue where permitted in accordance with land status
- (p) the corridor managers liaise with agencies in New South Wales to enhance the protection of corridor values

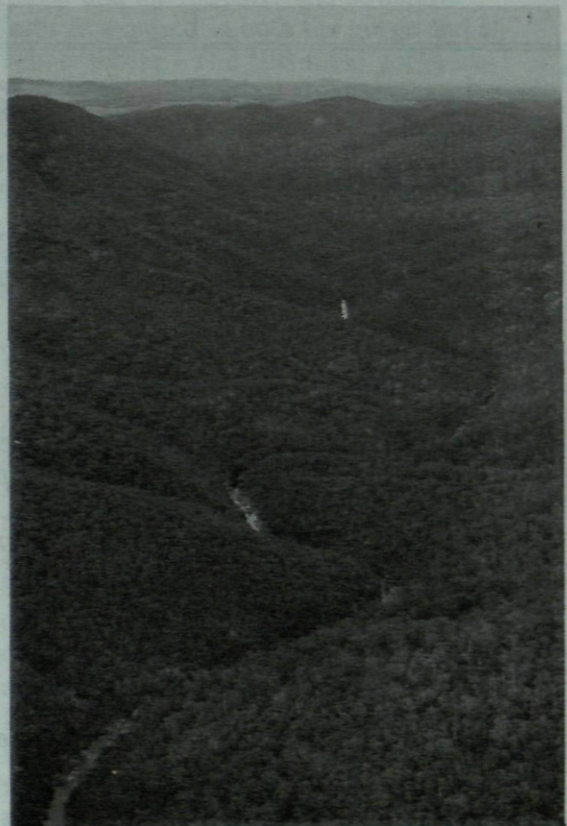
and that the corridor be managed by the Department of Conservation and Environment, in consultation with the Rural Water Commission in relation to waterway management.

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 Buchan heritage river corridor extends from 'The Playgrounds' near Mount Cobberas downstream to the Campbells Creek confluence. Over this reach it falls some 500 m in elevation and, after a gently sloping and broad valley in the upper section, has a deep and V-shaped valley. The river corridor forms part of a larger area within a site of outstanding botanical significance. Important riparian sites range from the alpine wet heathland in the upper reaches, and particularly at Native Dog Flat, where the rare Victorian endemic trailing beard-heath (*Leucopogon pilifer*) is found, to specific sample quadrats with high botanical significance for their undisturbed condition. The thick-leaf star-hair (*Astrotricha crassifolia*) - rare in Victoria - and bristle-fern (*Cystopteris filix-fragilis*) - rare in Australia and Victoria - have been recorded on the upper Buchan River. The vegetation of most of the corridor consists of a riparian forest community bounded by montane sclerophyll woodland.



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 vulnerable Australian grayling.

Also of importance is the section between Lake 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 Honey-suckle 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

A11 Upper Buchan River

That the 55 km river corridor from the 'Playgrounds' to the Campbell Creek confluence shown on Map A11 be used in accordance with general recommendations A1-A17 (a) to (l) above

that

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

that

- (n) the following significant values be protected*
 - (i) botanical values*

(continued)

A11 - Upper Buchan River (continued)

- (ii) scenic landscapes along the Buchan River*
 - (iii) Australian grayling habitat, by retaining free passage for migration, and maintaining water quality, flow, and in-stream habitat conditions*
 - (iv) the essentially natural condition of the Buchan mainstream*
 - (v) geologically significant exposures of Ordovician and Silurian sediments*
 - (o) other recreation activities continue where permitted in accordance with land status*
- and that the corridor be managed by the Department of Conservation and Environment, in consultation with the Rural Water Commission in relation to waterway management.*

Note:

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

MITCHELL AND WONNANGATTA RIVERS

The Mitchell and Wonnangatta 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 in elevation from the Great Dividing Range to its mouth in the Gippsland Lakes. It is the largest free-flowing river in Victoria in terms of annual flow, being free of barriers that affect the movement of native fish, or water diversions or additions that affect natural flows. It is an important example of the large-scale 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 a small intermontane basin - Wonnangatta Station area - 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 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 westernmost Australian occurrences of warm temperate 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. The riparian forest on the lower Wonnangatta is also of significance with 69 plant species being recorded, including the rare sticky bertya (*Bertya cunninghamii*).

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 abundance and diversity of native species recorded during fish surveys.

The river below the barrier at Bairnsdale also has a highly diverse fish population. In addition, the presence of species such as black 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.



Mitchell River at 'The Amphitheatre'

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 also interests walkers and river travellers. Nearby is the 'Slalom 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 and intrigue. On the lower Mitchell, Bairnsdale was a major port for river-boats.

A low barrier on an existing rock bar just upstream of Bairnsdale, was constructed to prevent the intrusion of saltwater during low flows. It was used as a pumping pool for Bairnsdale town water supply. The

movement of carp in advance of the saltwater that moves upstream during low flows is also restricted by this barrier. There is, however, no evidence that this barrier has affected the continued existence of those native species which have fresh and saltwater lifecycle requirements. A barrier, constructed in the lower end of the gorge last century and soon after breached by a flood, likewise does not affect the aquatic values.

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
	<u>13 500</u>	<u>256</u>

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

Concerns about security of water supply from the Mitchell River have often been raised. The major off-stream users of water from the Mitchell are irrigators on the Lindenow flats, and Bairnsdale water supply.

The Mitchell River has a large catchment (5450 sq. km) and an average annual flow of 960 000 ML per year. Flows are variable and strongly seasonal, with the mean September flow being 9 times the mean February flow. Daily flows from January to March average 720 ML, but in dry summers

can fall to less than 10 ML per day at Bairnsdale.

Irrigators currently use an average of 11 000 ML per year, and the Mitchell Water Board supplies about 3260 ML annually to Bairnsdale and small surrounding towns for domestic use. On an annual basis there is ample water in the Mitchell River system to supply this need and future needs.

However, as current diversions depend on run-of-the-river flows, restrictions on the use of water for agricultural purposes have been necessary, in about every fourth or fifth summer. Severe restrictions have been applied every 10 years on average. Supply security is currently below that of systems regulated by water storage, and this is the major resource matter addressed by these recommendations.

The current area irrigated and cropped on the Lindenow flats is about 3200 ha, close to the maximum area (3330 ha) capable of development. The remainder is under irrigated pasture. Previously, proponents of a dam on the Mitchell perceived that a major benefit would be an expansion of the area under (higher risk) vegetables on the Lindenow flats. In fact, this has occurred in the absence of a dam, from 920 ha in 1975, to 1310 ha in 1985, and in 1991 to a total area of some 3200 ha.

The Council's recommendations do not affect existing diversions and additional water from the Mitchell River could be used, provided that the volume, timing, and offtake do not significantly impair the identified river values. The recommendations must be viewed in conjunction with other current investigations, in particular, the Gippsland Water Strategy, which is being prepared by the Department of Conservation and Environment. The draft strategy report discusses a number of alternatives to provide water supply security and discusses the issues associated with provision of environmental flows in the Mitchell River.

Until recently, diversion of water from Victorian rivers, including the Mitchell, has not considered the environmental needs of aquatic and riparian ecosystems. However,

in accordance with the principles in the State Conservation Strategy, and the *Water Act* 1989, any new water resource development or additional diversion has to make provision for environmental water needs. A substantial allowance for environmental flows under the present situation may result in less water being available to irrigators.

The draft Gippsland Water Strategy identifies several alternatives to continue to provide for the existing water uses, and to address increased supply security, and environmental flows. Several alternatives could be used in combination, according to different circumstances on parts of the flats.

The full volume of water used annually need not be replaced - a partial solution would still improve in-stream flows. Storage of 10 000 ML would provide a high level of security for irrigators. The alternatives are now discussed.

1. Construction of on-farm storages. These would allow irrigators to store water for subsequent delivery during the growing season. The estimated construction cost per megalitre of water (\$180) is relatively high, due to the high construction costs associated with the flat nature of the land and the need to prevent seepage. The loss of valuable productive land would also have to be taken into account (probably about 3% of a 40 ha property). At least one irrigator currently uses an on-farm storage.
2. Construction of a groundwater artificial recharge scheme, which would refill the shallow aquifers for subsequent use. These aquifers are already utilised to some extent. Such a scheme could provide limited additional volume (3000 ML) as some of the known aquifers are too thin to store and yield sufficient quantities of water. In other areas the aquifer potential is not known. Costs are estimated at \$50 per megalitre.

Technical matters would need to be investigated, including aquifer storage capacity, bore yields, rate of discharge

to the river, and the likelihood of permanently flooding some low-lying areas.

3. Construction of a large off-river storage, for example, on Cobbannah Creek or Swamp Creek. At \$116 per megalitre, sites of 10 000 ML capacity would cost slightly more than those for on-river sites. The higher costs are attributable to pumping costs, poorer dam height-capacity relationships, and the need for road access. However, an off-river storage would offer advantages in environmental terms.
4. Construction of a 10 000 ML on-river storage on one of the Mitchell River tributaries (such as the Wentworth River or Dargo River) with its own catchment. These would cost about the same as the previously proposed Mitchell dam (\$107 per megalitre).

While not as significant as the Mitchell River corridor, such sites are also likely to have environmental values, and a dam would similarly act as a barrier on these rivers.

5. Construction of a groundwater supply scheme which taps the deeper LaTrobe Group aquifer (where water quality is suitable) in the vicinity of the Lindenow flats. This aquifer is restricted to the eastern part of the flats. Water salinity is around 1000 mg/l TDS, so that for some uses 'shandying' with surface water may need to be considered. Aquifer depths vary between 120 to 200 m, and bore yields would be expected to be up to 25 l/sec.

Due to the restricted extent of the aquifer it is likely that maximum development would be about 25 bores producing a total of about 3000 ML per year, at an estimated cost of \$61 per megalitre.

6. Construction of a storage on the Mitchell or Wonnangatta River corridor itself (\$107 per megalitre).

(Alternatives 1 to 3 would store water taken from the Mitchell at times of high flow.)

In view of the environmental values of the Mitchell and Wonnangatta Rivers in a State and national context, the Council firmly believes that the identified mainstream segment should remain free-flowing. That is, no in-stream impoundments, or artificial barriers that impede the passage of in-stream fauna are to be built. The Mitchell is the largest remaining river, in terms of annual flow, in the State without a dam; in fact it is the largest river from Grafton to (at least) Adelaide without a dam.

The Council, therefore, considers that alternative 6 above, a storage on the Mitchell River itself, is not appropriate as the associated changes to the flow regime would seriously damage several of the identified river values - the natural condition of the flow regime and the mainstream, free passage and habitat requirements for native fish, and canoeing opportunities. Significant botanical and geological sites may also be affected, depending on the site.

In the past, discussion about ensuring security of supply for irrigation and domestic use has focussed largely on proposals to dam the Mitchell, as if that was the only possible solution. In fact, there are alternatives that should be considered, and that would be more environmentally acceptable. Most may also be less costly to the beneficiaries, who will have to pay the full cost of any works. Before it reconsidered the recommendations below in a future review, the Council would have to be convinced that the additional cost of the next cheapest alternative to a Mitchell dam was substantial, and exceeded the river corridor's very high environmental values; that all alternatives had been fully investigated; and that the proposal was economically viable.

The Council recognises that further investigation of each of the alternatives is required and the final outcome may be a combination of a number of alternatives, each providing additional security for part of the area.

It is important to recognise that the Council's recommendations do not preclude future

works to improve security of supply for off-stream use, using Mitchell River water.

The Council is aware that it is proposing to close off one of the options, and believes that the alternatives (preferably involving a combination) are viable, based on information collected for the Gippsland Water Strategy. The values of the Mitchell and Wonnangatta River corridor can only be protected by maintaining the mainstream segment in a free-flowing condition. It is important to note also that the Council's recommendation that no dam be built on the corridor also applies to any proposal that might identify the Wonnangatta as a source of water for metropolitan Melbourne.

It is not the function of the Council to designate or recommend a particular alternative (or combination thereof) to a dam on the Mitchell. The Gippsland Water Strategy task force is studying water resources, uses and environmental flows in detail across the Gippsland region, and will include further discussion of these matters.

Ultimately any proposals for substantial water resource development would be likely to require an environment effects statement to be prepared and considered.

Economic considerations

The consultants reviewed past assessments of the economic values of a dam on the Mitchell and, excluding the cost of the loss of environmental values, concluded that a dam on the Mitchell for irrigation purposes was at best, 'a dubious economic proposition from the national or State viewpoint'.

It is appropriate to describe the economic viability of various alternatives to ensure supply security. A 1990 estimate prepared for the draft Gippsland Water Strategy, and not available to the consultants during their study, is that a 10 000 ML dam on the Mitchell would cost about \$1 070 000 per year in capital cost and annual operating costs. The benefit to users of a secure water supply can be calculated from the value of crop yield losses resulting from the periodic water restrictions, that is, losses that could be avoided if the supply was secure. These

losses have been estimated to equal about 12.5 ha for every 100 ha irrigated.

As outlined above, the area under crop has increased to near the maximum area in the absence of a dam. Accordingly, little increased area of crop can be attributed as being a benefit of improved water supply security. An extra 130 ha would take the cropped area to 'maximum expansion'. Allowing a 'double cropping' factor of 1.5, this extra area would be equivalent to 195 ha cropped.

Assuming an average gross margin of \$1160 per ha (a 1991 estimate from figures provided by the Victorian Farmers Federation), the above figure for yield losses and an extra 195 ha cropped, the total annual benefit to irrigators of a dam would be \$746 200, that is, only 70% of its cost.

As outlined above, the Government's 'cost recovery' policy requires that the off-stream users of water from new water resource development projects should pay for its construction and operation as well as the cost of water allocated to maintain the natural stream environment. As irrigators would receive about 85% of available yield from any development they are primary beneficiaries of improved security.

Users would have to pay the full cost, that is \$107 for every megalitre used (\$1.07 million divided by 10 000 ML) as opposed to the \$1.25 per ML currently paid by the irrigators.

It is doubtful whether the irrigators would be willing to pay these substantially increased water costs. In addition, this does not include the costs for losses of environmental values, nor provision for environmental flows. In these circumstances the Council believes that the construction of a dam to provide additional security of supply for irrigation is not an economic proposition, even at a local scale, and it is therefore appropriate to carefully investigate the alternatives that could provide supply security.

Of the larger scale alternatives 1, 3 and 4 (outlined above), the estimated annual costs

of construction and operation would be \$1.8 million, \$1.2 million and about \$1.2 million respectively, excluding any environmental costs. The Mitchell dam would cost \$1.07 million per annum. However, the environmental impact of the first two alternatives is likely to be small, while environmental costs of the Mitchell dam proposal would be substantial.

If the consultants' lower estimate - \$1.5 million per year - for Mitchell corridor environmental values is taken as a guide (although they considered the upper estimate of \$8.1 million was more likely), it can be seen that the total cost (including environmental considerations) of building a Mitchell dam is likely to be higher than the other alternatives.

The Council recognises that there are other benefits accruing to the local community from irrigated agriculture reliant on water from the Mitchell River, but these benefits are not affected by these recommendations. The beneficiaries must decide whether improved security of water supply, using options other than a dam on the Mitchell, is worth the cost.

In relation to the improved security of domestic water supply for Bairnsdale and smaller communities in the region, present and future needs and a secure supply in times of drought can be provided by an increase in off-stream storage capacity near the city using water from the Mitchell, or by augmentation of supply from other sources, including those outside the Mitchell Basin. The Mitchell Water Board has employed consultants to identify suitable sites for such an off-river storage.

Two other perceived benefits of dam construction were raised by submissions. The first is that a dam on the Mitchell could provide regulated flows which would assist in controlling water quality and algal blooms in the Gippsland Lakes. The hydrology of the Lakes and the evidence gathered to date on the cause of the blooms suggest that the impact of artificially regulated flows from such a dam would be inconsequential in this regard. The second is that a dam may also provide for flood mitigation. The main

reason advanced to construct a dam is to store water to ensure security of supply for irrigation purposes. To maximise the return from such an investment, the storage should be maintained near maximum capacity, in which state the flood mitigating effect is very low. If a dam of such capacity were constructed and empty, it is estimated by the Department of Conservation and Environment that the 1990 Mitchell flood would have filled it in 20 minutes. The flood would then have continued unabated.

Other Resource Issues

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.

Recommendation

A12 Mitchell and Wonnangatta Rivers

That the 256 km river corridor from the Wonnangatta headwaters to Lake King shown on Map A12 be used in accordance with general recommendations A1-A17 (a) to (l) above that

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

that

- (n) *the following significant 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*
 - (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*
 - (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 native species in the lower Mitchell*

(continued)

A12 - Mitchell and Wonnangatta Rivers (continued)

(viii) canoeing - Wonnangatta River, and Mitchell River particularly in the gorge

(o) other recreation activities continue where permitted in accordance with land status

and that the corridor be managed by the Department of Conservation and Environment, in conjunction with the Mitchell River Management Board in relation to waterway management, and the Port of Melbourne Authority in relation to navigable waters.

Notes:

- 1. While it is not the function of the Council to make recommendations relating to water allocations (the Gippsland Water Strategy is considering such matters), the Council's view is that the existing reliability of supply in relation to current urban and irrigation water entitlements should not be adversely affected.*
- 2. 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.*
- 3. Council is aware that the Mitchell River Catchment Co-ordination Group is currently undertaking a study of the lower Mitchell River corridor.*
- 4. Additional sections of the Wonnangatta Track may be upgraded or realigned in the future. The recommendations in Chapter F are to be included in an assessment of the need for, and impact of construction.*

THOMSON RIVER

The Thomson heritage river corridor begins just below the Thomson Dam which stores water for diversion to Melbourne, 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



Thomson River from Bruntons Bridge

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
	<hr/>	
	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

A13 Thomson River

That the 64 km river corridor from below the Thomson Dam to Cowwarr shown on Map A13 be used in accordance with general recommendations A1-A17 (a) to (l) above

that

- (m) (i) the corridor be retained free from further impoundments, artificial barriers, or structures that impede the 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 entering the corridor upstream from Cowwarr Weir only be permitted if their volumes, timing, and offtake do not significantly 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 water requirement, and ensure this is provided*

(continued)

A13 - Thomson River (continued)

- (v) *the canoeing quality of downstream releases be optimised within allocation agreements (consistent with the protection of in-stream biological values)*
- (vi) *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

- (n) *the following significant values be protected*
 - (i) *canoeing - Thomson Dam to Cowwarr Weir*
 - (ii) *scenic landscapes along the Thomson River for the whole reach*
 - (iii) *cultural heritage sites*
 - (iv) *fishing opportunities, especially for freshwater blackfish*
 - (v) *Australian grayling habitat, by not creating barriers to migration below the designated corridor, and by maintaining water quality, flow, and in-stream habitat conditions*
- (o) *the relatively natural mainstream condition be protected*
- (p) *other recreation activities continue where permitted in accordance with land status*

and that the corridor be managed by the Department of Conservation and Environment, in conjunction with the Rural Water Commission and the Board of Works (in relation to river flows) and the Latrobe Region Water Authority (in relation to waterway management).

Notes:

1. *The committee established to review releases from the Thomson Dam is convened by the Office of Water Resources.*
2. *Council is aware of concerns about the flow arrangements for the Thomson River below Cowwarr.*

YARRA RIVER

The Yarra 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, and the river an important feature in the landscape. 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.

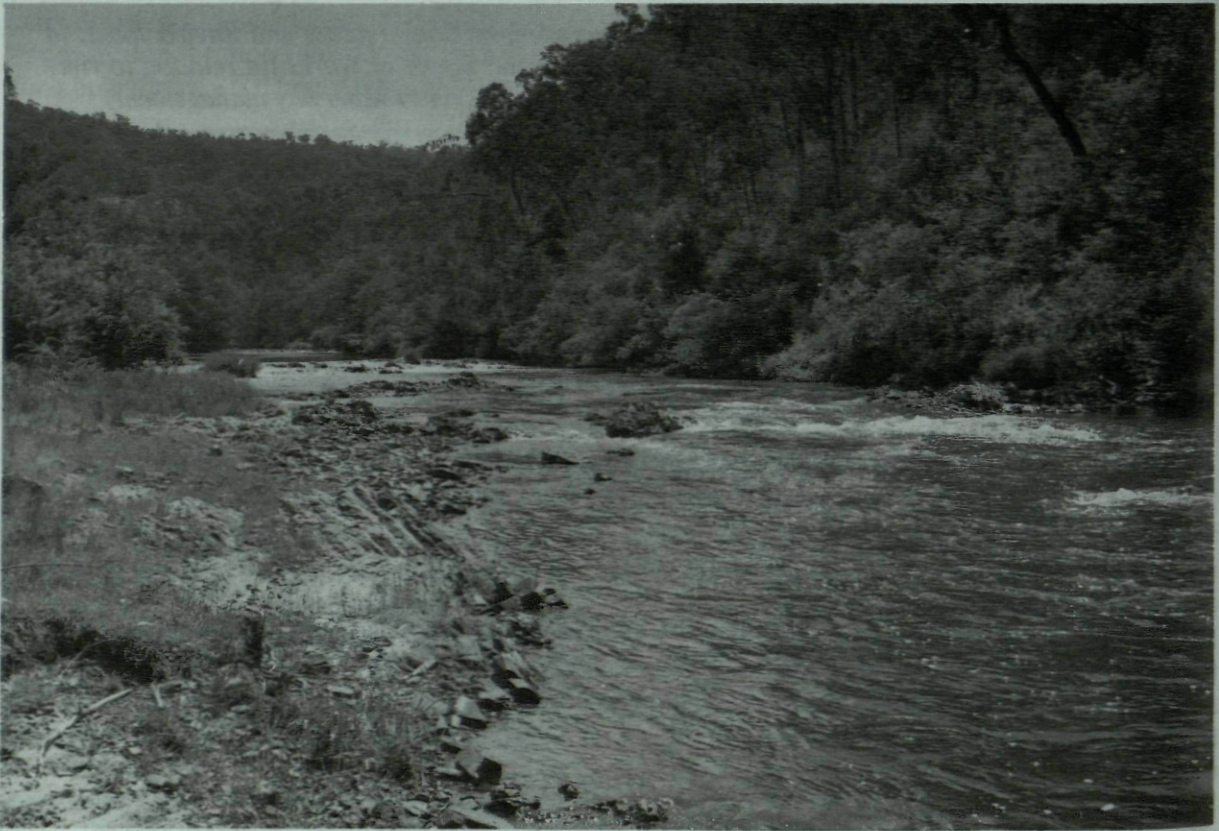
The riverside stand of Buxton gum (*E. crenulata*) south of Yarra Glen is of national significance. Although the species is endemic to south-central Victoria, this is one of only two known indigenous stands, and the species is considered endangered. It also contains a relatively intact tussock grassland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

At Everard Park a disjunct stand of mountain swamp gum (*E. camphora*) is its most western occurrence. Together with a significant (although small) remnant of floodplain vegetation, river red gum woodland with a relatively intact under-storey, 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.

The Yarra's 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 (*Gadopsis marmoratus*), 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.



Yarra River at Yering Gorge

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 Victorian 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 Victorian heritage river corridor. Within the corridor, a series of pumps - with a capacity of 1000 ML per day - lifts water at Yering Gorge to the Winneke treatment plant. A possible augmentation of this system - the 'combined scheme' - would use water from within the Yarra River basin, and may be required by the year 2016/17, depending on the interim demand for water, and the measures taken to meet this demand. These recommendations would not preclude the development of the 'combined scheme'.

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

The consultants concluded that the environmental values exceed resource values.

Recommendation

A14 Yarra River

That the 103 km river corridor from Warburton to Warrandyte shown on Map A14 be used in accordance with general recommendations A1-A17 (a) to (l) above

that

(m) (i) *any new impoundments, artificial barriers, or structures that impede the passage of in-stream fauna, or diversions of water from the river, only be permitted if their volumes, timing, and offtake do not significantly 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*

(continued)

A14 - Yarra River (continued)

that

- (n) the following significant values be protected*
 - (i) scenic landscapes from Yarra Glen to Warrandyte*
 - (ii) botanical values*
 - (iii) zoological values*
 - (iv) canoeing - Warburton to Warrandyte*
 - (v) river blackfish and Macquarie perch habitat*
 - (vi) fishing opportunities, especially for trout*
 - (vii) geological/geomorphological sites of significance*
 - (o) other recreation activities continue where permitted in accordance with land status*
- and that the corridor be managed by the Department of Conservation and Environment in conjunction with the Board of Works.*

Notes:

- 1. The Yarra River corridor lies within a broader valley area which in 1982 was given a 'classified' status by the National Trust, in recognition of its cultural, natural, recreation and scenic values.*
- 2. A number of arrangements are currently in place which specify minimum flows in the Yarra. These are a 73 ML per day at Millgrove (set in 1974) and 245 ML per day at Warrandyte (set in 1984). These flows were set to meet specific requirements at those times, but at present the environmental water requirements have not been determined.*
- 3. A project to investigate the effects of different flow levels on the environment and water quality has been jointly developed by the Environment Protection Authority, the Board of Works and the Upper Yarra Valley and Dandenong Ranges Authority. The implementation of this project awaits adequate resources.*

LERDERDERG RIVER

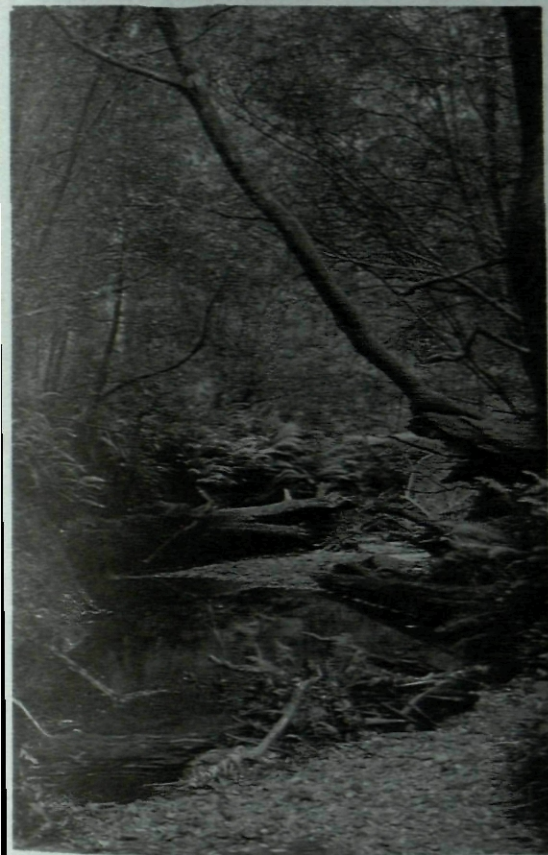
The Lerderderg heritage river corridor begins at the junction of Crowley and Cooper Creeks, in the Wombat Forest. It flows south-east past the township of Blackwood, through the Lerderderg Gorge to the Werribee Valley above Bacchus Marsh. The landscape throughout the upper reaches is dissected. This 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, about 300 million years ago. 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.



Lerderderg River above Blackwood

Vegetation along this corridor varies substantially. Within the gorge, the open forest II of red stringybark (*E. macrorhyncha*), blue gum (*E. pseudoglobulus*), and red box (*E. polyanthemus*) occurring on the lower slopes changes clearly to the dry open forest I associations of red stringybark, long-leaf box (*E. goniocalyx*), 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 (*E. obliqua*), broad-leaf peppermint (*E. dives*), manna gum, and brown stringybark (*E. baxteri*). Manna gum becomes dominant on alluvial soils close to the river, while associated species include mountain grey gum (*E. cypellocarpa*), blue gum, and candlebark (*E. rubida*). 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 (*Stipa breviglumis*), tortuous rapier-sedge (*Lepidosperma tortuosum*), slender saw-sedge (*Gahnia microstachya*), swamp bush-pea (*Pultenaea weindorferi*), hairy beard-heath (*Leucopogon microphyllus*), and violet westringia (*Westringia glabra* var. *bacchi*).

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 overnight 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
	<hr/> 5490	<hr/> 63

In State forest the corridor is of variable width. Upstream of Simmons Reef, the boundary on the south side of the river generally follows the Lerderderg River Road. This 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. 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. On the north side of the river upstream of Blackwood, the corridor boundary varies in width, from 50 m to about 380 m. It follows the point where steep slopes directly facing the river change to gentler, long slopes or spur tops. 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 this corridor, are diverted by a weir near the downstream end, within the Lerderderg Gorge, to the Merrimu Reservoir. It is proposed that this reservoir be enlarged, and that additional volumes be diverted from the Lerderderg River during high flows, subject to recommendation A15(m)(i) below.

The timber resources affected by these recommendations are 9750 cu.m class C+ sawlogs, 2100 cu.m class D sawlogs; and 6050 cu.m residual roundwood. Withdrawal of this resource will reduce regional sustainable yield by about 0.9% in the Midlands Forest Management Area.

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

A15 Lerderderg River

That the 63 km river corridor from the junction of Crowley and Cooper Creeks to the mouth of the gorge shown on Map A15 be used in accordance with general recommendations A1-A17 (a) to (l) above

(continued)

A15 - Lerderberg River (continued)*that*

- (m) (i) *new impoundments, artificial barriers, or structures that impede the 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 significantly 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

- (n) *the following significant values be protected*
 - (i) *geological and geomorphological area of State significance - the Lerderberg Gorge*
 - (ii) *geological features of international significance - Permian glacial exposures near the gorge mouth*
 - (iii) *scenic landscapes along the Lerderberg River from Crowley Creek to the gorge mouth*
 - (iv) *blue gum and manna gum open forests, and the riparian forest transition along the entire corridor*
- (o) *the cultural heritage features be recognised*
- (p) *other recreation activities continue where permitted in accordance with land status*

and that the corridor be managed by the Department of Conservation and Environment in conjunction with the Rural Water Commission.

AIRE RIVER

The Aire Victorian heritage river corridor extends from the Hopetoun Falls Scenic Reserve 35 km downstream to the ocean. The Aire drains one of the highest rainfall areas in the State.

The mainstream section of the Aire River contains undisturbed corridors of native vegetation comprising mostly cool temperate rainforest species. In the forested area along the Aire River, myrtle beech (*Nothofagus cunninghamii*) flanks almost the entire length of the watercourse. This is unusual in that most stands of this species along other streams in the region are discontinuous. Vegetation adjoining the rainforests is

mountain ash (*E. regnans*) and messmate wet sclerophyll forest in the upper reaches, and damp sclerophyll forest dominated by messmate and mountain grey gum in the lower part of the gorge.

The Aire River has created a spectacular valley with numerous pools, riffles, and waterfalls. Two sections of the Aire have been assessed as having high scenic landscape value - from the commencement of the corridor to the mouth of its rugged gorge near the Great Ocean Road, and in the estuary below Lake Craven. Several geomorphological and geological features of importance are also found here - the gorge, a

lake created by a landslip, and a structurally controlled meander, all being of State significance.

The cool clear waters in the forested areas provide good habitat for trout while the lower reaches are regarded as some of the best wild trout waters in the district with large fish being taken.

The Aire River contains significant wildlife conservation values. It has an exceptionally large population of platypus and its native fish are of interest.

This river is particularly notable for its diverse native fish fauna, with 12 species being recorded. Two species - the Australian grayling and Tasmanian mudfish - are classified as vulnerable; three species are potentially threatened and one species is indeterminate.

The Aire valley includes a popular scenic drive, and the river is readily accessible at several points for picnicking and camping.

Tenure

Public land tenure	Area (ha)	Length (km)
State forest	570	24
Otway National Park	108	2
Softwood Production	32	2
Wildlife reserve	20	1
Public land water frontage reserve	90	10
	820	35

The corridor boundary is as follows. In the hardwood production areas, it includes a minimum width of 100 m each side of the river, plus areas of cool temperate rainforest with a minimum 20 m buffer, and old growth mountain ash wet sclerophyll forest on slopes greater than 30° (where these are adjacent to the corridor), to a maximum width of 200 m each side of the river. In the Aire Valley softwood plantation, the corridor width is 50 m each side of the river to Hopetoun falls, including the scenic reserve at the falls, and two popular camping areas.



Aire River Falls

The river corridor would be reduced to the public land water frontage reserve for the 6 km stretch that flows through open agricultural land at the downstream end of the corridor.

The Aire River corridor - 200 m wide each side - passes through the Otway National Park for its remaining 3 km before it flows into the sea.

Resources

No water abstractions are proposed for the Aire River until at least 2030, when it is envisaged that a further review of water requirements will be undertaken in the south-west of Victoria.

Forest management planning for the available timber resources has taken account of the significant values contained along the Aire

River. The importance of this stream corridor was highlighted in Council's Corangamite Area Final Recommendations (1978) and specific recommendations were made for its protection. The Proposed Forest Management plan for the Otways protects this corridor by a 200-m-wide buffer on each side of the river in the lower gorge (downstream from Clearwater Creek), with a 100-m-wide buffer on each side upstream from there to the Aire Valley Plantation.

The Aire River corridor, described above, would add adjoining areas of rainforest (protected under the Code of Forest Practices) and areas of old growth ash forest on steep slopes (protected under

prescriptions). There is accordingly no impact on timber resources.

Council also considered a uniform 200-m-wide corridor (on each side) in this section (below the softwood plantation), however this would have affected 140 ha of productive hardwood forest, carrying some 12 000 cu.m of standing mountain ash D+ grade sawlogs, including 66 ha of mature/overmature forest incorporating 'old growth' areas and carrying a standing volume of 5150 cu.m. A wider corridor would also have included 15 ha of sawlog-quality blackwood, carrying 600 cu.m and overall, reduced regional sustainable yield by 2.5% in the short term. This proposal was therefore rejected.

Recommendation

A16 Aire River

That the 35 km river corridor from Hopetoun Falls to the ocean shown on Map A16 be used in accordance with general recommendations A1-A17(a) to (l) above

that

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

that

- (n) the following significant values be protected*
 - (i) scenic landscapes from the commencement of the corridor to the mouth of the gorge, and below Lake Craven*
 - (ii) cool temperate rainforest along the corridor*
 - (iii) Australian grayling and Tasmanian mudfish habitat*
 - (iv) native fish diversity*
 - (v) geomorphological sites of significance*
- (o) the following important features be protected*

(continued)

A16 - Aire River (continued)

- (i) habitat for platypus*
- (ii) opportunities for trout fishing*
- (p) other recreation activities continue where permitted in accordance with land status*
- (q) arrangements necessary to protect the values of the estuary and associated lakes, and reduce flood impacts on private land, be investigated*

and that the corridor be managed by the Department of Conservation and Environment, in conjunction with the Rural Water Commission in relation to waterway management.

GLENELG RIVER

The Glenelg Victorian heritage river corridor is located on the lower Glenelg from Fort O'Hare at 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 black 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.



Glenelg River at Forest Camp North

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
	<hr/>	<hr/>
	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 Map A17. 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. The recommendations provide for

the examination of these issues. 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.

The river is narrow and it is important both that overcrowding is avoided, and that safe passage is provided for watercraft with low freeboard, such as dinghies and canoes.

Recommendations for the consideration of speed boats are outlined in section F1. Having regard to overcrowding and waste disposal issues, the use of the corridor by 'houseboats' - watercraft designed to provide overnight accommodation - is of particular concern. Council has therefore recommended that they not be permitted in this corridor.

Recommendation

A17 Glenelg River

That the 83 km river corridor from Dartmoor to the sea (excluding the section in South Australia) shown on Map A17 be used in accordance with general recommendations A1--A17 (a) to (l) above

that

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

that

- (n) the following significant 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*
 - (iv) canoe touring - Dartmoor to Nelson*
 - (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*

(continued)

A17 - Glenelg River (continued)

- (vii) *recreational fishing opportunities - especially for bream, estuary perch, and mullocky*
- (o) (i) *other recreation activities continue where permitted in accordance with land status*
- (ii) *the use of houseboats not be permitted*
- (p) *the corridor managers liaise with agencies in South Australia to enhance the protection of corridor values*

and that the corridor be managed by the Department of Conservation and Environment, in conjunction with the Rural Water Commission.

MURRAY RIVER

For the section of the Murray River that forms the New South Wales/Victoria border only the frontage to the south bank lies in Victoria.

The Land Conservation Council has, in its regional studies along the Murray, recognised the significance and diversity of values of the south frontage to the Murray River and the need to protect them. As a result of these studies all public land in Victoria that abuts the Murray includes, as a principal land use objective, the protection of nature conservation values, cultural heritage values, scenery and recreational opportunities.

The main public land use category along the Murray is the River Murray Reserve. There are also several parks.

The River Murray Reserve follows the river as well as its major anabranches. Adjacent to larger public land areas the Reserve is often several hundred metres wide. It also includes areas of reserved and unreserved Crown land considered necessary to maintain the treescape and the river environment.

In a number of sections, however, the Reserve comprises only the relatively narrow 60-m-wide strip of public land between private land and the River. Council has previously suggested that the Reserve be zoned to provide for a range of permitted uses.

Other land tenures along the Murray include national, State and regional parks. These also provide for the protection of nature conservation, recreation, scenic, and cultural heritage values.

Council considers that the Murray River, with its extraordinary array of cultural, recreational, scenic, and nature conservation values along its Victorian frontage, would be an obvious candidate if a national heritage river system were to be developed.

The land use and management issues along the Murray are many and the responsibilities lie with the various State and Commonwealth agencies such as the Murray-Darling Basin Commission.

Murray River Parkway Proposal

In September 1989, the third Fenner Conference on the Environment was held in Canberra at the Australian Academy of Science on the theme 'Conservation and Management of the River Murray System - Making Conservation Count'. A resolution of the conference was to establish a Murray-Darling Parkway extending from the mouth of the Murray along the two major arms of the river system. Subsequently, the Murray-Darling Basin Commission has provided funds to carry out a feasibility study to examine this proposal, focusing on the Murray River.

Currently, the concept embraces the idea of a corridor of land along the Murray River involving a variety of tenures and different ownerships. It would encompass all current public land uses under a co-operative management program to ensure the effective conservation of riverine biota, cultural heritage, and recreation values, and current

agricultural and forestry industries. Participation in the Parkway, whether by private landholders or public authorities, would be by way of voluntary agreements which are sensitive to current land uses, but which have a focus on the maintenance and conservation of the River Murray system.

Recommendation

A18 Murray River

That

- (a) the areas of Victoria's public land abutting the Murray River continue to be used for the purposes previously approved by the government for the Alpine Area - Special Investigation, North-eastern Area (Benalla-Upper Murray) Review, Murray Valley Area, and Mallee Area Review*
- (b) for the purposes of establishing priorities for management, the Murray River be considered as if it were a Victorian heritage river*

and that

- (c) initiatives that promote and enhance the protection of its values, through co-ordination with interstate and Commonwealth agencies, the Murray-Darling Basin Commission in particular, be supported by the State government with a view to protecting the scenic, recreational, cultural, and ecological values of the Murray River corridor.*

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. They commonly range in size from 1000 to 10 000 ha. An 'essentially natural' catchment is one with no urbanisation, clearing, intensive agriculture, grazing, timber-harvesting, plantations, mining, extractive industries, water storages, water diversions, river engineering works, or roads parallel and immediately adjacent to streams.

In considering grazing as a land-use filter Council notes that there are very few areas of Victoria which have not, at one time or other, been grazed by domestic stock. Grazing records are also incomplete. When assessing catchments for their naturalness the period and intensity of grazing were considered, excluding those catchments that are currently grazed or have been recently grazed.

Changes to the fire regime may also affect the naturalness of a catchment. It is recognised that fire is a natural occurrence in most Victorian ecosystems, and that it is an essential component of their dynamics. However, when the frequency, intensity, or time of occurrence of fire and area burned are changed significantly, as has occurred over the last 200 years, ecosystems can markedly alter. The effects of such changes in fire regime on the essentially natural condition are, however, not understood sufficiently to enable modifications to the fire regime to be used as a land use filter. In fact, it may not be possible to define a 'natural' fire regime.

Pest plants and animals occur across much of Victoria, though population densities vary widely. Plants such as blackberries, and pest animals such as foxes and brumbies may occur in areas which would otherwise be essentially natural. There is insufficient data to enable the presence of pest plants and animals to be used as a filter in the selection of essentially natural catchments. However, where they do occur it is appropriate that control measures be taken. In general, essentially natural catchments are relatively free of pest plants and animals compared with other areas of land.

State-wide studies to identify and rank catchments have used various departmental records of these activities. 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. More detailed analysis and field inspection of these catchments, however, has shown that many have had one or more uses that diminish their naturalness, such as mining, water diversion, some timber-harvesting, stock-grazing, and roading.

Council has now established 45 catchments as being essentially natural. These are listed in Appendix III.

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 ²	Jobs ³ affected if resource is withdrawn (person/year)	Forest management area
B5	Log Bridge Creek - East Branch	1280	0.1	negligible	Wodonga
B6	Mt Tabor Creek	1800	0.1	negligible	Wodonga
B7	Banimboola Creek	2400	0.2	negligible	Wodonga
B8	Devils Creek - Middle Branch	No economic stands of merchantable timber			
B9	Yarrarabula Creek	1620	0.1	negligible	Wangaratta
B10	Long Jack Creek	940	<0.1	negligible	Wangaratta
B11	Williams Creek	240	0.2	negligible	Benalla/Mansfield
B21	Stony Creek	800	<0.1	negligible	Tambo
B22	Wongungarra River headwaters	No economic stands of merchantable timber			
B25	Punchen Creek	< 300	<0.1	negligible	Tambo
Other catchments not recommended					
-	Cavender Creek	25 900 ¹	0.3	0.7 long term	East Gippsland
-	Decimal Creek	67 000 ¹	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.

Source: Resource Assessments Branch, Department of Conservation and Environment

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

Based on a framework of third order essentially natural catchments, it was possible to define larger catchments, or areas containing adjacent catchments that incorporate these additional catchment values. They 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.

Based on exploration to date, none of the catchments within State forest contains 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 if the resources are withdrawn as recommended, and estimates of direct job losses. On balance Council considered that the value to the community of maintaining these catchments in at least their present condition warranted their protection, with two exceptions - Decimal Creek - a tributary of the Humffray River, and Cavender Creek - a tributary of the Yalmy River. In considering these catchments, Council was mindful that:

Decimal Creek catchment

- * contains three land systems - 1.1/Ss87, 1.1/Ss83, and 1.1/Ss91, each of which is represented in three or more other recommended essentially natural catchments;
- * contains 1932 regrowth alpine ash (*E. delegatensis*), producing 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.

Cavender Creek catchment

- * contains land system 1.1/Ss713, which is represented in four other recommended essentially natural catchments; contains at maturity, 23 500 cu.m of class C+ sawlogs. The labour involved in the direct processing of this timber resource would be equivalent to 0.7 persons per year over the long term.

Consequently Council considered that a change in the land use of the Decimal and Cavender Creek catchments, from State forest, was not appropriate.

The Council believes that the catchment areas described below should be protected in their entirety from future disturbance. The total area of essentially natural catchments is

154 020 ha, with 33 (totalling 134 400 ha) wholly in existing parks and reserves and 10 (totalling 19 620 ha) fully or partly in State forest.

Management and Use of Essentially Natural Catchments

Recreation

Council considers that these catchments provide opportunities for a range of recreational activities which can be carried out in ways consistent with the maintenance of the essentially natural condition of the catchment. In principle these activities would generally include those permitted by the existing land status. There may be practical constraints in pursuing some activities within these catchments. For example a stream flowing from a catchment 2000 ha in size, is likely to be less than 1 m wide, less than 30 cm deep and totally enclosed by vegetation, constraining activities such as angling, canoeing or swimming. They are also largely untracked. With minor exceptions the use of powered watercraft would not be possible in these catchments. Section F1 provides guidance to the manager when considering recreational activities.

Fire

As described above changes in fire regime can alter ecosystems. Council notes that some catchments lie within priority zones for fuel reduction burning. It would be preferred that when fire plans are being developed or reviewed that priority zones be located outside these essentially natural catchments, where possible. In some instances manipulation of the fire regime within catchments may be necessary to ensure that particular plant or animal species or communities are conserved.

When fire suppression is required, and alternatives such as aerial fire suppression are not available it would be preferable for fire lines constructed by earth moving equipment to be located outside the catchment or along the catchment divide.

Other Catchment Areas

Council acknowledges the implications of choosing such rigorous land use filters for essentially natural catchments, and third order as the assessment unit. Council also recognises that there may be many first or second order catchments, including Reference Areas previously recommended by Council, that meet the condition necessary for them to be considered essentially natural.

Many catchments smaller than third order and in an essentially natural condition occur in existing conservation reserves. In such reserves the resource implication arising from the protection of these catchments is probably very low. It is therefore appropriate that the condition and importance of such catchments be recognised when Park management plans are being developed or reviewed.

In the Snowy River National Park, for example, the third order catchment containing Swamp Creek, a tributary of the Deddick River, was at one stage partly cleared in its lower reaches. The upper section - the majority of the catchment - is in an essentially natural condition. The natural area is however less than third order, and is therefore not included in these recommendations.

Detailed plans of the recommended catchments are not included in this report; however, they are available from the Council on request.

ESSENTIALLY NATURAL CATCHMENTS

Recommendations

B1-B26 That the catchments shown on Map 1 and described below be maintained in at least their present essentially natural condition

(continued)

B1-B26 - Essentially Natural Catchments (continued)

that

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

- * *clearing of indigenous vegetation*
- * *timber-harvesting*
- * *plantation establishment*
- * *mining*
- * *mineral exploration, except in accordance with the recommendations outlined in section F11 and where permitted by land status*
- * *extractive industries*
- * *water storages*
- * *water diversions*
- * *river engineering works*
- * *new roads or the upgrading of existing roads*
- * *domestic stock grazing*
- * *the discharge, emission or deposit of any material that may affect the essentially natural condition of the catchment*
- * *use of biocides other than in accordance with an approved management plan (see Note 5)*
- * *stocking of non-indigenous species (see Note 6)*
- * *use of power-boats, in order to protect the streams from hydrocarbon contamination*

(b) *their water quality be recognised and protected, and if not already so they be scheduled as aquatic reserves under the relevant Water - State Environment Protection Policy*

(c) *they be available for water production, education, non-manipulative scientific study, existing recreational activities permitted in accordance with the land status, and for proposed activities where these do not conflict with the maintenance of the essentially natural condition*

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

Notes:

1. *In protecting the essentially natural condition, closure of some existing tracks may be required, for example dead-end or spur tracks that do not provide access to a particular destination.*
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.*
4. *Where these areas include proclaimed or approved reference areas, the recommendations for use of reference areas have primacy.*
5. *Several of these catchments contain pest plants and animals that will need appropriate forms of control.*

(continued)

B1-B26 - Essentially Natural Catchments (continued)

6. *Stocking is to occur only for conservation purposes using indigenous species, and where the status of a species is at risk as a result of some unforeseen change.*
7. *Proposed Recommendations have recently been published for the Council's current Wilderness Special Investigation. Certain of the objects of those proposed recommendations parallel recommendations in this category, although management details differ. The following table lists recommended essentially natural catchments, and related Wilderness proposed recommendations.*

<i>Essentially natural catchment recommendation</i>	<i>Related Wilderness Special Investigation Proposed Recommendation</i>
<i>B1 Red and Benedore Rivers etc</i>	<i>A17 Sandpatch</i>
<i>B2 Rodger River and Mountain Creek</i>	<i>A14 Snowy River and A15 Bowen</i>
<i>B3 Avon River</i>	<i>A7 Avon</i>
<i>B10 Long Jack Creek</i>	<i>B12 Dandongadale</i>
<i>B13 unnamed Genoa River tributary</i>	<i>A16 Genoa</i>
<i>B14 Winnot Creek</i>	<i>A16 Genoa</i>
<i>B16 Gattamurh Creek</i>	<i>A13 Tingaringy</i>
<i>B17 Wallaby Creek</i>	<i>A13 Tingaringy</i>
<i>B18 Mt Gelantipy Creek</i>	<i>A14 Snowy River</i>
<i>B20 Brodribb River headwaters</i>	<i>B18 Brodribb</i>
<i>B26 Mt Vereker Creek</i>	<i>B22 Vereker</i>

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 is within the Croajingolong National Park, and is also part of a Biosphere Reserve declared under the UNESCO program, along with the remainder

of the national park and the adjacent 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.

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 previous Council recommendations.

Plant species present make the vegetation communities in the catchments of outstanding botanical significance. The coastal heathlands at Seal Creek are among the most species-diverse plant communities in the World, outside tropical lowland rainforest. Near the mouth of Shipwreck Creek, rare species include the tiny spyridium (*Spyridium cinereum*), rush fringe-lily (*Thysanotus juncifolius*), and sheath rush (*Cyathochaeta diandra*). In addition, undisturbed lowland sclerophyll forest, dominated by an overstorey of red bloodwood-silvertop (*E. gummifera*-*E. sierberi*), occurs in the Benedore River and Seal Creek catchments.

The plant communities also provide animal habitat for a number of significant species, including the ground parrot (*Pezoporus*

wallicus), diamond python (*Morelia spilota spilota*) and she-oak skink (*Tiliqua casuarinae*) - all of which are vulnerable - and the rare swamp skink (*Egernia coventryi*).

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 scenic and 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-B26 (a) to (c) above

that

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

and that

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

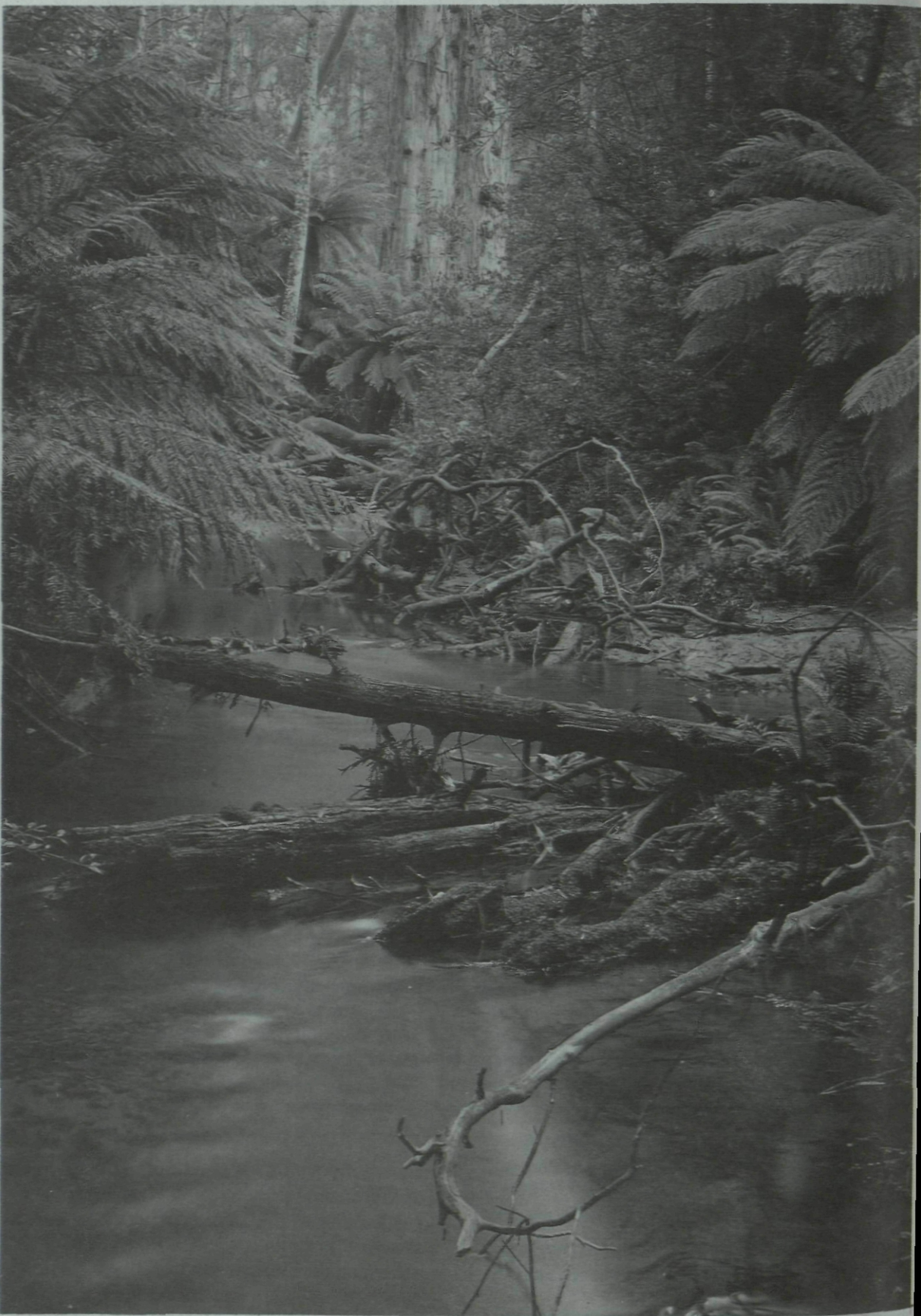
Notes:

1. *The upper Benedore River is a Reference Area, and the whole Benedore River is a declared Scientific Reference Segment under the State Environment Protection Policy - Waters of Far East Gippsland. The streamside spraying of pesticides and herbicides is prohibited.*
2. *The catchments contain a number of significant plant communities, and habitat for the ground parrot which may require artificial burning regimes to ensure their conservation (Meredith and Jaremovic, 1990).*

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;



Rodger River

and New Country Creek - a tributary of Mountain Creek.

Rodger River and Mountain Creek vary in features such as bedrock geology and morphology. The upper Rodger River catchment is an upland basin, comparatively broad with gentle slopes, whereas Mountain Creek has a deeply 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, vegetation diversity 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 42 090 ha shown on Map 1 be used in accordance with the general recommendations B1-B26 (a) to (c) above

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 39 840 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; an 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 watercourses 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–B26(a) to (c) above

and that

- (d) *Australian grayling habitat be protected by retaining free passage to the sea 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 that are 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 occurrence. Mountain ash wet sclerophyll forest dominates, but excellent examples of montane forest, myrtle beech cool-temperate rainforest, sub-alpine forest, and other communities also occur here.

The old-growth mountain ash forest provides habitat for a wide range of significant species, resulting in its categorisation as having 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 (*Tyto tenebricosa*), a species classified as rare in Victoria, and the endangered Leadbeaters possum (*Gymnobelideus leadbeateri*).

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. Because of its scientific and aesthetic values, the O'Shannassy catchment was registered as a classified landscape by the National Trust in 1982.

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 experience its beauty. However, many people just want to know that areas exist having nationally important floristic and faunal values, 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 the general recommendations B1-B26 (a) to (c) above

that

(d) sites of botanical and zoological significance be protected

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

Notes:

- 1. 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.*
- 2. The Cumberland Road is a main road under the Transport Act. There has been a proposal to upgrade this road including the 3 km section that lies within the catchment. Because of the important environmental and scenic attributes of this area, such a proposal could be considered in any future review of these recommendations.*

Isolated essentially natural catchments

Recommendations

B5-B26 *That these areas shown on Map 1 be used in accordance with the general recommendations B1-B26 (a) to (c) above*

B5 *Log Bridge Creek - East Branch*

B6 *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.

B7 *Banimboola Creek*

B8 *Devils Creek - Middle Branch*

B9 *Yarrarabula Creek*

B10 *Long Jack Creek*

B11 *Williams Creek*

B12 *Double Creek*

B13 *Unnamed tributary to Genoa River*

(continued)

B5-B26 - Isolated essentially natural catchments (continued)

B14 Winnot Creek

*Note: The Winnot Creek essentially natural catchment and the Winnot Creek reference area coincide. Management of this area should also take into account its importance as habitat for the vulnerable southern barred frog (*Mixophyes balbus*) and the giant burrowing frog (*Heleioporus australiacus*).*

B15 Errinundra River - East Branch

B16 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, the aims of which would maintain its essentially natural character. Council therefore proposes that the Victorian section also be managed to maintain its current condition. Council is also aware that brumbies are present in the Gattamurh Creek area.

B17 Wallaby Creek

B18 Mount Gelantipy Creek

B19 Musk Creek

B20 Brodribb River headwaters

B21 Stony Creek

B22 Wongungarra River headwaters

B23 Blue Rag Creek

B24 Pinnacle Creek - East Branch

B25 Punchen Creek

B26 Mount Vereker Creek

Other Catchment Areas in Conservation Reserves

B27 *That the essentially natural condition of catchments to first- and second-order streams in reserves managed primarily for conservation, be recognised when management plans for these areas are being developed or reviewed.*

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

The State Conservation Strategy specifies a commitment to the selection of such representative examples and their maintenance in at least their present condition. This is similar to the Council's standard policy of ensuring that, as far as practicable, examples of the major land types across the State 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, using a method that integrates 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 1:250 000 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 1:500 000 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 in its catchment 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 streamflow 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 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 a substantially 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 (similar to the 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).

Table 2 and Appendix IV identify the 15 recommended 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. A number of these occur within existing proclaimed water supply catchments. Also shown is their status - whether part of a Victorian heritage river (H), or proclaimed water supply catchment (C).

Some of those recommended have freehold land along parts of their courses. 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. Views from several water boards in submissions expressed concern about the effects of the recommendations on their storages and/or diversions from within or downstream of the identified reaches. The recommendations do not affect use or storage of water in these rivers downstream of the point specified. This applies to urban water supply offtakes downstream of the representative river reaches of the Buchan, Nicholson, Lerderderg, and Moorabool Rivers and the Gellibrand River (South Otway offtake). Big River (C1), Snowy Creek, McCallum Creek, Macalister River, and Lerderderg River have irrigation water storages downstream. Water boards with storages or offtakes within representative river reaches include Colac (Gellibrand River, C12) and Alberton (Tarra River, C13). The likely impact of the recommendations on the Colac Water Board's supply is negligible, given the extent of the representative river catchment outside the Board's area, and the fact that Colac's annual use of around 3500 ML is only 1.6% of the river's average annual flow (at Carlisle River). The Colac Water Board also considers that its current system can meet demand for at least the next 40 years.

The Alberton Water Board uses 690 ML annually, that is, only about 1.4% of the total flow in the Tarra River (at Yarram). There are no plans to build a dam on the river. These Boards' continued use and reasonable augmentation would not be affected by the representative river recommendations.

REPRESENTATIVE RIVERS

Recommendations

C1-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***

(continued)

C1-C16 - Representative Rivers (continued)

that

- (c) changes to the flow regime within the designated reach be permitted only where hydrological behaviour 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 considered for priority in programs for:*
 - * restoration of degraded beds and banks and frontage 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)*
 - * 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 or further divert the water resources in the representative river reach of 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 in conjunction with the Rural Water Commission and relevant waterway authorities, in consultation with relevant water boards.

Note:

Several of these rivers are in existing national or State parks, or coincide with Victorian 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 location) ³
C1	East Victorian dissected uplands	5 ¹	Upper Big River (Glen Valley)
C2	East Victorian dissected uplands	4	Snowy Creek (Granite Flat)
C3	East Victorian dissected uplands	3	Dargo River (Dargo)
C4	East Victorian uplands, dissected plateau	3	Macalister River (Glencairn)
C5	East Victorian dissected uplands	2	Buchan River (Mellick Munjie Creek)
C6	East Victorian dissected uplands, riverine plains	2	Thurra River (Point Hicks)
C7	East Victorian dissected uplands	1	Nicholson River (Deptford)
C8	East Victorian dissected uplands, riverine plains	1	Cornella Creek (Colbinabbin)
C9	West Victorian dissected uplands	1 ¹	Avoca River (Avoca)
C10	West Victorian dissected uplands, volcanic plains	2	Lerderberg River (O'Briens Crossing)
C11	West Victorian dissected uplands, volcanic plains	1	McCallum Creek (Carisbrook)
C12	Otway Ranges, dissected plains	3	Gellibrand River (Carlisle River)
C13	South Gippsland Ranges, riverine plains	2	Tarra River (Yarram)
C14	Dissected coastal plains, volcanic plains	2	Kennedy Creek (Kennedy Creek)
C15	Volcanic plains, coastal plains	1	-2
C16	Volcanic plains, west Victorian dissected uplands	1	Moorabool River (Morrison's)

Note:

1. Hydrological region calculated from catchment yield data.
2. While this type is recognised, all streams considered were substantially modified, and no representative has been recommended.
3. Representative Rivers lie upstream of the nominated stream gauge.

D. OTHER RIVER USES AND VALUES

In Victoria, a number of major water supply systems have been developed to meet urban, industrial, and irrigation demands. In many instances, these systems have resulted in the movement of water between major river systems, and its transport over hundreds of kilometres.

Water for urban and industrial use is supplied from storages and reticulated to cities and towns, the sources of water being dams or offtakes on rivers and streams. These supplies are administered by the Board of Works, Rural Water Commission, or Water Boards across the State.

Future needs are being, or have recently been considered in regional water resource strategies such as the Department of Conservation and Environment's South-West region and Gippsland Water Strategies, the State Water Plan, and the Melbourne Water Resources Review Panel investigation.

Agricultural use of water

Most agricultural crops depend on water in the surface soil. The extent to which plants can obtain this surface water depends on seasonal variations in rainfall and evaporation. In Victoria, the time with the most sunlight and warmth for plant growth is also the time of lowest rainfall and highest evaporation, leaving insufficient water available in much of the State to sustain plant growth. Moreover, rainfall has substantial natural variations from year to year.

In such a climate, augmenting rainfall with irrigation water offers considerable benefits. Perennial pastures can replace annual grasses, tree and annual crops can be grown despite unreliable rainfall, and fodder crops can be grown under irrigation in summer to take advantage of the heat and prolonged daylight hours.

Some 570 000 ha of farmland are under irrigation, 500 000 ha in public schemes and the remaining 70 000 ha by private diversions. Although this land represents

only 4% of the area devoted to farming in Victoria, it produces 24% of the State's agricultural production in average years, worth \$630 million at the farm gate. In drought years the figure approaches 30%.

Effects of the recommendations

The Council stresses that the vast majority of Victorian streams and the water resources capable of further utilisation will continue to be available to meet community needs under these recommendations.

The recommendations do not affect existing uses, and in most cases will not affect future uses, other than as follows.

- * Some options for future supply will be unavailable, for example, those involving dams on several of the Victorian heritage rivers (see Chapter A). However, the Council believes that alternative sources are available.
- * In new schemes, provision will be required to be made for releases for environmental purposes (see section F6).
- * Existing users, and the community generally, will benefit from improved catchment, frontage, and stream bed and bank management (see Chapter E and section F9), particularly where water quality issues are addressed (see section F8).
- * Improvements in the efficiency of present uses (see section F7) will also benefit the whole community by making more water available, and delaying the construction of new storages.
- * By protecting river and stream values, these will remain available for appreciation and use by present and future generations (see Chapters A and B, and this chapter).

Community Use of Rivers

The Council has made recommendations to protect only the most outstanding areas as

Victorian heritage rivers (some 3% of the total length of named streams in the State) and it believes that the remaining streams in the State would continue to be available for many future uses, including consideration for water resource development, where appropriate. However, while the Council believes that these are legitimate and necessary uses, many streams, other than those recommended as Victorian heritage rivers, have scenic, recreational, cultural and/or ecological values that are worthy of protection. These streams are extensively used and widely appreciated. For example, in public land areas camping and picnicking along streams, fishing, duck hunting on rivers and associated wetlands, deer-hunting and bushwalking in catchments, and touring or four-wheel-driving (on existing tracks) adjacent to rivers are popular activities, along with appreciation of riverine scenery and ecological values. These would continue under these recommendations, subject to management decisions in accordance with the land status.

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. The recommendations in this chapter include additional recognition and protection for areas along rivers with values of lesser significance, without changing existing land use categories.

Rivers and streams flow through areas with a variety of land tenure, reflecting Council's previous recommendations for use. Some in State forest have natural features zones; others have buffers identified in forest management plans. National and State park management plans may recognise rivers by appropriate zoning. In proclaimed water supply catchments, land use determinations may specify protective buffer strips along streams and areas used primarily or exclusively for water supply often provide a high degree of protection.

Earlier recommendations made by Council in area studies and reviews identified small

localised areas - streamside reserves - for passive recreation and conservation. Other 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.

Public land water frontage reserves, in areas largely bounded by freehold land, are covered in the next chapter.

Other rivers with known high values

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

Many areas with significant values were considered but not recommended as Victorian heritage rivers. However, in accordance with the Order in Council, the recommendations in this chapter are intended to provide general protection for them, where possible, given that future water resource development or other activities may have some impact on certain streams. These values are listed in Appendix V, but their locations are not shown on the maps accompanying this report.

As Appendix V shows, rivers other than the seventeen in Chapter A have an array of significant values. These rivers did not meet the criteria established by the Council for Victorian heritage rivers, particularly in relation to the extent and distribution of their values. Many have localised high-value sites, while others included only short reaches with significant values. The Buckland, lower Mitta Mitta and Gellibrand Rivers are examples of rivers important for their recreational and other values. The rivers previously considered by Council but not recommended - the King, Loddon, Tyers, and Bunyip Rivers - also have significant values worthy of protection. Other rivers proposed in submissions as candidate heritage rivers are listed on page 31, and most of these also have significant values.

OTHER RIVER USES AND VALUES

Recommendation

DI That

- (a) rivers and streams, and adjoining areas, continue to provide water for agricultural, urban and industrial uses, and timber, minerals, and other resources, subject to (c) to (e) below, where land status permits*
- (b) 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 land status, unless otherwise specified in these recommendations*
- (c) the areas with values 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) guidelines for the protection of identified high significance scenic landscape, cultural heritage, ecological, and recreation values be developed in accordance with the recommendations 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 recommendations continue to be used for the purposes agreed to by the government following publication of recommendations for public land across the State.*

E. RIVER FRONTAGES, BEDS AND BANKS

This category applies to public land associated with streams flowing through areas that are broadly private land. This may consist of a narrow public land frontage (often 20 m wide) and the bed and banks, or only the bed and banks of the streams.

Previously Council has made recommendations for river and stream frontages, but not for stream beds and banks other than in relation to river management, or as part of larger area recommendations, such as parks or State forest. This separation reflected the existing division of management responsibilities between separate government agencies and authorities for different sections of the watercourse.

Although administratively convenient, this division does not encourage the recognition that the values and uses of streams, their frontages and catchments are interrelated and should be managed in a co-ordinated way.

In some instances this has led to confusion in the public mind about who has responsibility for river bed, bank and frontage issues, and how a co-ordinated response to these issues is to be achieved.

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 distance varied from 'one to three chains' (20–60 m) depending on the size of the river, although along the Murray River the distance is 60 m. These reservations have a combined length of some 25 000 km. 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 or the centre of the stream, although the beds and banks of watercourses are deemed to have remained public land under the *Water Act* 1905, and subsequent Acts.

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 some distance from the present stream, which now has private bed banks and frontages, although the water in such watercourses is Crown controlled. This occurs for example on the Goulburn River breakaway near the Acheron River confluence.

In many cases, these public frontages have been licensed by the adjacent land owner, 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 Division of Survey and Mapping in the Ministry For Finance, 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 general if the frontage is defined as a fixed distance from the river bank and changes in the river course are considered 'imperceptible' rather than 'sudden', the public frontage moves with the river. If the frontage is defined by a surveyed boundary, then changes in the river course will lead to a change in frontage width. In some instances it may lead to the loss of the public frontage. In both cases the beds and banks remain as public land, provided the watercourse remains as the 'boundary' of the adjoining allotments.

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 Environ-

ment. In all cases the Crown controls the water and specified persons have a right of use. 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.

Vegetated frontages also provide many benefits for the adjacent landowner, without the owner necessarily requiring direct use. Along rivers susceptible to bank erosion, a public land water frontage is a form of insurance - at least 20 m of public land must first erode before private land is under threat. In cleared areas the vegetated frontage acts as a windbreak that may reduce wind stress on stock and the loss of moisture from adjacent paddocks, leading to increased production. In some areas vegetation along the frontage is important in lowering the local groundwater table, and in all cases is paramount in mitigating river erosion.

Intact frontages are valuable as wildlife habitat, and 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 40 000 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 10 000 are current. Among other things, the licensee is required to control pest plants and animals. These recommendations do not affect the rights - described in the *Water Act 1989* - of people to take water, free of charge, for domestic and stock use from a waterway which their property abuts.

At present about 130 individual licences have been issued for the cultivation of 410 ha of frontage reserve across Victoria. In principle, Council believes cultivation of riverside public land to be an inappropriate use. Cultivation is inconsistent with the maintenance or restoration of riparian and associated in-stream values, it increases the potential for bank instability, and restricts the use of the frontage for other purposes. Consequently Council has recommended that no additional riverside frontage reserves be licensed for cultivation. Council is not aware of the specific circumstances for each of the existing cultivated areas. Frontage reserves licensed for cultivation may, for example no longer be adjacent to the river, as a result of changes in the river course. Consequently, it would be appropriate for the land managers to evaluate whether cultivation should continue when the licences are being considered for renewal.

Recreational use of licensed frontages is permitted. The *Land (Amendment) Act 1983* provides for the public to 'enter and remain for recreational purposes' although camping is excluded from licensed frontages. 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, however. 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.

It is neither necessary nor appropriate that a large proportion of the State's frontage reserves be developed or promoted for widespread and intensive recreational use. Streamside reserves recommended in previous investigations may be used for picnicking, walking and angling,

conservation of flora and fauna, and other purposes. At present 274 such reserves have been recommended in Victoria.

Similarly, recreational activities which can be carried out at many places along a river, such as picnicking and swimming, should be focussed at nodes in public land water frontage reserves, if the demand is substantial. The choice, by the managers, of location and development of these nodes should consider: the recreational need for the site; the suitability of the site for recreational use and routine management (in terms of its capability, and its nature conservation and cultural heritage values); provision of readily identified public access to the river; and the adjacent private land use. It is also important that nodes chosen have the deepest possible frontage. Bridge or ford crossing of rivers may often meet these requirements. The careful location and selective development of such nodes is likely to reduce the frustration experienced by river-side landowners, and visitors to rivers.

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.

Many recreational groups have developed 'codes of behaviour', for their members which encourage a higher standard of conduct than that required by regulation. Recommendations for such codes are described in section F1.

Although in the past managing authorities have allowed the clearing of vegetation and the cultivation of limited areas of frontage,

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 and a reduced capability to provide for a variety of uses. Regeneration of vegetation has not occurred in substantial areas. High, steep and collapsing banks are a hazard for grazing stock, unattractive for recreational purposes, they destroy valuable stream-side vegetation and contribute to stream siltation which in turn degrades in-stream habitat. Across the State long sections of rivers and their frontages are now degraded and in need of management attention. For example, the State of the Rivers Task Force report (1986), 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. There are a number of solutions to this problem including the paving of stock watering points.

The extent and perception of these problems along rivers varies across Victoria. These reflect differences in river geomorphology, riparian vegetation, the use of the adjacent private land, the use of the river itself, and regional circumstances and attitudes.

It is clear that resource, technical, social and administrative factors have led to the degradation of beds, banks and frontages. Many of these factors have now changed, or are changing, and the circumstances are now conducive to maintaining river and frontage values and restoring degraded areas.

The resource implications vary. Some may be cost-neutral such as streamlining and coordinating administrative arrangements, or where a choice is available between environmentally damaging and environmentally benign approaches; on the other hand some may have high associated costs.

The financial and labour costs of maintaining streams and their frontages (survey, fencing, pest plant and animal control, revegetation, in-stream works) or restoring the values of degraded frontages are high, and are a major factor in the absence of change to past approaches to river and frontage manage-

ment. However, various programs now exist that are leading to improved management. For example, waterway authorities currently spend about \$3 million per annum on erosion and revegetation programs, and the Department of Conservation and Environment also provides grants for frontage works. These programs, however, only meet a portion of the State's requirements.

A concern of many people expressed in submissions and discussions is that the resources available for restoration and maintenance programs have been reduced over the years.

In view of the high costs of these activities, Council believes that the introduction of a priority system for the identification, protection, and restoration of streams and their frontage sections would lead to a progressive improvement in their condition. While a listing for action is needed in priority order, the condition of Victoria's streams, in particular, their frontages is such that in the long term many sections will need attention. The scale of the problem requires that priorities should be determined for action starting now but continuing over a 10 to 20 year time frame. Stable streams and well vegetated frontages would benefit in-stream and bank habitat, stock management and water quality, enhance scenic quality, protect cultural heritage sites, and increase property values on adjoining freehold land.

The stream and its frontage make an integrated unit. Unstable streams can lead to the loss of frontages irrespective of the quality of riparian vegetation. In many cases, however, good quality bank and frontage vegetation is all that is needed to ensure stream stability. The following guidelines for establishing priorities are considered appropriate.

Guidelines

Establishment of priority for management action should be based on the following (not in a particular order):

- * recommended Victorian heritage rivers and representative rivers with public land frontages where values are at risk

- * the presence of values significant at local level or above, particularly where these values are 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)
- * areas in which special measures are necessary to protect domestic water supplies, buildings and other public utilities
- * areas that are currently unstable and require action - where appropriate - to prevent major bed or bank instability, including sections of river which have undergone sudden or major changes in their courses.
- * degraded areas (It is recognised that the resources required to address highly degraded areas are large. In practice, it may be more cost effective to allocate resources to maintain the condition of other rivers to prevent them from becoming highly degraded.)

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. Equivalent in-stream actions may also be required.

Frontage grazing licences currently provide that, at the direction of the Director-General of Conservation and Environment, revegetation of licensed land and reclamation of eroded areas be carried out, and that stock be excluded from areas being revegetated or reclaimed.

Development and implementation of management priorities should occur in conjunction with community-based organisations, such as catchment co-ordination groups associated

with river management authorities, and local government. This will also provide opportunities for identification and assessment of values and priorities at a local level. Council considers that involvement of local communities and interest groups, and a co-operative approach, are integral to the success of restoration and maintenance of degraded frontages, beds and banks. It is also important that the goals of any program and the priority of any works be clearly defined.

Council recognises that the successful restoration and maintenance of frontages, beds and banks depends on the interest and support of adjacent land owners which will only be gained by a collaborative approach to the identification and resolution of problems.

There are many beneficiaries of frontage, bed and bank restoration and the ongoing management for pest plant and animal, and erosion control. These include the adjacent land owner, those owning river bank land downstream and upstream, those using the water and the river downstream, visitors to the catchment and Victorians in general. This distribution of benefits should be recognised, and appropriate resources for restoration and maintenance should be provided by each of the different beneficiaries. In some areas in the past a landholder contribution has been provided in labour rather than cash.

For equity to be achieved it is appropriate that the licence fee set should reflect its true worth to a licensee, but that a rebate could be provided to the licensee according to restoration works or other management activities carried out from which the community at large gains benefit. Council notes that the current licence fee is considered by some to be only nominal in value, for example the current average annual grazing licence fee is \$60-\$70.

Accurate and accessible technical information on river frontage, bed and bank values is needed to enable them to be managed for their diversity of values. The 1990 'Environmental Guidelines for River Management Works' prepared for the Standing Committee on Rivers and Catchments, assists in this matter.

Submissions also identified the need for a companion - guidelines for river frontage management - and extension material suitable for riverside land owners.

Given the complexity of values and uses of river frontages, beds and banks, it is important that administrative arrangements are clearly identified and coordinated. Particular attention should be given to defining the role of government agencies, particularly since the recent introduction of the *Water Act 1989* and the inclusion of the former Department of Water Resources within the Department of Conservation and Environment. It is important that decisions reflect the wide range of values of frontages, beds and banks, especially nature conservation values. In the past the natural ecological functions of a river system have tended to be ignored, restricting the range of opportunities available to present and future generations. Those who are likely to be immediately affected by frontage, bed and bank management - whether as direct beneficiaries or not - should be consulted. They include the

adjacent landowners, relevant LandCare and other community groups with an interest in the values and uses of waterways.

The Council has made recommendations for public land water frontage reserves since the mid-1970s, and these are the basis of the following recommendations. However, while the existing Council recommendations recognise the values 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 appropriate recreation activities. As noted above, Council has not previously made recommendations for the use of stream banks and beds, adjacent to water frontage reserves or private land. Accordingly, Council resolved to review the existing recommendations. The amended recommendations, listed below, apply to public land water frontage reserves across the State and to beds and banks adjacent to public frontages or private land.

RIVER FRONTAGES, BEDS AND BANKS

Recommendations

Public Land Water Frontage Reserves

E1 That public land water frontages

- (a) be used to***
 - (i) conserve native flora and fauna as part of an integrated system of habitat networks across the State***
 - (ii) maintain or restore indigenous vegetation***
 - (iii) protect adjoining land from erosion, and provide for flood passage***
 - (iv) protect the character and scenic quality of the local landscape***
 - (v) provide protection for cultural heritage features and associations***
 - (vi) provide access for recreational activities and levels of use consistent with (i)-(v) above (see Note 1)***

(continued)

E1 - Public Land Water Frontage Reserves (continued)

- (vii) *where this does not conflict with (i)–(vi) 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 guidelines and programs for restoration of frontages, including re-establishing or regenerating indigenous vegetation*
- (ii) *at a regional level, to develop strategies for managing frontage reserves while vegetation is being restored*
- (iii) *at a local level, to set priorities and a time-table for frontage restoration and maintenance*

and these guidelines, programs and strategies be implemented according to the priorities and time-table so determined (see Notes 2–6)

that

- (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) *if appropriate, suitable areas for more intensive recreational use be identified and facilities established*
- (iii) *where land exchanges are proposed that involve frontage land that is no longer adjacent to rivers, efforts be made to prevent loss of any nature conservation or other values of this land from the public land estate (see Note 5)*
- (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) (vii) above, recreation use by the public for activities such as walking, nature observation, or fishing be permitted while motorised forms of recreation not be permitted*
- (ii) *licensees be required to provide stiles in any fences erected across their licence area if requested to do so by the land manager (see Notes 7 and 8)*
- (iii) *no new cultivation for agriculture be permitted, and areas currently cultivated be reviewed by the land manager as part of a systematic assessment of river restoration priorities, with a view to phasing out inappropriate cultivation*

(continued)

E1 - Public Land Water Frontage Reserves (continued)

- (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, to permit regeneration of native plants that have particular value for nature conservation, or to protect cultural, recreational, and scenic values that are sensitive to the impacts of grazing (see Note 8)*
- (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 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 present manager), in consultation with the relevant waterway authority (see Note 9).

Stream Beds and Banks

E2 *That stream beds and banks, subject to other recommendations and guidelines in this report and statutory requirements*

- (a) *be used to*
 - (i) *conserve or restore habitat for native flora and fauna*
 - (ii) *provide for appropriate recreational activities and levels of use*
 - (iii) *provide for flood passage and drainage requirements of adjacent land*
 - (iv) *where necessary, provide for the passage of artificial flows of water stored within the catchment or transferred from other catchments*
- (b) *be maintained in a stable condition using environmentally sound techniques*
- (c) *where this does not conflict with (a) and (b) above, provide a source of sand and gravel*

and that stream beds and banks be securely reserved and managed by the relevant waterway authority or the Rural Water Commission (or present manager), in consultation with the Department of Conservation and Environment.

E3 *That*

- (a) *the interrelated nature of the values and uses of river frontage, beds and banks be recognised in management planning and implementation*
- (b) *initiatives be developed and implemented to remove economic, social, administrative and technical factors that lead to losses of river bed, bank, and frontage values, or to difficulties in achieving effective and co-ordinated restoration and maintenance programs*

(continued)

E3 - Stream Beds and Banks (continued)

- (c) *programs for stream bed, bank and frontage stability be carried out in accordance with Recommendation F9.*

Notes:

1. *Recommendation F1(h) provides that a code of behaviour for recreational users of river frontages be developed and promoted.*
2. *Council recognises that a number of bodies currently exist which undertake, or are capable of undertaking the functional requirements at State, regional or local levels. In this context 'regional' would cover a single river basin or a number of adjacent basins, and 'local' an area within a river basin, such as individual drainage catchments or a particular river reach.*
3. *It is envisaged that for community consultation, Catchment Co-ordination Groups where they exist, or similar groups where they do not, could carry out or facilitate stages E1(b) (ii) and (b) (iii) above, and that the Standing Committee on Rivers and Catchments or equivalent organisation could carry out or facilitate E1(b)(i). When determining priorities, restoration or maintenance programs which lead to direct site improvement are to be given precedence.*
4. *Vegetation re-establishment or regeneration may require the temporary or permanent removal of stock from some frontage areas.*
5. *These areas could include values such as remnant vegetation, wetland habitat, opportunities for recreational use or contain features of cultural significance, such as scarred trees.*
6. *Identification of priorities in E1(b) (iii) should take into account the guidelines set out above.*
7. *The choice of a suitable design for stiles should involve representatives of the frontage user groups such as the Victorian Farmers Federation and peak recreation groups.*
8. *These are provisions in existing legislation, regulations, or licences.*
9. *It is Council's intention that these areas remain within the public land estate and be securely reserved. The Crown Land (Reserves) Act 1978 requires that areas to be reserved be surveyed, a process which is expensive and protracted. If alternative methods become available which will achieve Council's intention of secure reservation, for example using a record plan, then these could be used, provided that the reservation is otherwise comparable to permanent reservation under the Crown Land (Reserves) Act 1978.*

F. MANAGEMENT GUIDELINES AND POLICY RECOMMENDATIONS

Previous chapters have outlined Council's specific recommendations 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. These recommendations apply to all public land associated with rivers and streams in Victoria (outside cities and rural cities).

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 Water quality
- F9 Waterway management
- F10 Utilities and survey
- F11 Mineral and stone production

F1 RECREATION

Background information and recommendations published in previous Council recommendations have been revised to cover issues associated with recreational fishing, motorised watercraft on rivers, fossicking, public participation and resource inventory, the use of areas by large organised groups, codes of behaviour 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 water-based and water-enhanced recreation 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, boating, canoeing, and picnicking. Hunting often requires water bodies (for ducks) or river valleys (for deer). 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.

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 'outdoors' 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 on the species sought, preferred access, and desired success rate.

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 be used (by licensed drivers) on 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 include high-powered boats capable of racing at speed, 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 fishing. 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. These issues require management attention to ensure the areas chosen are capable of sustaining the use of powered watercraft likely to cause erosion problems.

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 Fossicking

When fossicking, most people seek gold, but there is also interest in gemstones. Fossicking in and along the creeks and rivers has a number of advantages over other fossicking areas: 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 covered in section F11 below.

To fossick for gold and gemstones, a Miner's Right or Tourist Fossicking Authority is required under the *Mineral Resources Development Act 1990* (this Act is scheduled for proclamation at the end of July 1991). It entitles the holder and, in the case of a Tourist Fossicking Authority, those accompanied by the holder, to search for minerals on both Crown land and (with the owner's permission) private land. Specific conditions apply to the search for minerals on land held under a mining licence. In common with other exploration, and mining activities, fossicking is excluded by legislation from reference and wilderness areas, and generally national and State parks.

Activities under a Tourist Fossicking Authority or Miner's Right are restricted to the use of non-mechanical hand tools. The use of explosives, the removal or damage of any trees or shrubs, and the disturbance of an Aboriginal place or object is prohibited.

Since 1 November 1990, the use of eductor dredges has not been permitted in Victoria.

Public participation and resource inventory

Identification of peak recreation groups assists public participation in planning and management. So too does the 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. This involvement is likely to be most productive when groups have been able to establish a self-critical and rigorous approach to describing their requirements. Consideration should be given to providing the resources and infrastructure needed to enable community organisation to become active partners in the decision making process.

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 frequent use, or 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, localised environmental impacts at regularly used sites, and demands for exclusive access to particular venues - a demand Council believes in general to be inappropriate.

Codes of behaviour for recreational activities

Many recreational organisations have developed, and encouraged their members to follow voluntary codes of behaviour. Codes outline socially and environmentally responsible behaviour, beyond that simply required by regulations. Codes provide for the maintenance of the resource on which the recreational activity depends, harmony with those following the same or different recreational activities, or other users of the area. Codes also assist other users to understand the way some recreational activities are pursued. The success of a code is measured by the extent to which it is followed, so they need to be regularly promoted. In general only a small proportion of those following a recreational activity belong to a formal recreational organisation, so codes need to be widely promoted to ensure all participants are reached.

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 Byrne and Vise, 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 and other recreation planning techniques can identify changes likely to be made to recreation settings by development proposals, road closures, and so on. These techniques assist in the identification of appropriate management actions to control impacts.

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 impractical 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 significant damage to, or conflict with the primary purpose of the area*
- (c) *planning ensure:*
 - (i) *a range of recreational opportunity settings is 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, the protection of other flora and fauna values, 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 behaviour be developed and promoted to encourage responsible recreational use of water and water frontages, particularly those with an extensive boundary with private land (see Notes)*
- (h) *to facilitate planning, key recreational groups be encouraged to assist the development of methods that identify:*
 - (i) *the significance of recreational resources*
 - (ii) *the impacts that may result from the use of that resource*

(continued)

F1 - Recreation (continued)

(iii) the management options that reduce these impacts

and that

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

Notes:

- 1. A number of codes have been developed that are general in application, including 'Sharing the Countryside - Guidelines and Information for Land Holders and Recreation Groups' (Victorian Outdoor Education Association 1988).*
- 2. The development of codes is not considered a substitute for the routine enforcement of existing regulations controlling (for example) littering, firearm use, pets or unseemly behaviour.*
- 3. Development of codes of recreation practice should involve the Departments of Conservation and Environment, and Sport and Recreation; recreation interest groups, and representatives of non-recreator but affected individuals, such as the Victorian Farmers Federation.*

F2 NATURE CONSERVATION

This section provides principles and guidelines for the protection of habitat values when logging riverine forest, for the protection of native aquatic flora and fauna and their habitats, 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. These include commonly known animals, such as platypus, frogs, tortoise, and fish, but also include a range of aquatic plants and the small and often poorly known bacteria and fungi that are the decomposers at the bottom of the food chain. Although they may not be specifically mentioned in this section, they are important. Sites of geological and geomorphological significance also occur 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 properly may have major economic and environmental implications. For example, discharges of waste 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. It must be realised that disturbances at any point may affect water quality, or biological values in downstream areas of the catchment. In some instances, such as channel aggradation, impacts may move upstream of the point of disturbance.

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

manipulative experiments can be helpful in predicting the outcomes of natural changes, or those induced by management techniques.

Further research into the identification of in-stream plant and animal species is required. Many aquatic species (particularly microflora, invertebrates and protists) are undescribed and the discovery of many new species is likely. 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.

Baseline data-gathering, surveys and recent 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 management regimes, and the impact of stream regulation and other disturbances on in-stream biological values.

Ecological research takes time, and some research based on repeated observations may span years or decades. There is often a further delay in the availability of research results as they await formal publication.

It is important that wherever possible the most recent information, or general principles that emerge from research be incorporated in decision-making processes.

Riparian 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, including the overstorey, the shrub and the 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 plants and macroinvertebrates at the low end, to fish and other vertebrates

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, but the time taken for re-establishment is likely to be long. Similarly, while mature river red gum overstorey may appear to be good habitat with many nesting hollows, the ground or shrub layer must 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 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'.

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 provide only minor waterfowl habitat in comparison with wetlands. For many visitors, however, birds are often the most conspicuous and delightful part of the 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.

When timber harvesting is considered, the Code of Forest Practice provides for the general protection of riparian values. Council believes that the application of the following guidelines would cover the specific conditions met when timber-harvesting of floodplain communities is considered.

Guidelines for timber-harvesting in river red gum associations

- * In order to implement the following, identify values and mark individual trees prior to felling.
- * Harvest according to a low-intensity selection system or through the limited use of patch fellings where these are silviculturally necessary, and will not affect significant environmental, cultural or recreational values.
- * The following areas should be excluded from harvesting:
 - a buffer strip along specified rivers and streams
 - areas adjoining popular recreation locations
 - sites with threatened plant or animal species or associations, or nests of significant animal species, and surrounding buffers
 - areas of river red gum woodlands and open forest with a relatively intact understorey
 - areas with significant plant or animal habitat identified in future surveys
 - a proportion of the dominant overstorey age class
 - areas of particular scenic importance

- Aboriginal canoe trees or other significant trees

- * Carry out operations so as to retain diverse ground and shrub layers.
- * In areas important for reptile habitat, firewood collection must be restricted (in some circumstances this will require the cessation of firewood collection).

The silvicultural culling of non-harvestable trees in these floodplain communities may produce changes incompatible with the maintenance of significant flora and fauna values, and may need to be restricted.

Fish

Among the 58 fish species found in Victoria's inland waters, 46 are native species, 27 of which are restricted to fresh water throughout their life cycle. The remaining 12 species were introduced over the last 150 years. Recreational angling issues 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.

Woody debris provides key in-stream habitat for fish, as well as stabilising bed and banks (in many cases) and retaining naturally occurring nutrients in the aquatic system. The primary source of woody debris, and organic matter for the aquatic food chain is the riparian vegetation. Hence the removal of woody debris, or the riparian vegetation has serious consequences for the stream biota and their habitat.

Riparian vegetation also filters pasture run-off, buffers stream water against high summer temperatures by shading, and prevents erosion and hence sedimentation. Sedimentation will smother fish habitat, spawning sites and food sources. Substrate provides egg deposition sites, nursery grounds for juvenile fish, habitat areas for fish, and invertebrates which form

part of the aquatic food chain, and riffle areas for the oxygenation of the water.

Alteration or removal of substrate (eg gravel extraction) may have adverse effects on fish and change the shape and behaviour of the river channel.

Fish are sensitive to a number of factors that affect water-quality. These are measured according to criteria that include turbidity, dissolved oxygen, salinity, nutrient levels, and temperature. Impoundment of water may also have a major impact on the temperature of the released water. 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 (eg mercury) in fish tissue, leading to a gradual deterioration in the health of the fish. Such non-lethal effects may be just as detrimental as a 'fish kill' in the long term.

Particular stream-flow conditions trigger spawning and migratory behaviour. For example, rising water levels accompanied by rising water temperature are important as a cue for spawning in golden perch. Changed stream-flow conditions, particularly a reversal of the natural flow due to regulation, may decrease spawning success and may 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 aquatic biota. This is of particular importance where many fish in coastal streams have both fresh and marine phases in their life cycle. Fish passage may also be affected by barriers including dams, weirs, drop structures and road crossings. It must be kept in mind that for many species of fish, it is the juvenile stage which undertakes upstream migration, and therefore even small

structures, such as culverts under roads, can act as insurmountable obstacles.

More research needs to be undertaken on the impact of introduced fish on populations of native fish, and other aquatic fauna.

Although in many instances certain native and introduced fish can be found within the same water bodies, there is some evidence that introduced species, including brown and rainbow trout, have had deleterious effects on some natives, particularly galaxiids. Some undesirable introduced fish such as carp have been declared a noxious species, while others such as English perch have been found to carry disease.

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. It should be noted that the conservation status of some species varies according to whether the Victorian or Australian context is adopted (See Appendix VI). (For the Australian context, see Harris, 1985.)

For example, the freshwater herring is listed as endangered in Victoria due to reductions in range and small population numbers. However, 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 and Queensland. The use of Victorian context is appropriate for this Investigation. The protection of species at their limit of distribution is important to ensure that the genetic diversity of the population is maintained. Further, Council cannot guarantee that fish populations in adjacent states will be maintained. However, it is appropriate that management actions that protect fish be implemented on a catchment basis.

Council notes that Victorian legislation covering the protection of flora and fauna - *Flora and Fauna Guarantee Act 1988* -

considers the conservation status of taxa and communities in Victoria only.

Invertebrates

Aquatic invertebrate fauna are of inherent importance. For instance, the invertebrate fauna have 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.

Invertebrates in Victoria's rivers and streams have not been widely surveyed. Department of Water Resources (1989) summarised existing 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 or restore the riverine conditions.

Council believes that the application of the following principles and guidelines will assist when considering the maintenance or restoration of in-stream habitat.

Principles and guidelines for aquatic flora and fauna habitat protection

- * Implement programs to maintain, or restore native riparian vegetation.
- * To improve water quality, develop and apply programs to reduce water turbidity, and to prevent toxicants reaching streams.
- * To moderate the effects of altered flow regimes in regulated systems, carry out investigations to determine water-release regimes, and associated water quality issues that minimise adverse effects on aquatic biota.
- * To maintain in-stream habitat, avoid channelisation and retain woody debris in place wherever possible, or move it into the bank so that it remains in the water.
- * Maintain unimpeded fish passage; provide fish ladders to assist migration and movement past artificial barriers.
- * Maintain aquatic invertebrate habitat, by maintaining or restoring riparian vegetation, in-stream habitat diversity, and natural flow regime.
- * Do not introduce fish species outside their natural range unless recommendation F2(b)(iv) and (v) are met, nor stock introduced fish outside areas currently stocked.
- * Design, construct and maintain roads (sealed or unsealed) to avoid direct sediment input or runoff to streams. Particular attention should be given to siting roads as far from the stream as possible; minimising the number of crossings; and constructing crossings to minimise the disturbance to the stream bed and banks, and riparian vegetation (See Section F10).

NATURE CONSERVATION

Recommendation

F2 *That*

- (a) *the principles and guidelines for aquatic flora and fauna habitat protection outlined above be applied when assessing, planning and implementing works likely to affect stream habitat*
- (b) *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, as follows*
 - (i) *to evaluate the habitat and water quality requirements of native aquatic flora and fauna*
 - (ii) *to determine the minimum width of natural stream buffers necessary to protect aquatic communities from activities on adjacent land*
 - (iii) *to establish the biology and habitat requirements of native aquatic flora and fauna, and determine the impact of introduced species*
 - (iv) *to ameliorate the impact of barriers on aquatic species, specifically the design of fish ladders appropriate to the requirements of Victoria's native fish*
 - (v) *the results of current research and surveys be incorporated into management plans, and taken into account in land management decisions, wherever appropriate*
- (c) *as the biology and habitat requirements of native aquatic flora and fauna with the Victorian conservation status 'endangered' and 'vulnerable' become 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)*
- (d)
 - (i) *stocking of fish only occur if other native fish species, or significant flora and fauna are not put at risk*
 - (ii) *the stocking of introduced fish species be excluded from streams where they do not already occur, especially the small coastal streams of Far East Gippsland, and from Wilsons Promontory, in recognition of their special conservation status*

and that

- (e) *when proposed aquaculture projects (plant or animal) are being considered, potential off-site impacts on aquatic ecosystems be taken into account.*

(continued)

F2 - Nature Conservation (continued)

Notes:

1. *Recommendations elsewhere in these documents make reference to protection of nature conservation values. In particular refer to A1-17, B1-27, C1-16(e), D1(b), (c) and (d), E1(a)(i), E2(a)(i), F6, F8.*
2. *AWRC river basins 4, 6, 7, and 8 have been poorly surveyed for ecological values.*
3. *As further information becomes available, species currently with an 'indeterminate' conservation status may be classified as 'endangered' or 'vulnerable' and hence this recommendation would then apply to them.*

F3 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 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.

Local, regional and State branches of cultural heritage associations, such as the Royal Historical Society of Victoria and the National Trust, are often a ready and important source of information on historical sites and should be contacted when regional studies are being undertaken.

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 - such as historical and cultural heritage societies - be an integral part of the decision-making process when considering historical sites.*

F4 VISUAL RESOURCES

The following background information and recommendations cover the management of spectacular and commonplace visual resources.

Victoria's 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 understory 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. In some parts of the State, such as the Otways and Strzelecki Ranges, waterfalls and fern gullies

are important parts of the image used to promote the region to tourists.

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 assess the scenic value of rivers in Victoria (Scenic Spectrums, 1986), and the rivers subsequently examined are 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's 'Visual Management System' (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. These reaches should be reassessed at a larger scale and level of detail consistent with any proposed management activities.

It is certain that many other places or reaches of rivers and streams have scenic value. These can only be identified through detailed studies of a particular region. Some land-scapes have been assessed by the National Trust - for example, the classified landscapes at Trawool, Upper Yarra Valley and O'Shannassy catchment. Coverage of the State is incomplete however. Many of these scenic features will already be known to and valued by locals and visitors. Their importance should be reflected in management planning.

VISUAL RESOURCES

Recommendation

F4 That

- (a) *features of high scenic value and of localised occurrence, such as waterfalls and gorges be protected through management plans or prescriptions*
- (b) *public interest in visiting waterfalls and gorges be recognised, and the principles of the Recreational Opportunity Spectrum and other recreation planning techniques be applied when responding to this interest in management plans*
- (c) *the identification of visual resources and assessment of visual impacts be included in considerations of river corridor management*
- (d) *the maintenance or enhancement of visual resources along rivers be an aim of plans or activities likely to influence them*
- (e) *the value of the commonplace visual environment be recognised and managed to ensure that it is not subject to the cumulative adverse impact of uncoordinated changes*

and that

- (f) *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 (see Note)*

Note:

The development of guidelines which are practical and cost effective to implement should involve waterway managers and representatives of relevant interest groups, such as the Victorian Farmers Federation.

F5 FLOW REGULATION

These guidelines and 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 diversion 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.

In the past the approach to planning water use involved estimating the 'divertible water resource' - that is, that part of the total resource (measured as mean annual flow) of suitable quality, which can potentially be regulated by diversion works and hence utilised for off-stream purposes. This approach took no account of environmental water requirements.

The report 'Water Victoria - A Resource Handbook' (Department of Water Resources, 1989) lists the divertible resource for each river basin, and how much has been developed. The undeveloped but divertible resource totals some 3420 gigalitres for the State. The Rural Water Commission has pointed out that the Mitchell and Snowy River basins contain about one third of the State's remaining divertible water resources. The Council agrees that further resources exist, provided that any new diversions are timed and are of such volumes as to not

affect specified values, and that any storage (holding high flows for later use) is not constructed on the recommended heritage river corridors.

In some other basins resources are substantially developed, and committed to off-stream uses. In such cases the ability to provide for environmental water requirements is limited. (See section F6 and the Glossary for descriptions of an environmental water requirement). Interim or informal arrangements that provide minimum flows are in place for a number of rivers.

However, at present no secure allocations of water for environmental purposes, as provided by the *Water Act 1989*, have been made for Victoria's regulated river systems. Council is concerned that in such circumstances additional water allocations for off-stream use may constrain the ability to retain sufficient water within the river system to meet its environmental needs.

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. These guidelines are also relevant to some other schemes such as drainage and wastewater disposal (see section F8 - Water quality).

New projects

- * For storage site selection, existing environmental values and consequences of the storage construction and operation should be evaluated, 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, such as sedimentation resulting from 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 to protect designated values.
- * Where dams are constructed on smaller streams, downstream flows should be provided at their natural low-flow level.

Existing projects

- * Reviews of water-release regimes from established storages should be carried out to 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 river-bed and bank stability.
- * The review should also consider opportunities for recreational flows, bearing in mind existing constraints on water use.

Diversion other than from storages

- * For existing diversions where the cumulative effect of all diversions is significant, reviews of the diversion policy and operation should be carried out. Consideration should be given to altering any diversion policy causing loss of ecological, scientific, or recreational values, to minimise such losses.
- * New diversions should be considered for approval only after considering the outcome of the above guidelines as applied to the river in question, 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.

Hydro-electricity generation schemes

- * These schemes should: meet the guidelines for water resource developments outlined above; incorporate measures to minimise major and rapid fluctuations in downstream water levels; and include consideration of their impact on aquatic values.

FLOW REGULATION

Recommendation

F5 That

- (a) *the guidelines outlined above be taken into account in the assessment, development, construction, operations and maintenance of new water resource projects, and in the operation of existing storages and diversions (see Note 1)*
- (b) *the environmental effects of the maintenance and decommissioning of storages be investigated, and where adverse effects arise, and cost-effective solutions exist to reduce these effects, they be implemented (see Note 1)*

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.*

Note:

1. *The implementation of F5(a) and (b) above should include consideration of the economic and social implications that may arise.*
2. *Council believes that reviews of water regimes should be carried out by the relevant water supply authority in conjunction with the Department of Conservation and Environment. The biological and recreational investigations should be coordinated with engineering and water supply investigations, and be carried out in consultation with affected interest groups.*

F6 ENVIRONMENTAL AND RECREATIONAL WATER REQUIREMENTS

This section provides recommendations that would assist in determining and implementing water requirements necessary to maintain designated environmental and recreational values downstream of major diversions or storages. An 'environmental, or recreational water requirement' is defined as follows. For an environmental (biological) value, it is the water required to maintain particular in-stream, riparian floodplain, wetland or estuarine biological values. For recreational values it is likewise the water required to maintain particular water-based or water-enhanced recreational values. Water requirements are commonly measured in terms of depth or flow volume requirements at a particular time of year.

It is important to recognise that aquatic biota have evolved in response to natural unregulated flow regimes, and that alterations to such flows are likely to have detrimental effects.

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 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 migration and spawning cycle of fish and invertebrates or reduce the composition and integrity of wetlands on floodplains, because of either unseasonal and sustained high flows

or the removal of periodic floods. 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, aquatic flora and fauna 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.

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 water 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 Victorian 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.

In regard to the application of existing research, alteration of the flow regime is

likely to adversely affect environmental values and the greater the change, the greater the effect. The absence of detailed information should not become an impediment to the allocation of an environmental water requirement. The requirement should be based on established general principles, recognising that detailed work may result in the fine tuning of the supply of water, to ensure that the environmental benefit for a given allocation is maximised.

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. The conditions that enhance these recreational benefits may however not be compatible with the maintenance of particular aquatic ecological values.

ENVIRONMENTAL AND RECREATIONAL WATER REQUIREMENTS

Recommendation

F6 That:

- (a) *research be undertaken to establish the water regime requirements of the native aquatic biota of Victoria's inland waters*
- (b) *models to determine environmental water regimes that maintain the ecological values of in-stream and riparian habitats, floodplain wetlands, and estuaries be developed*
- (c) *the guidelines for incorporation of environmental flow requirements in planning new water projects be applied*
- (d) *for existing regulated systems:*
 - (i) *guidelines be developed for the incorporation of environmental water requirements in discharge regimes (see Note 2)*

(continued)

F6 - Environmental and Recreational Water Requirements (continued)

- (ii) where conflicts arise between water supply and in-stream, riparian, wetland, or estuarine ecological values or recreational values, current discharge regimes be reviewed*
- (e) the techniques necessary to maintain or enhance recreational opportunities downstream of water resource projects be established*
- (f) guidelines be developed for 'recreational water requirements', which complement the 'Guidelines for Incorporation of Environmental Water Requirements in Planning New Water Projects', and be included in future water resource planning*
- (g) Victorian heritage rivers be given priority in reviews and investigations undertaken to establish appropriate environmental and recreational water requirements (see Note 2)*

and that

- (h) the planning of future storages involve consideration of off-stream storage sites, and where constructed, diversions to such storages be timed so as to minimise the environmental effects of reduced downstream flows.*

Notes:

- 1. Research and provision of environmental water requirements must recognise both the water regime and water quality requirements of the ecosystem under consideration.*
- 2. Development of these guidelines should include consideration of the economic and social implications that may result if they were implemented.*
- 3. In some circumstances the maintenance of environmental and recreational values in a regulated system may not be compatible with management objectives. Where this is the case, the maintenance of environmental values should be the first priority, if significant ecological values are identified.*
- 4. Council believes that reviews of water regimes should be carried out by the relevant water supply authority in conjunction with the Department of Conservation and Environment. The biological and recreational investigations should be coordinated with the engineering and water supply investigations, and be carried out in consultation with affected interest groups.*

F7 WATER USE EFFICIENCY

These 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 65% of the water released from the headworks. Of the water reaching farm and town storages in this system, a further 50% is lost through seepage and evaporation. Inefficient use may also result in other environmental costs. Leakage from irrigation channels and inappropriate irrigation practices are among the causes of high water tables in northern Victoria which contribute to salinity problems. 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 to environmental water requirements.

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***

(continued)

F7 - Water Use Efficiency (continued)

(d) the achievement of environmental benefits through the efficient use and allocation of water resources be a high priority of water management authorities

and that

(e) water saved through reductions in demand or increased efficiency in the public domain (this generally includes the storage and distribution system) be considered for allocation to environmental purposes, where environmental water requirements have not already been provided, and/or to reduce the need for new projects to meet water demand.

F8 WATER QUALITY

This section discusses water quality and its effect on the health of the numerous plants and animals dependent on rivers and streams, and the implications for some off-stream uses. Issues relating to flow regulation are covered in section F5. Losses of water quality may also have an impact on the recreational values discussed in section F1.

Water quality is a key feature of river systems determining many of their in-stream and riparian biological characteristics, and the ways in which society may directly use them.

Under natural conditions, water 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, the physical and chemical character of surface water 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, the physical and chemical parameters fluctuating with time. The turbulence of river flow keeps the water temperature reasonably constant throughout its depth at any measured point.

Aquatic biota have evolved in response to natural variations in water quality and alterations to such conditions may have detrimental effects. Changes in water quality

are also likely to affect the range of uses that society may make of river water.

We can measure the health of our rivers and streams in terms of environmental quality and suitability for recreation and other uses, such as domestic water supply, by monitoring selected physical, chemical, and biological water-quality indicators. 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). Biological indicators include abundance and diversity of fish, invertebrates and plant species, and the concentration of toxicants in tissues.

River water is vulnerable to culturally induced changes. Rivers have often been used as convenient sinks in which to discharge wastes. Rivers are also sensitive to poor land-use practices within the catchment. Consequently, those who use the rivers at the top of a catchment are rarely inconvenienced compared with those who use the river downstream. Discharges and poor land-use practices have also had adverse effects on aquatic ecosystems.

There is increased public interest in water quality issues, and support for schemes that protect existing areas of high water quality,

and which lead to improvement in water quality in degraded areas. It is recognised, however, that this may lead to an increase in immediate costs to the community. It should be noted that the long-term environmental and economic costs of the continued degradation of water quality has often been neglected in the past.

Some agricultural, urban and industrial land uses and waste discharges have lowered riverine water quality, causing changes beyond naturally occurring variations. Changing land use is 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 intensive agriculture may add organic matter, phosphorus and nitrogen (from fertilisers and animal excreta), and various biocides (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.

One of the few studies of biocides done 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 contaminants, 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 biocides 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.

Discharges and leaching from present and past mining operations can also increase the range and concentration of chemicals present in stream water and sediments.

Mercury pollution, from past mining operations, has led to restrictions on the consumption of trout caught from some rivers.

Industrial and domestic discharges and run-off from urban areas are major sources of a diverse range of pollutants. These include nutrients, suspended solids, bacteria and other pathogens, metals and other persistent contaminants, and thermal pollution. Nutrient inputs can cause increased plant growth, which may lead to de-oxygenation. Discharges from fish farms are of particular concern as they may include pathogens and nutrients.

Sediments entering streams through erosion may also have an impact on water quality, with nutrients and contaminants adhering to sediment particles being subsequently released to the water column.

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 qualities from those that existed prior to dam construction. These altered qualities can have major impacts on in-stream biota. For example, where the released water has a lower temperature than that occurring under natural conditions this may lead to the loss of some fish species from the affected reach. The water has to flow many kilometres before it returns to a condition similar to that occurring naturally. This situation occurs in most older storages. 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. Algae grow in most water bodies, responding to nutrients and light. Algae are an important component of aquatic ecosystems but become problematic when algal blooms occur. These 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. Some types of algae, when present in large numbers, can also have serious effects on the suitability of water for a range of uses. Changes to the colour, clarity or smell of a body of water, or the formation of a surface scum by some algae can make water aesthetically unsuitable for recreational purposes. Other types of algae can produce unpleasant tastes and disrupt water treatment plants. Blue-green algae, such as *Nodularia* species, can also produce toxins which may be fatal to stock and cause gastroenteric problems and skin rashes in humans. In 1987 the Gippsland Lakes suffered a major algal bloom. Apart from the impact on fish populations, this adversely affected the recreational use of the Lakes, which is an important component of the regional tourism industry. 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 may therefore be required to maintain adequate water quality.

State Environment Protection Policies for Victorian Waters

The government has declared 11 State Environment Protection Policies (SEPPs) for Victorian waters. Of these, 10 deal with specific rivers and bays, and their catchments. The most recently declared water SEPP, 'Waters of Victoria' is an umbrella policy which applies to all waters except

those covered by a separately declared SEPP.

The water SEPPs set beneficial uses, establish objectives for selected water quality indicators, and specify certain actions in an attainment program to achieve objectives. All State government departments, statutory bodies, and municipal authorities are required to implement these policies in so far as they relate to their areas of responsibility. Council supports these policies and believes that their implementation should be given a high priority.

As 'Waters of Victoria' has the most general application, the following discussion outlines this policy.

'Waters of Victoria' protects a number of beneficial uses throughout the waters of the State. The beneficial uses of particular relevance for the protection of nature conservation, recreation, and scenic values are:

- * maintenance of natural aquatic ecosystems and associated wildlife
- * water-based recreation (swimming, boating, aesthetic)

'Waters of Victoria' refers to the Environment Protection Authority's publication 'Recommended Water Quality Criteria' which sets environmental standards considered sufficient to protect the various beneficial uses of water. This publication relies heavily on information from overseas research. The Australian and New Zealand Environment Council is currently developing national water quality criteria which will incorporate contemporary Australian data wherever it is available. It should be noted that while the revision of all water quality standards, to ensure that Australian species and aquatic ecosystems are comprehensively represented, may be a long-term goal, present criteria allow reasonable management of water quality.

Although 'Waters of Victoria' clearly protects water for recreational purposes, a commonsense approach must be followed when selecting areas for these purposes. Just

as it is prudent to avoid swimming in areas with snags, or during floods, so particular areas, for example near discharge points, should also be avoided by intending swimmers.

Drinking of stream water when camping or walking by a stream is another activity which may be appealing, but may carry with it an element of risk to human health. Even in mountain streams draining forest areas, there may be water pollution from recreational uses, grazing stock, licensed discharges, or even native animals and birds. While 'Waters of Victoria' does protect the beneficial use - potable water supply - this protection is only afforded at town water supply offtakes, and is not at such a level of protection to enable stream water to be drunk without treatment.

The attainment program of 'Waters of Victoria' refers to the development of codes of practice by the Environment Protection Authority in co-operation with other public and private bodies. The impacts on water quality of urban run-off, soil erosion, disposal of waste-water, and land and fresh-water salinisation have been highlighted for early consideration. Council believes that codes of practice covering the use of fertilisers, herbicides, and pesticides should be given a high priority. For such codes of practice to achieve widespread acceptance and hence use, their development and promotion should involve all relevant user groups.

It also provides instructions for the planning and management of land use so as to minimise polluted run-off from specific sites and the catchment as a whole.

The attainment program further allows for the staged implementation of its provisions, with priority given to existing problems and areas under threat. The Environment Protection Authority is identified as having a lead role in initiating and coordinating this process.

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, much more needs to be known about our aquatic ecosystems and species that reflect changes in water quality. The community must also recognise the effect of habitat degradation, due to riparian vegetation decrease and stream modification, on the biological values of rivers.

Water-quality reporting

A recent systematic review of water quality data is given in the 1988 State of the Environment Report - 'Victoria's Inland Waters'. The Report assessed the levels of the following water quality indicators, wherever sufficient data were available:

- * physical and chemical indicators - turbidity, suspended solids, conductivity (a measure of salinity), dissolved oxygen, biochemical oxygen demand, pH, phosphorus, and nitrogen
- * biological indicators - information on macro-invertebrates (such as insects, worms, and shellfish) fish, and streamside vegetation

Although the data did not allow a systematic and detailed assessment across the State, the following pattern emerged:

- * Some 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.

Water Supply Catchments

The Council's statutory roles under the *Land Conservation Act 1970* include providing advice concerning policy on the use of land (whether public land or any other land) in any proclaimed water supply catchment. This role, and its implementation, are discussed in the Council's *Statewide Assessment of Public Land Use report (1988)*.

The current condition of Victorian water supply systems - from the catchment through to the reticulation system - is not ideal. The 1988 *State of the Environment Report* evaluated these systems, concentrating on microbiological quality. Using quality criteria applying to reticulated water - that is, water supplied from the tap - it concluded, that only 6.5% of all Victorians living in rural towns and cities received water free from bacterial contamination. The quality of water available in the catchment, and the level of its treatment before delivery to consumers are major determinants of the ultimate quality of water supplied.

Many catchments used for water supply have a multiplicity of land uses, and comprise both public and freehold land. Where not well managed, the following land uses and activities may cause or increase the risk of detriment to water quality arising from such catchments:

- * intensive agriculture - involving for example row crops, field crops, orchards, piggeries, poultry farms, and dairies, which necessitate repeated cultivation, fertiliser or pesticide application, animal access to watercourses or manure disposal.
- * extensive farming that may involve land clearing, traffic of stock over erodible areas, stock access to streambanks, poor grazing management, exposure of the soil surface,

and increased groundwater recharge leading to salinity problems

- * townships with areas under intensive development, a high population density, stormwater drains, and septic tanks or sewage treatment and disposal
- * road construction, earthworks or other construction activities, and timber-harvesting operations, where any of these leave substantial areas on erodible soil types exposed to storm rainfall or where appropriate conditions are not applied

Catchments provide a necessity - water for drinking, cooking, and washing - and it is reasonable for communities to expect land management in their catchments to be a standard that minimizes water degradation.

A continuum of catchment land use stretches from fully protected catchments subject to policies of strict control, commonly known as 'closed' catchments, to those with a multiplicity of uses, where land users are advised how their land can be managed compatibly with water production. The appropriate level of catchment control varies according to the water supply system - whether treated, what lines of defence exist against pollution, the end use of the water, the capability of land in the catchment to support particular uses, and so on.

In addition to urban supplies, the importance of rivers for various recreation activities is clear. Several activities, such as swimming, require water contact; others using boats may result in water contact. Bushwalkers, car-based campers and picnickers may wish to drink and otherwise use river water. In combination, the many recreation users represent a substantial part of the community who would prefer their water, for the above purposes, to be of good quality.

In its previous recommendations for water production, Council has recognised that the prime water-producing areas of the State coincide with the principal mountain and forested areas, and that these areas are major attractions for recreation. In many areas

catchments can be managed for a range of uses consistent with the provision of adequate protection of the water resource. Council realises that the optimum combination of land uses for catchments will vary from one land type to another. Where there is a multiplicity of land uses in a catchment supplying water for 'domestic' and other purposes, Council has expressed the view that the catchment should be recommended for proclamation under the *Soil Conservation and Land Utilization Act 1958* and *Land Conservation Act 1970*. After proclamation, a land-use determination can be made, specifying the most suitable uses of all land in a catchment.

In relation to this Investigation, several Victorian heritage rivers are within proclaimed water supply catchments. These include the Mitta Mitta, Howqua, Big, Bemm, Buchan, Mitchell, and Wonnangatta, and Lerderderg Rivers. As well as providing particular urban water supplies, they are extensively used for recreation (the Buchan River to a lesser extent). Council considers that, in part because of their significance for

recreational use, catchment management plans should be prepared for these rivers and relevant parts of their catchments to protect the identified values. Where appropriate, statutory support for relevant parts of such catchment plans could also be sought - for example by appropriate amendments to municipal planning schemes or by the preparation of whole-of-catchment or partial determinations of land use.

In submissions for this Investigation, several water authorities have referred to catchment protection by essentially natural catchment designation (see Chapter B), the effects of representative river proposals on new storage construction (see Chapter C), and general comments relating to protection of catchments with a range of land uses. Six heritage rivers are used for urban water supply, seven heritage rivers and 16 essentially natural catchments are within proclaimed water supply catchments, and these recommendations will assist in providing protection to these catchments.

WATER QUALITY

Recommendation

F8A That

- (a) *wherever appropriate, programs to improve water quality in specific rivers and streams be co-ordinated in accordance with the principles of integrated catchment management*
- (b)
 - (i) *the systematic evaluation of water quality in Victorian rivers, in relation to State Environment Protection Policies for Victorian Waters, be commenced by the Environment Protection Authority, with priority given to Victorian heritage rivers (see Note 1)*
 - (ii) *where non-compliance with the objectives of the State Environment Protection Policies is found, a management plan to improve water quality be developed (see Note 2)*
- (c) *research into suitable biological indicators (species or communities) of stream quality be accelerated (see Note 3)*
- (d) *high priority be given to the development and implementation of a cost-effective State-wide monitoring program of key water quality indicators (see Note 1)*

(continued)

F8A - Water Quality (continued)

and that

- (e) codes of practice for the use of fertilisers, pesticides and herbicides, particularly in agricultural areas in domestic water supply catchments, be given a high priority for development by the Environment Protection Authority in consultation with other relevant public and private organisations*

Notes:

- 1. The Rural Water Commission and the Environment Protection Authority have major roles in the collection of water quality data. They maintain a network of 172 and 48 (respectively) water monitoring stations across the State. In addition, a number of organisations monitor their 'local' areas (notably the Board of Works and the Latrobe Region Water Authority.*
- 2. Catchment co-ordinating groups, or similar bodies with a role in catchment management, should be involved in developing these plans, and may have to be established for this task.*
- 3. Where possible the entire aquatic community should be monitored. Though this approach requires greater resources, it provides a better picture of overall stream health.*

Salinity

Salinity is widespread throughout the northern and western parts of the State, affecting plains and upland 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.

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, its causes and its effects on general land use have been canvassed in many reports including Council recommendations for the Murray Valley Area (1985), and the Mallee Area Review (1989). Salinity issues as they relate to rivers and streams are twofold.

- * Increased salinity of water flowing in rivers can adversely affect many riverine values 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. All watercourses discharging to the Murray are now governed by a salt-load quota - set by the Murray Darling Basin Commission.

The present monitoring system takes only limited account of very high peak concentrations of salt in Victorian rivers, although such events may kill aquatic plants and animals. Hart *et al.* (1989) suggest that adverse biological effects will occur in rivers and streams when salinity reaches about 1000 mg per L, a value that is sometimes exceeded in a number of Victorian rivers. However, as yet there are no long-term programs measuring peak salt concentrations in the State's rivers.

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. Measures now being taken in irrigated areas include the more efficient distribution and application of irrigation water (to reduce accessions to the groundwater table) and groundwater pumping. Generally, these actions only lower the water table by a small amount. Although useful for agriculture, this may not significantly benefit the adjacent and lower-lying rivers and streams.

In combating salinity problems, there has been an increase in the planned discharge of salt-rich surface and near surface waters from agricultural areas to rivers.

The direct discharge of saline waste water to rivers increases the salt concentration, with the degree of increase depending on the relative flow and salt levels in the discharge and in the river. These discharges may also contain elevated concentrations of fertilisers and biocides. Where the discharge to the

river is via an open unlined drain, additional sediment scoured from the drain itself may also be added to the river. This addition of fertilisers, biocides and sediment to rivers may, along with salt, have a range of undesirable impacts. Among the approved recommendations for the area covered by the Mallee Area Review (1989), Council specified that new schemes for the disposal of saline drainage water not include disposal onto river floodplains.

Council recognises the planning, resources and effort that have gone into the development of the salinity management plans, and in general supports their aims. However, their economic analyses do appear primarily to compare the costs of engineering alternatives, with only limited attention to the range of environmental values that may be affected.

It is generally acknowledged that discharge of saline water to rivers is not a long-term solution to land degradation. However, any long-term solution will require the treatment of the causes of land degradation over a long period. Council recognises that a number of economic, technical, social and planning issues would need to be resolved before the discharge of saline waste can be precluded.

SALINITY

Recommendation

F8B 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) *the impact of saline discharges (and possible associated nutrients, biocides and sediments) on aquatic ecosystems be investigated and established*
- (c) *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*

(continued)

F8B - Salinity (continued)

and that

- (d) *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.*

Notes:

1. *Council is aware that a number of approved salinity management plans include the discharge of saline water to rivers as a component.*
2. *Several of the guidelines for water resource projects (see section F5) are also relevant to schemes for disposal of saline wastewater.*

F9 WATERWAY MANAGEMENT

Principles and guidelines published in previous Land Conservation Council recommendations have been updated.

Waterway management has the following aims:

to protect and enhance the environmental, economic, recreational, cultural, and scenic values of rivers, and protect public and private assets from damage arising from river and stream processes.

The perceptions and functions of waterway management have changed substantially in recent years. Rivers are now considered an aquatic resource rather than just water-carrying channels requiring bed and bank stabilisation. Their potential for multiple use is widely accepted. Interventionist management techniques are expensive and may adversely affect other values, so the emphasis should be on preventative measures.

Existing waterway management authorities include river management boards and river improvement trusts, the Dandenong Valley and Western Port Authority, and the Latrobe Region Water Authority. The Rural Water Commission is responsible for floodplain management for most of the State, and for waterway management (under Section 67 of the *Water Act 1989*) where there is not a constituted river management board. 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. Other organisations involved with some aspects of the management of rivers include three drainage trusts (also constituted as 'waterway management authorities'), several community drainage schemes, and some LandCare groups.

Section 189 of 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 relating to the use and to the economic, social, and environmental values of land and waterways
- * to develop and to implement effectively schemes for the use, protection, and enhancement of land and waterways
- * to investigate, promote, and research any matter related to its functions, powers and duties in relation to waterway management
- * to educate the public about any aspect of waterway management

The Act stipulates that an authority 'must perform its functions in an environmentally sound way'.

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 woody debris 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, transport of sediment to the stream, and reduction in woody debris and organic matter inputs to streams. An increase in urban development - with disposal of storm water and other effluents directly to streams - has also altered flow regimes and water quality.

- * 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.
- * Alluvial mining activities last century and early this century involved disturbance of floodplain vegetation and of beds and banks through hydraulic sluicing and dredging. This caused an increase in sediment loads, which severely disrupted the natural conditions of several rivers. It is not clear whether rivers affected in this manner have yet recovered. Unstable tailings and mullock heaps may continue to add sediment.
- * Management techniques once widely practised - such as wetland drainage, the removal of woody debris, and to a lesser extent, river channelisation and straightening - have also played major roles in reducing river values.
- * 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.

Waterway 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 can ensure that long-term adverse impacts are minimised.

Removal of woody debris from the centres of wide streams damages fish habitat, but tethering 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.

Waterway authorities are required to act within their district. In the past, where trust districts encompassed only part of the stream, they could sometimes treat only the symptoms of problems, the causes being along tributary streams 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 drew attention to the undesirable changes in the river environment that had occurred over the past century. A concept that river-management works should be based on a whole-catchment philosophy was subsequently developed. The Minister for Water Resources then 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, and this has been further developed by the *Water Act* 1989.

The State of the Rivers Task Force report (1986) expanded on the above approach, and gave a river by river assessment of needs.

The Standing Committee on Rivers and Catchments was established to advise on priorities for co-ordination of catchment activities around the State, approve catch-

ment management plans, and resolve disputes between agencies. Its 'Environmental Guidelines' (1990) 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 Resources 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.

Waterway 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 Department of Conservation and Environment has proposed that, to reflect this, annual report balance sheets of the waterway authorities should include environmental achievements for the year.

Another aspect of this approach is the co-ordination of activities in the whole catchment. The *Water Act* 1989 requires that waterway authorities 'must participate in forming and consulting with catchment coordination 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 (now in the Latrobe Region Water Authority), Mitchell River and Ovens River Management Boards, and one for the Wimmera catchment, with wide representation of not only catchment and water organisations involved in management and use, but also the community. 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.

Recommended managers

The recommendations for Victorian heritage rivers and representative rivers identify the managers to implement them. These are the Department of Conservation and Environment, in conjunction with a particular waterway authority, and/or other land or water managers where relevant. In other areas, in relation to waterway activities, the appropriate waterway authorities are recommended to have the primary role, while the Department would have the leading role in managing corridor public land, and protecting in-stream and riparian values.

Although community organisations exist that have an interest in particular streams, they do not have the authority to operate effectively on a whole catchment basis. For many rivers, no waterway authority or other relevant local organisation exists, and accordingly the Rural Water Commission in consultation with the Department of Conservation and Environment (or relevant existing manager) has been specified as managers.

Principles for managing rivers

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.

The geomorphic processes operating differ between rivers, and between different parts of a river. It is important that waterway management methods be chosen to suit the conditions, and that the methods used are reviewed regularly, to ensure that only those that are efficient and most appropriate are used.

The Council believes that the following principles should apply in determining the need for and design of management works.

Catchment-based solutions

- * Where problems arise in waterway management, 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 waterway 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, to reduce the velocity of floodwaters as they leave and re-enter the flood-course, to ensure the input of food sources for aquatic ecosystems, and as habitat.
- * Vegetation planted for waterway 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

- * Waterway managers should have access to the full range of expertise necessary to manage rivers for all their values and uses.
- * In the design of works, careful attention should be given to protecting or restoring 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

WATERWAY MANAGEMENT

Recommendation

F9A That

- the assessment of the need for, and the planning and implementation of, waterway management works involving any changes to the beds and banks of streams incorporate the principles outlined above*
- the effectiveness of waterway management works, and effects on river values, be researched and, where appropriate, management techniques be changed*
- reporting mechanisms and criteria be developed in order to identify the environmental impact of river works, and monitor progressive achievement of the maintenance or restoration of a river's environmental values*

(continued)

F9A - Waterway management (continued)

and that, except where specified otherwise, Victorian rivers be managed by the relevant waterway authority or the Rural Water Commission (or existing manager) in consultation with the Department of Conservation and Environment.

Restoration of riparian vegetation

Much of the State's substantial in-stream and stream-bank erosion and consequent sedimentation 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 and transported to watercourses. Bed and bank erosion, the principal form affecting rivers, is caused in part by greater peak flows and the removal of vegetation.

Chapter E - River frontages, beds and banks - contains recommendations for restoration of degraded riparian areas.

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 riparian habitat for native animals, a reduction in woody habitat for aquatic fauna 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). As a result a riparian verge consisting of exotics does not represent an ecologically sustainable

situation, resulting in a permanent reduction in in-stream values.

The ready ability of willows to grow from seed or cuttings swept downstream by floods means they often invade native vegetation along riverbanks downstream of the original planting. Basket willow now invade long sections of many rivers, the Tambo River being one example, as a result of this process.

Willows should not be used if other stream stabilisation methods can be applied. However, with the limited resources available, willows may be a cheap erosion control method for small isolated erosion problems, which if left unattended may become more serious. There may, therefore, need to be a trade-off between the use of willows with their inherent problems, and the possibility that more serious erosion problems will develop. The latter option may become the most damaging for the stream environment.

In such circumstances, supplementary plantings of native species, preferably indigenous, should be made, and the willows removed when stability is achieved. Care should be taken to ensure that willows do not proliferate and invade banks downstream. Many native species, including *Casuarina cunninghamii* and *C. glauca* have been successfully used for bank-erosion control.

Where grazing is likely to be a threat to the maintenance or regeneration of riparian vegetation, the fencing of the stream frontage may be the most effective method of protection (see Chapter E). 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.

RESTORATION OF RIPARIAN VEGETATION

Recommendation

F9B 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 application of the following guidelines.

- * Exotics should be replaced 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 are only to be used in those exceptional circumstances where they are the only effective method. Once stability is achieved and can be maintained, they should be removed and replaced by native, preferably indigenous species.*

F10 UTILITIES AND SURVEY

Recommendations for utilities have been extensively covered in previous Council investigations and 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, 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

Recommendation

General utilities

F10A That

- (a) *existing easements continue to be used to provide access and services where they are not causing significant diminution of other river values. Where they are, alternatives should be sought and easements relocated wherever possible*
- (b) *new power-lines, pipelines, communications equipment, and other utilities be planned to avoid disturbance to the values of rivers and streams, particularly Victorian 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 Victorian 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.

	<i>Recommendation</i>
<i>Railway lines</i>	
<i>F10B That</i>	
	<i>(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</i>
	<i>and that</i>
	<i>(b) landscape and conservation values of railway easements be protected by observing the guidelines in Council's past recommendations.</i>

Survey, navigation, and communication

New access roads, cleared lines-of-sight, and clearings for towers and other structures can

have a substantial impact on Victorian heritage rivers, essentially natural catchments, remote recreational settings, or scenic vistas.

	<i>Recommendation</i>
<i>Survey, navigation and communication</i>	
<i>F10C That</i>	
	<i>(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</i>
	<i>and that</i>
	<i>(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.</i>

Road and track construction, maintenance and upgrading

Roads and tracks that lie close to rivers and cross watercourses may have impacts on aquatic values. Dependent on their design, maintenance and proximity to streams, roads may be a source of direct sediment input to streams. There is a common tendency when constructing, widening or realigning roads and tracks along streams in steep valley sections to dispose of fill onto the stream batter. Although a cheap method of fill

disposal, slumping of the batter or rainfall run-off from the exposed batter surface can cause sedimentation and turbidity in the adjacent stream.

Stream crossings also require attention, as they may be a source of sediment. In addition, attention to the design and construction of culverts and fords is necessary to ensure that they do not, during low flows, form a barrier to the passage of in-stream fauna, especially fish.

Recommendation

Road and track construction, maintenance and upgrading

F10D That

- (a) *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 or turbidity*
- (b) *in siting new roads and tracks, locations parallel and close to streams be avoided and crossings minimised, and the need for such roads be assessed in the context of the direct disturbance to areas of environmental significance, and the maintenance of recreational opportunity settings*

and that

- (c) *stream crossings be constructed to minimise disturbance to streambed and banks, riparian vegetation and the passage requirements of native aquatic fauna.*

F11 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 and in accordance with definitions given in the *Mineral Resources Development Act 1990 (MRDA 1990)*, which is scheduled for proclamation at the end of July 1991.

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.

Mineral Exploration

The government has the responsibility to establish the existence and extent of the State's earth resources. In the main, provisions in the *Extractive Industries Act 1966* and *MRDA 1990* provide the tenure under which private enterprise is encouraged at its own cost to explore for new deposits.

When a new deposit is discovered in an area where extraction or mining is not a currently approved land use, the deposit 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.

It is important therefore that the reservation of conservation areas should not automatically exclude exploration for earth resources. Attention should rather be directed towards ensuring that other values and interests are protected. As discussed later, however, some areas should remain undisturbed.

Exploration - as defined by the *MRDA 1990* - encompasses a wide range of methods for evaluating an area's mineral 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. costeaning and bulk sampling), are generally not compatible with the conservation of sensitive values.

A mandatory code of practice for the exploration and rehabilitation of exploration sites, as provided by the *MRDA 1990*, will cover such issues and is currently being developed.

Commercial Exploration and the Recreational Search for Minerals

Under the *MRDA 1990* exploration is systematic and commercial in its approach, and is allowed under an Exploration Licence.

A Miner's Right permits the individual permit holder to search for minerals but neither mechanical equipment nor explosives can be used, nor can the holder remove or damage trees or shrubs or disturb any Aboriginal place or object. A Miner's Right entitles the holder to search for minerals on both Crown land - subject to certain exemptions - and (with the owner's permission) private land. The holder cannot, however, search on land held under a mining licence.

A Tourist Fossicking Authority permits the holder and accompanying people to search for minerals under conditions similar to those permitted by a Miner's Right.

Since 1 November 1990, the use of eductor dredges has not been permitted in Victoria.

Under current legislation exploration 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 activities under an Exploration Licence, Tourist Fossicking Authority or Miner's Right 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 be restricted. In addition, limited areas of land surface may, because of their special public importance or inherent instability, warrant either permanent or temporary exclusion from these activities. 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 Council's recommendations, but will be determined by consultation between the Department of Conservation and Environment and the Department of Manufacturing and Industry Development (DMID).

Activities under an Exploration Licence, Miner's Right, or Tourist Fossicking Authority where they involve minimal disturbance to soil, and in the case of an Exploration Licence, minimal disturbance to vegetation, will be permitted on public land other than these limited areas, and those specifically nominated in these

recommendations and Council's previous 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 DMID together determine that such exemptions or exceptions should no longer apply.

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 *Extractive Industries Act 1966* and the *MRDA 1990*.

Stone

Materials defined as '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 either river beds or 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 for Exploration and Mining

The principles detailed below have been specified in numerous of Council's past recommendations. Current practices of the DMID are in line with them. In addition, activities carried out under provisions of the *MRDA 1990* and *Extractive Industries Act 1966* are subject to assessment by the DMID - Environmental Unit. The terms 'exploration', 'extractive industry' and 'mining' are those defined by the relevant Acts.

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 mining or extractive industry and from exploration where the methods proposed would adversely affect the identified values. Appropriate methods for exploration in essentially natural catchments are listed below. The DMID 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 should be used for exploration for, and production of, minerals, stone, and energy materials.
- * When tenure is issued for operations under the *MRDA 1990* or *Extractive Industries Act 1966* 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

licence or lease and with the requirements of the relevant Act.

- * Consultation should continue between the DMID, 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.
- * The current system of ensuring that, before work commences, the availability of funds for progressive and final reclamation of any excavation or operation should continue.
- * 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 extractive industry and mining on public land.

- * Rehabilitation bonds be set to ensure adequate site rehabilitation. The DMID should continue to require identification of end-use options and where possible require a work plan that shows 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 extractive industry should be opened in areas that the land manager, in consultation with the DMID, 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' (including gravel and sand) 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 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. The Department of Conservation and Environment should be consulted if it is not the land manager, or if extraction is proposed from a streambed or bank under authority other than that administered by the Department.
- * 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 and subject to relevant controls, 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.

Principles for mineral exploration in essentially natural catchments

In order to protect the values of essentially natural catchments the following principles should be observed when considering exploration within them.

- * Remote sensing be permitted.
- * Mineral exploration requiring direct entry to the catchment only be permitted

in essentially natural catchments when the specific information sought cannot be obtained elsewhere.

- * No structures be erected, vehicular tracks constructed, or vegetation disturbed within the catchment.
- * Access within an essentially natural catchment be on the same basis as that for other members of the public - by foot or non-mechanised watercraft, or by existing road or track maintained for vehicle access by the public.
- * Within the catchment no motorised drilling equipment other than self-contained hand-held motorised rock drills be used. Small hand held soil augers may be used.
- * Sample collection be subject to prior consultation and agreement with the land manager (to ensure that sample site location and density, and sample quantity avoids impact on the essentially natural condition of the catchment).
- * Where survey grids are to be used, the use of satellite navigation aids be encouraged, and if pegs and tapes are used, these be removed on the completion of survey.
- * Survey techniques that involve use of large (above 4 amp at 110 volts) electric current not be permitted within the catchment.

In addition to the above, approval under the *Soil Conservation and Land Utilisation Act 1958* should continue to be sought for exploration, mining, or extraction operations for 'minerals', 'petroleum', or 'stone', where the subject land is within a proclaimed water supply catchment.

MINERAL AND STONE PRODUCTION

Recommendations

F11A That public land (other than reference areas and certain water production areas in accordance with Council's policy, and except where excluded in accordance with land status) continue to be available for exploration and mining under licence subject to the principles and guidelines set out above.

(continued)

F11 - Mineral and Stone Production (continued)

F11B That

(a) *public land (other than reference areas and certain water production areas, and except where excluded in accordance with land status) continue to be available for exploration for 'stone' subject to the principles and guidelines set out above*

and that

(b) *in relation to extraction from stream-beds:*

(i) *new licences or permits 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*

(ii) *the managing authority consult with the relevant waterway authority (where it is not the manager) regarding proposals for stream-bed extraction, so that any such extraction serves to assist in restoration rather than exacerbating waterway management problems.*

F11C That public land (other than reference areas and certain water production areas, and except where excluded in accordance with land status) continue to be available for exploration and production of 'petroleum', subject to the principles and guidelines set out above.

F11D That the search for minerals under a Tourist Fossicking Authority or Miner's Right, involving minimal disturbance of soil (see Note 2), be permitted on public land other than:

(i) *those areas specifically excluded in these or previous recommendations of Council, or in accordance with land status*

(ii) *those areas that the land manager and the DMID together may determine*

Notes:

- 1. Legislation has excluded new mining and exploration tenements from national, State, and wilderness parks scheduled under the National Parks Act 1975.*
- 2. The Mineral Resources Development Act 1990 prohibits the removal or damage of any tree or shrub on any land under a Tourist Fossicking Authority or Miner's Right.*

Essentially Natural Catchments

F11E That

(a) *regional-scale geological mapping and sampling, geochemical sampling of stream sediment, soils and rock, and geophysical surveys be permitted in essentially natural catchments where they are carried out in accordance with the above principles*

(b) *prospect-scale geological mapping and sampling, soil geochemical sampling, and geophysical surveys may be permitted, subject to consultation with the land manager, where they are carried out in accordance with the above principles*

(continued)

F11E - Mineral and Stone Production (continued)

- (c) *where, at the completion of an exploration program to the extent provided by the above, a company wishes to undertake further exploration in an essentially natural catchment, the government should determine whether further exploration and possible subsequent mining should take place, and whether a review of land use is warranted. It may then determine that the Council should provide advice on appropriate land use.*

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

Waterway authority

A waterway management authority constituted under the *Water Act* 1989

and acting in accordance with that *Act*.

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.*
- Biosis Research Pty Ltd (1989). Nature conservation values of the rivers and catchments of Gippsland. *Water Resource Management Report Series No. 44.* (Department of Water Resources: Melbourne.)
- 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.*
- Biosis Research Pty Ltd and Scenic Spectrums Pty Ltd (1989). Conservation, scenic, recreation and resource values of selected rivers and streams in Victoria. *Report to the Land Conservation Council.*
- 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.*
- Commissioner for the Environment (1988). *State of the Environment Report 1988 - Victoria's Inland Waters.* (Office of the Commissioner for the Environment: Melbourne.)
- 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.)
- Gippsland Water Strategy Task Force (in preparation). *Gippsland Water Strategy.* (Department of Conservation and Environment: 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.)
- Gullan, P., Cheal, D., and Walsh, N. (1990). *Rare or threatened plants in Victoria.* (Department of Conservation and Environment: 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.

- Jackson, P. (1991). Australian threatened fishes-1990 Supplement. *Australian Society of Fish Biology Newsletter* 21(1).
- 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.)
- Land Conservation Council (1989). Rivers and Streams Special Investigation - Report. (Land Conservation Council: Melbourne.)
- Land Conservation Council (1990). Rivers and Streams Special Investigation - Proposed Recommendations. (Land Conservation Council: Melbourne.)
- Land Conservation Council (1991). Wilderness Special Investigation - Proposed Recommendations. (Land Conservation Council: 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. (1990). Conservation value and status of Victorian rivers - Part II. East Gippsland Rivers. (Royal Melbourne Institute of Technology: Melbourne.)
- Macmillan, L., and Kunert, C. (1990). Conservation value and status of Victorian rivers - Part I. Methodology - classification nature conservation, and strategies for protection. (Royal Melbourne Institute of Technology: Melbourne.)
- Milner, P. (1990). Northern diversion sites - mining heritage, preliminary report. *Water Resource Management Report Series No. 56*. (Office of Water Resources, Department of Conservation and Environment: Melbourne.)
- Mitchell, P. (1990). The environmental condition of Victorian streams. (Department of Water Resources: 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*, 40-5.
- Scenic Spectrums (1986). A preliminary scenic assessment procedure for Australia's river landscapes. *Report to the Victoria National Estate Committee*.
- 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.)

Upcher, C. (1991). Northern diversion sites
- archeological survey, preliminary report.
Water Resources Management Report Series
No. 57. (Department of Conservation and
Environment: Melbourne.)

See also the Information sources,
Appendix V

Appendix I

LIST OF SUBMISSIONS

Sub. no.	Name	Affiliation	Sub. no.	Name	Affiliation
Written submissions following publication of the Resources Report					
1	RICHARDSON		56	WRIGHT	FRIENDS OF MALLACOOTA
2	RICHARDS	BENALLA WATER BOARD	57	HAYNES	SHIRE OF STAWELL
3/1	MIDDLETON	SHIRE OF BANNOCKBURN	58	BALLARD	RURAL WATER COMMISSION OF VICTORIA
4	MOORE	SHIRE OF NEWSTEAD	59	BALKIN	SHIRE OF DIAMOND VALLEY
5	BANFIELD	LODDON-CAMPASPE REGIONAL PLANNING AUTHORITY	60	BOGG	DEPARTMENT OF SPORT AND RECREATION
6	ENTWISLE	SCHOOL OF BOTANY - UNIVERSITY OF MELBOURNE	61	LAMBERT	ORBOST DISTRICT ENVIRONMENT GROUP
7	MARTIN		62	WILKINSON	COLAC DISTRICT WATER BOARD
8	SENIOR	RIVER BASIN MANAGEMENT SOCIETY INC	63	VALE	BARMAH FOREST PRESERVATION LEAGUE
9	ANDERSON	ROCHESTER WATER BOARD	64	LAW	SHIRE OF NATHALIA
10	MCDONALD	SHIRE OF KERANG	65	HUON	VICTORIAN ASSOCIATION OF FOREST INDUSTRIES
11	TURNER	CASTLEMAINE HISTORICAL SOCIETY INC	66	HASLER	VICTORIA ASSOCIATION OF FOUR WHEEL DRIVE CLUBS INC
12	JACKEL	SHIRE OF ROCHESTER	67/2	FRASER	
13	WALLIS	SHIRE OF WANNON	68	TAYLOR	COLLINGWOOD HISTORICAL SOCIETY
14	THOMPSON	LATROBE VALLEY FIELD NATURALISTS	69	COLES	ENVIRONMENT PROTECTION AUTHORITY
15/1	WHITE	SNOWY RIVER IMPROVEMENT TRUST	70	BRIGGS	
16	REDWOOD	UPPER BRODRIEBB PROTECTION COMMITTEE	71	WHITEHEAD	VICTORIAN APIARISTS' ASSOCIATION INC
17/1	OSBORN	MARYBOROUGH FIELD NATURALISTS CLUB	72	HALLS	MELBOURNE BUSHWALKERS
18/1	WHITE	LAND PROTECTION ADVISORY COMMITTEE - ORBOST REGION	73	MARSHALL	AUSTRALIAN HERITAGE COMMISSION - HISTORIC ENVIRONMENT
19	RIMMER	THE VICTORIAN MOUNTAIN TRAMPING CLUB	74	TONTA	CITY OF MORDIALLOC HISTORICAL SOCIETY
20	WILSON	DEPARTMENT OF INDUSTRY, TECHNOLOGY AND RESOURCES	75	COOKE	LAND PROTECTION ADVISORY COMMITTEE MELDURA REGION
21	WALLIS		Written submissions following publication of the Proposed Recommendations		
22	WILLIAMSON	SCENIC SPECTRUMS PTY LTD	1	ROBINSON	
23	MCLAUGHLIN		2	DONKIN	
24	EDDY		3	WORLAND	HAMILTON WATER BOARD
25	SEMPLE	VICTORIAN FIELD AND GAME ASSOCIATION	4	JABOOK	BENALLA WATER BOARD
26	HORGAN	STATE ELECTRICITY COMMISSION OF VICT	5	JOHNSTON	SHIRE OF EAST LODDON
27	MEAKIN	VICTORIAN PISCATORIAL COUNCIL	6	STURMS	
28	ODDIE	MT EMU CREEK CATCHMENT CO-ORDINATING GROUP	7	MOLL	
29	LEVY	ANIMAL LIBERATION	8	WALKER	
30/1	HOPGOOD	VICTORIAN RECREATIONAL FISHERMEN'S ADVISORY COUNCIL	9	SIMMONS	VICTORIA ARCHAEOLOGICAL SURVEY DEPARTMENT OF CONSERVATION AND ENVIRONMENT
31	FOSTER	DEPARTMENT OF CONSERVATION, FORESTS AND LANDS	10/1	MATHESON	ORBOST WATER BOARD
32	BLIZZARD	MACEDON WATER BOARD	11	WARD	GIFFSLAND BRANCH - PROSPECTORS & MINERS ASSOCIATION VICTORIA INC
33/1	CROUCH	WYPERFELD NATIONAL PARK & LAKE ALBACUTYA ADVISORY COMMITTEE	12/1	WILKINSON	COLAC DISTRICT WATER BOARD
34	IONES	VICTORIAN AMATEUR CANOE ASSOCIATION INC - TOURING COMMITTEE	13	HOBSON	TAMBO WATER BOARD
35	TREMAYNE	WILDLIFE RESCUE CONSULTANCY	14	DYER	SHIRE OF KERANG
36	LARKIN		15	CAMBREY	
37/2	WOODROFFE	ROYAL HISTORICAL SOCIETY OF VICTORIA	16	WRIGHT	UPPER YARRA VALLEY & DANDENONG RANGES AUTHORITY
38/1	CURTIS	CONCERNED RESIDENTS OF EAST GIFFSLAND	17	COPLAND	LODDON-CAMPASPE REGIONAL PLANNING AUTHORITY
39	BERICK	THE COUNCIL OF VICTORIAN FLY FISHING CLUBS INC	18/1	HOBSON	SHIRE OF TAMBO
40/1	GARDNER	GELLIBRAND RIVER SYSTEM COMMITTEE	19	CLINE	
41/1	KUNERT		20	JELINEK	
42/1	FARIS	CONSERVATION COUNCIL OF VICTORIA	21	MILLER	
43/1	SENIOR	BOARD OF WORKS	22	O'ROURKE	
44/1	BARNETT	VICTORIAN NATIONAL PARKS ASSOCIATION INC	23	GILBERT	CITY OF SHEPPARTON
45	DRUMMOND	IAN DRUMMOND AND ASSOCIATES PTY LTD	24/1	JAMES	SHIRE OF RODNEY
46/1	COLVIN		25	GILBERT	SHIRE OF GISBORNE
47	EDDY		26	DAVIES	
48	TANNER	MORNINGTON PENINSULA AND DISTRICT WATER BOARD	27	KOEHN, DOEG, O'CONNOR & RAADIK	
49/1	BURNS	FEDERATION OF VICTORIAN WALKING CLUBS INC	28	BARFORD	COUNCIL OF VICTORIAN FLY FISHING CLUBS INC
50	MOLONEY	SHIRE OF DIMBOOLA	29	HUON	VICTORIAN ASSOCIATION OF FOREST INDUSTRIES
51	QUINLAN	VICTORIAN NATIONAL PARKS ASSOCIATION INC - LINEAR PARKS COMMITTEE	30	McSPADDEN	
52	BIRD		31	OFFICER	
53	FINLAYSON	CENTRE FOR ENVIRONMENTAL APPLIED HYDROLOGY - UNIVERSITY OF MELBOURNE	32	GLASSOCK	ALBERTON WATER BOARD
54	LEACH	INSTITUTE OF WATER ADMINISTRATION	33	STEPHENS	SHIRE OF ALBERTON
55	BRODY	LEXTON LANDCARE GROUP	34	GARDNER	
			35	MORGAN	ENVIRONMENT PROTECTION AUTHORITY
			36	MINCHIN	
			37/1	MILLS	MACALISTER IRRIGATION DISTRICT ADVISORY COMMITTEE - RURAL WATER COMMISSION OF VICTORIA

Sub. no.	Name	Affiliation	Sub. no.	Name	Affiliation
38	COVENTRY		101	GREG	ALBURY WODONGA ENVIRONMENT CENTRE
39	GAZZARD (FAMILY)		102/1	GOUDIE	WIMMERA INDUSTRIAL MINERALS
40	BERRY	MALLACOOTA WATER BOARD	103	MANN	AUSTRALIAN PAPER MANUFACTURERS
41	SPITTY	SHIRE OF HEYTESBURY	104	ROSE	BEMM RIVER PROGRESS & IMPROVEMENT ASSOCIATION
42	STEVENSON		105/1	COLLINGS	SHIRE OF MAFFRA
43	ROBINSON	EAST GIPPSLAND RIVER MANAGEMENT BOARD	106	McEWAN	VICTORIAN ASSOCIATION OF FOUR WHEEL DRIVE CLUBS
44	STEVENSON	VICTORIAN STATE EXECUTIVE - AUSTRALIAN DEER ASSOCIATION	107	TAYLOR	OVENS RIVER MANAGEMENT BOARD
45	LEHMANN		108	MIDDLETON	SHIRE OF BANNOCKBURN
46	BENTLEY	ALPINE RESORTS COMMISSION	109	FOX	SHIRE OF UPPER YARRA
47/1	SMITH	SHIRE OF MANSFIELD	110	GLEESON	SHEPPARTON WATER BOARD
48	THOMPSON	LATROBE VALLEY FIELD NATURALISTS CLUB INC	111	HOPKINS	
49	LANSBURY		112	HOPKINS	HORSHAM HIGH SCHOOL
50	POSTER	ROYAL HISTORICAL SOCIETY OF VICTORIA	113	HOPKINS	WIMMERA ENVIRONMENT GROUP
51	LAW	SHIRE OF NATHALJA	114	TOYE	
52	MYNARD	VICTORIAN MISCATORIAL COUNCIL	115	JOHNSON	NELSON RESERVES COMMITTEE OF MANAGEMENT
53/1	ALLEN	SHIRE OF MINHAMITE	116	LADSON	IAN DRUMMOND & ASSOCIATES PTY LTD MID GOULBURN RIVER MANAGEMENT BOARD
54	MARTIN		117	ROBINSON, THOMAS & ATKINSON	AUSTRALIAN ENVIRONMENTAL ASSESSMENT & SURVEYS PTY LTD
55	ELLIOTT, C & D		118/1	LAMBERT	ORBOST & DISTRICT ENVIRONMENT GROUP
56	WILLIAMS		119	BAKTON & HINE	
57	MONTGOMERY	SHIRE OF OXLEY	120/1	WHITE	SNOWY RIVER IMPROVEMENT TRUST
58	JARMAN		121/1	McLAUGHLIN, C & Y	
59	GRIMES	LATROBE REGIONAL COMMISSION	122	MALCOLM	
60/1	BALDWIN	SHIRE OF WIMMERA	123	CLUGSTON	WIMMERA CATCHMENT CO-ORDINATING GROUP
61	LEWIS		124	ALEXANDER	SHIRE OF TRARALGON
62/1	CULLEY	BOARD OF WORKS	125	BOTHE	
63	MORGAN		126	KRAEMERS	
64	McMAHON		127	DALZIEL	SEYMOUR ENVIRONMENT GROUP
65	SLAGTER		128	McLACHLAN	VICTORIAN FIELD & GAME ASSOCIATION
66	FARNES	PORTLAND FIELD NATURALISTS' CLUB INC	129	EMONSON	SHIRE OF YARRAWONGA
67	MARSHALL	VICTORIAN SEEKERS CLUB INC	130	WHEELER	THE BALD HILLS LANDCARE GROUP INC
68/1	KRUTOP	GIPPSLAND WATER UTILIZATION COMMITTEE	131	STONE	
69	EADIE		132	COLE	ROBERT M.H. COLE & CO
70	HINE		133	MUTTON	ALPINE FLY FISHERS
71	TREASURE		134	NEWMAN	MID-GOULBURN CATCHMENT CO-ORDINATING GROUP
72	HEWITT	YARRIAMBLACK CREEK FLOW PROTECTION COMMITTEE	135	BENBOW	SHIRE OF HEYWOOD
73	SUTTON		136	MOLONEY	SHIRE OF DIMBOOLA
74	OSBORN	MARYBOROUGH FIELD NATURALISTS' CLUB INC	137/1	SENIOR	RIVER BASIN MANAGEMENT SOCIETY
75/1	KERR	LATROBE VALLEY WATER & SEWERAGE BOARD	138	DAINTON	SALINITY PROGRAM ADVISORY COUNCIL - SHEPPARATON VIC ROADS
76	HOBSON	TAMBO RIVER IMPROVEMENT TRUST	139	PATTERSON	
77	JONES	TOURING COMMITTEE - VICTORIAN AMATEUR CANOE ASSOCIATION	140	DAVIES	
78	PRIOR	SUNRAYSLA-MALLEE BRANCH - AUSTRALIAN CONSERVATION FOUNDATION	141/1	REDDICK	CITY OF BAIRNSDALE
79	WINTER	PROSPECTORS' AND MINERS' ASSOCIATION OF VICTORIA INC	142	COLLINS	
80/1	NEWTON	SHIRE OF BAIRNSDALE	143	LOMAX	SHIRE OF MAVOR
81	WHITE		144/1	KUNERT	
82/1	NEWTON	EAST GIPPSLAND MUNICIPALITIES STEERING COMMITTEE	145/1	BARBER	CONSERVATION COUNCIL OF VICTORIA
83	BARLOW	SHIRE OF OMEO	146	LUMB	THE OFFICE OF THE ENVIRONMENT DEPARTMENT OF CONSERVATION & ENVIRONMENT
84	THEGE	SHIRE OF NARRACAN	147	FLEISCHER	MITCHELL RIVER MANAGEMENT BOARD
85	COX		148	APITZ	DEPT OF PLANNING - NSW GOVERNMENT
86	HODGE		149	LANGFORD	RURAL WATER COMMISSION OF VICTORIA
87/1	MAHOOD	WESTERN VICTORIA FIELD NATURALISTS CLUBS ASSOCIATION	150	POLLOCK	GARDENLAND FROZEN FOOD PTY LTD
89	RIMMER	THE VICTORIAN MOUNTAIN TRAMPING CLUB	151	WIDDICOMBE	SHIRE OF DUNMUNKLE
90	FOSTER	SHIRE OF LOWAN	152/1	HORGAN	STATE ELECTRICITY COMMISSION
91	READ		153	HOGG	DEPARTMENT OF SPORT AND RECREATION
92	MAY	TULLAROO CATCHMENT CO-ORDINATING GROUP INC	154	KIRBLE	OMEO & TAMBO VALLEY GROUP COUNTRY WOMEN'S ASSOCIATION OF VICTORIA
93	BLACK	WEST GIPPSLAND PEACE AND ENVIRONMENT GROUP INC	155	BALDWIN, R. & M.	
94/1	FRASER		156	NATION	
95	DALGARNO	DEPARTMENT OF MANUFACTURING & INDUSTRY DEVELOPMENT	157	GILCHRIST	
96	DOERY	FRIENDS OF WYPERFELD NATIONAL PARK	158	BLACKMORE	MURRAY-DARLING BASIN COMMISSION
97/1	HUMANN	VICTORIAN NATIONAL PARKS ASSOCIATION INC	159	HOPGOOD	VICTORIAN RECREATIONAL FISHERMEN'S ADVISORY COUNCIL - DCE
97	QUINLAN	LINEAR PARKS - VICTORIAN NATIONAL PARKS ASSOCIATION INC	160	BRAYSHAW	SHIRE OF AVON
98	SHADE	SHIRE OF WARRACKNABEAL	161	BROUGHTON	BRUTHEN & DISTRICT COMMUNITY FORUM
99	REYNOLDS	VICTORIAN CHAMBER OF MINES INC	162	ROBERTS	MITCHELL WATER BOARD
100/1	ADDINSALL	MT. BEAUTY TIMBER INDUSTRIES	163	BARTON	
			164	O'BRIEN	MACALISTER THOMSON IRRIGATION DISTRICT COUNCIL - VICTORIAN FARMERS FEDERATION
			165	ARBUTHNOT	VICTORIAN FARMERS FEDERATION
			166	HERMANS, J. & R.	

Appendix I - List of Submissions

Sub. no.	Name	Affiliation
167	WOOD	BAIRNSDALE CHAMBER OF COMMERCE
168	SIMPSON	
169	MITCHELL	TRARALGON WATER BOARD
170	NICHOL	EAST GIPPSLAND REGIONAL DEVELOPMENT BOARD - VICTORIAN EASTERN DEVELOPMENT ASSOCIATION
171	GRAHAM	
172	WEATHERALL	SHIRE OF ORBOST
173	HOBSON	EAST GIPPSLAND MUNICIPALITIES CORPORATION STEERING COMMITTEE

Sub. no.	Name	Affiliation
174	GALE	COASTAL OPERATIONS - PORT OF MELBOURNE AUTHORITY
175	HERBERT	ENVIRONMENT & NATURAL RESOURCES SUB-COMMITTEE - VICTORIAN EASTERN DEVELOPMENT ASSOCIATION
176	DOBBY	
177	MUNRO	LAND PROTECTION COUNCIL - DEPARTMENT OF CONSERVATION & ENVIRONMENT

Note: '1' - indicates an addendum received; none other in some cases.

Appendix II

SOCIAL AND ECONOMIC APPRAISAL OF DRAFT PROPOSED RECOMMENDATIONS

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 (August 1990). The complete report can be inspected at the Council's offices. It may also be borrowed as an inter-library loan from the Department of Planning and Housing library.

Further information on values, resources, and potential impacts provided in submissions on the Proposed Recommendations has been considered by Council. Where relevant, details have been discussed in the Introduction and Chapters A to F.

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.¹

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.²

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 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.

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.

1. The possible impacts for the Goulburn, Wimmera, Snowy, and Glenelg Rivers would arise only if Council were to recommend the provision of environmental flows. This is not the case.
2. A summary of the timber resources for the essentially natural catchments has been provided in Table 1 - Chapter B.

**ENVIRONMENTAL AND RESOURCE VALUATIONS AND IMPLICATIONS OF
DRAFT PROPOSED RECOMMENDATIONS
(Summary extracted from Consultants' Report)**

Note: Further information on values, resources and potential impacts provided in submissions on the Proposed Recommendations was also considered by Council. Where relevant details have been discussed for each Victorian heritage river - see Chapter A.

Environmental values ¹	Water sector	Timber resources	Minerals and stone ^{2,3}	Industry	Economic assessment
A1 - Mitta Mitta River					
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	
A2 - Ovens River					
Economic valuation \$0.7-6.3*m/yr	No specific proposals	No impact of recommen- dations 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	
A3 - Howqua River					
Economic valuation \$1.1*-8.1m/yr	RWC - No implications	Flows through State forest; some resource affected 5800 m ³ 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 Valuations and Implications of draft Proposed Recommendations (continued)

Environmental values	Water sector	Timber resources	Minerals and stone	Industry	Economic assessment
A4 - Big River					
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 ³ 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 ⁴	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	
A5 - Goulburn River					
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 Valuations and Implications of draft Proposed Recommendations (continued)

Environmental values	Water sector	Timber resources	Minerals and stone	Industry	Economic assessment
A6 - Wimmera River					
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				
A7 - Bemm, Goolengook, Arte, and Errinundra Rivers					
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	
A8 - Snowy River					
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 ⁵	Implications of East Gippsland Pulp Mill proposal not evaluated due to lack of economic data
	<\$.01m/yr	<\$.01m/yr	<\$.01m/yr		

Environmental and Resource Valuations and Implications of draft Proposed Recommendations (continued)

Environmental values	Water sector	Timber resources	Minerals and stone	Industry	Economic assessment
A9 - Suggan Buggan and Lower Berrima Rivers					
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	
A10 - Upper Buchan River					
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	
A11 - Mitchell and Wonnangatta Rivers					
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 ⁵	The environmental values are likely to exceed resource values
	<\$.01m/yr	<\$.01m/yr	\$0.01m/yr; Rank 7	Recommendations have insignificant impact	
A12 - Thomson River					
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 Valuations and Implications of draft Proposed Recommendations (continued)

Environmental values	Water sector	Timber resources	Minerals and stone	Industry	Economic assessment
A13 - Yarra River					
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	
A14 - Lerderderg River					
Economic valuation \$0.7-2.0*m/yr	RWC - no implications	Some timber resource affected, around Blackwood and above 18 975 m ³ 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	
A15 - Glenelg River					
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 the consultants' view of the likely dollar value of environmental features
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)
4. Assumes no diversion permitted, so is no longer relevant.
5. Gippsland route rejected, so is no longer relevant.

COMMENTS ON THE CONSULTANTS' SOCIAL AND ECONOMIC APPRAISAL

In submissions and briefings, interest was expressed in the contingent valuation method and the assumption used by the Consultants to calculate the \$ value of environmental attributes for this Investigation. The consultants' report discusses in detail the various assumptions made. Their report refers to the literature that has researched each assumption, and expresses the outcome of that research. Their conclusions are that contingent valuation methods produce values that are replicable, consistent with demand theory and consistent with results from other methods such as 'travel cost' and 'hedonic pricing'. These methods give results with an accuracy of plus or minus 50%, similar to the accuracy of some estimates of value derived through market prices.

The dollar values determined by the consultants are based on the results of 76 existing studies in the field of economic research in the United States of America, New Zealand and Australia. Each \$ estimate chosen was the modal (most common) \$ value found from numerous studies relevant to particular environmental characteristics. The relative visitor 'popularity' of different rivers was recognised directly (in the use valuations), and by use of the weighting factor (for the existence valuations). Accordingly, for this Investigation, it is unlikely that new specific-purpose surveys could have improved the relevance of the results.

In calculating the existence (preservation) values, the consultants were cautious, and used a weighting factor when applying the 'preservation values' (in \$ per household-year) to all households in the State. The factor is based on the relative popularity of regions across the State as reflected in park visitor numbers, multiplied by 10% (or 30%) to reflect the proportion of those who visit the river corridors. The factor varies from 0.0014 (Suggan Buggan) to 0.018 (Yarra) for the rivers, and from 0.0007 to 0.0042 for the essentially natural catchments. The valuations were multiplied by these weighting factors, then by the number of Victorian households (1 000 000).

Further, rather than simply present a single \$ value for the environmental attributes of each river, the consultants calculated four valuations: total visitor-year (ie recreational user) values, using both 10% and 30% of regional visitor numbers; and total existence value household-year values, also using the 10% and 30% levels. Extreme values were excluded, and the lower and higher estimates were listed for each river. The consultants marked (*) that figure they concluded to be most likely, after reference to actual visitor numbers for particular rivers.

However, even if the lowest estimates are used, in virtually all cases the \$ valuation of environmental attributes greatly exceeds the foregone resource \$ value.

Appendix III

ESSENTIALLY NATURAL 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
	Benedore 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
	New Country Creek	8523-273789	Mountain Creek	4750	22	National Park
B3	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

Appendix III (continued)

Recommendation number	Catchment name	Grid reference of lowest point	Tributary of	Area (ha)	Basin	Public land tenure
B6	Mount Tabor Creek	8424-457569	Mitta Mitta River	900	1	State Forest
B7	Banimboola Creek	8424-456594	Mitta Mitta River	2290	1	State Forest
B8	Devils Creek - Middle Branch	8224-899284	Buckland River	2710	3	State Forest
B9	Yarrarabula Creek	8224-772205	Buffalo River	3770	3	State Forest
B10	* Long Jack Creek	8224-639112	Dandongadale River	2480	3	State Forest
B11	Williams Creek	8123-270658	Goulburn River	1010	5	State Forest
B12	Double Creek	8822-366419	Mallacoota Inlet	1590	21	National Park
B13	unnamed tributary	8723-146624	Genoa River	1120	21	National Park
B14	Winnot Creek	8723-001745	Cann River-East Branch	1280	21	National Park
B15	Errinundra River - East Branch	8623-694661	Bemm River	2480	21	National Park
B16	Gattamurh Creek	8524-305120	Snowy River	990	22	National Park
B17	Wallaby Creek	8624-392040	Tingaringy Creek	2660	22	National Park
B18	* Mount Gelantipy Creek headwaters	8523-196826	Snowy River	1900	22	National Park
B19	Musk Creek	8523-195573	Rodger River	770	22	National Park
B20	Brodribb River headwaters	8623-519661	Brodribb River	7610	22	National Park
B21	* Stony Creek	8423-670914	Tambo River	1110	23	State Forest
B22	Wongungarra River headwaters	8323-053980	Wongungarra River	1710	24	State Forest/ National Park
B23	Blue Rag Creek	8323-055911	Wongungarra River	1290	24	National Park
B24	Pinnacle Creek - East Branch	8323-084582	Wonnangatta River	1520	24	National Park
B25	Punchen Creek	8322-316476	Swamp Creek	1050	24	State Forest
B26	* Mount Vereker Creek	8120-510853	Bass Strait	2560	27	National Park

* Informal place name Sources: Identification of catchments - various reports: see Macmillan (1990); Macmillan and Kunert (1990) Biosis (1988); Biosis (1989); and Biosis and Scenic Spectrums (1989)
Additional information - held at LCC offices

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 (except type 15), and this is marked with an asterisk (*).

Type	Geomorphic unit	Hydrological region	River candidates	Basin/flow gauge ²	Status ³	Land tenure, comments-
1	East Victorian dissected uplands	5 ¹	* Upper Big River (above Glen Valley)	1/412	C	Mainly Alpine National Park, historic area
		5 ¹	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	Marl 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	3 3 3 3 3 3 3 3 3 3 3 3	Timbarra River	23/207	C	State forest; too much high plain - not typical; isolated wetter area
			* Dargo River (Dargo)	24/205	C	Alpine National Park, State forest; adjacent to rain-shadow area
			Wongungarra River	24/207	C	State forest; drier (region 2) tributary upstream (Crooked River)
			Tanjil River	26/216	C	State forest, freehold; sudden change from region 4
			Mitta Mitta River (Hinnomunjie)	1/203	H, C	Freehold, Alpine National Park, State forest
			Gibbo River	1/217	C	Alpine National Park, State forest
			Cudgewa Creek	1/208	C	Pines, freehold, State forest, national park; unusual shape
			Ovens River (Bright)	3/205	C	State forest, freehold, pines, Alpine National Park
			Yea River	5/217		Freehold, State forest, pines; western limit of region
			Latrobe River (Willow Grove)	26/204		State forest, freehold, etc.
			Latrobe River (Noojee)	26/205		State forest, freehold, pines
			Tyers River	26/007	C	State forest, freehold, Saw Saw National Park; region changes too quickly
			Woori Yallock Creek	29/215		Freehold, some public land
4	East Victorian uplands, dissected plateau	3 3 3 3 3 3 3 3	Buffalo River (Abbeyard)	3/222	C	State forest, some freehold; too little plateau
			Rose River	3/217	C	Freehold, State forest, Wabonga State Park
			Wonnangatta River (at Waterford)	24/201	H, C	Alpine National Park, State forest, freehold; contains region 2 tributary
			Wonnangatta River (at Crooked River)	24/206	H, C	Alpine National Park, some State forest
			Delatite River	5/214	C	Freehold, State forest, alpine resort
			Barkly River	25/217	C	State forest, some freehold
			Macalister River (Licola)	25/209	C	Alpine National Park, State forest, freehold
			* 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 ²	Status ³	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	C	Pines, freehold, State forest
			Hurdle Creek	3/224	C	Freehold, pines, State forest; isolated region 2 catchment
			Seven Creeks (Euroa)	5/237	C	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	C	State forest; rain-shadow between regions 4 and 3
			Rodger, Yalmy Rivers	22/217	H	State forest, Snowy River National Park
			Comblenbar River	21/211	C	State forest, freehold
			Murrindal River	22/216	C	State forest, freehold
			Bunyip River (Tonimbuk)	28/212	H	State park, State forest; small
			Dandenong Creek	28/204	C	Freehold; semi-urbanised
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	C				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
			* Lerderberg River	31/213	H, C	State forest, Lerderberg State Park, some freehold
			(O'Brien Crossing) 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

Appendix IV (continued)

Type	Geomorphic unit	Hydrological region	River candidates	Basin/flow gauge ²	Status ³	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 Gippeland Ranges, riverine plains	2	Morwell River (Morwell)	26/408		Freehold, some public land
		2	* Tarra River (Yarram)	27/200		Freehold, some public land
		2	Tarwin River (Tarwin)	27/202		Freehold, some public land
		21	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 inclusion through Tertiary material
		21	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)	32/204	C	Freehold, State forest, water production-
		1	Moorabool River (Batesford)	32/202		Freehold, State forest, Brisbane Ranges National Park, water production
		11	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

Appendix V 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 Victorian heritage rivers, and those referred to in recommendation 01, 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.

In some instances, it was necessary to use multiple line entries to record data for one river. Where this occurs the river name is listed in the first line, and '(continued)' entered in the following line(s) listing data for that river.

Stream and basin	Grid no.	Tributary of	Angling Intro.	Native	Canoe	Car camp	Flora	Fauna	Geo./ geom.	Fish div.	Fish stat.	Cult. herit.	Scenic value	Stream and basin
BASIN 1														
BENAMBRA CK	007	MORASS CK	X				2, S, 21							BENAMBRA CK
BIG R	007	MITTA MITTA R	X											BIG R
BOGGY CK	006	DRY FOREST CK				P						1, S, 16	EN/F, 25	BOGGY CK
BOUNDARY CK	006	CLUGGEWA CK										3, S, 16		BOUNDARY CK
BUCHEEN CK	006	TALLANGATTA CK					1, S, 21							BUCHEEN CK
BULLHEAD CK	006	MITTA MITTA R					1, S, 21							BULLHEAD CK
BANDARRA R	007	MITTA MITTA R	P, X		1, S, 20		2, S, 21							BANDARRA R
BUNROY CK	006	MURRAY R					1, S, 21							BUNROY CK
BURROBYE CK	005	MURRAY R	X				1, S, 21							BURROBYE CK
COBUNGRA R	007	MITTA MITTA R	P, X								C, 29	3, X, 1		COBUNGRA R
CORRYONG CK	006	MURRAY R	X	X							C, 29			CORRYONG CK
CLUGGEWA CK	006	MURRAY R	X	P, X							C, 29		EN/A, 22	CLUGGEWA CK
DART R	007	DARTMOUTH DAM	X							0, 29				DART R
DEEP CK	007	MORASS CK	X				1, S, 21							DEEP CK
DIGGERS CK	007	LITTLE SNOWY CK	P, X	P, X										DIGGERS CK
GIBBO R	007	DARTMOUTH DAM	X				1, R, 21							GIBBO R
(continued)			X				1, S, 21							(continued)
GLEN WILLS CK	007	BIG R	X		1, R, 20							2, X, 1		GLEN WILLS CK
INDI R	006	MURRAY R	X	X	3, N, 20	P						1, X, 1	EN/M, 22	INDI R
(continued)			X										EN/A, 22	(continued)
KOETONG CK	006	LAKE HUME	X	X								1, S, 16		KOETONG CK
LIMESTONE CK	007	INDI R	X									1, X, 1		LIMESTONE CK
LITTLE SNOWY CK	006	MITTA MITTA R	X	X								1, X, 1		LITTLE SNOWY CK
LIVINGSTONE CK	007	MITTA MITTA R	X									1, S, 16		LIVINGSTONE CK
(continued)			X											(continued)
LUCYVALE CK	006	CLUGGEWA CK	X	X			1, S, 21							LUCYVALE CK
MIDDLE CK	007	BIG R	X				1, S, 21							MIDDLE CK
MITTA MITTA R	006	MURRAY R	P, X	P, X	4, S, 20	P	1, R, 21	1, N, 21		0, 29	C, 29	1, R, 16	EN/M, 25	MITTA MITTA R
(continued)					1, R, 20		3, S, 21	1, R, 21					EN/A, 25	(continued)
(continued)													EN/F, 25	(continued)
MORASS CK	007	DARTMOUTH DAM	X	X			1, S, 21							MORASS CK
MURRAY R	005	LAKE HUME	X	X			3, S, 21					1, S, 16	EN/A, 22	MURRAY R
(continued)			X				1, R, 16						EN/A, 22	(continued)
MARIEL CK	006	CORRYONG CK	X	X							C, 29		EN/A, 22	MARIEL CK
REIDS CK	006	BOUNDARY CK					1, S, 21							REIDS CK
SANDY CK	006	LAKE HUME												SANDY CK
SCRUBBY CK	007	MITTA MITTA R					1, R, 21							SCRUBBY CK
SNOWY CK	007	MITTA MITTA R	X	X	2, S, 20	P	2, R, 20							SNOWY CK
(continued)														(continued)
VICTORIA R	008	COBUNGRA R	X				1, S, 21						1, X, 1	VICTORIA R
WATCHINGORRA CK	007	MITTA MITTA R		P										WATCHINGORRA CK
WISES CK	006	LAKE HUME					1, S, 21							WISES CK
BASIN 2														
BOGONG CK	007	KIEWA R					1, S, 21	1, R, 21						BOGONG CK
COMMISSIONERS CK	006	YACKANDANDAH CK					1, S, 21	1, M, 21				1, S, 16		COMMISSIONERS CK
(continued)	006	MURRAY R	P, X	P, X	3, R, 20	P	1, S, 21	1, S, 21			C, 29 ¹	1, S, 16	EN/T, 22	KIEWA R
KIEWA R, EAST BR	007	KIEWA R	X											(continued)
KIEWA R, WEST BR	007	KIEWA R	X											KIEWA R, WEST BR
MOUNTAIN CK	007	KIEWA R	X											MOUNTAIN CK
MURRAY R	006	MURRAY R	X	X	1, S, 20			1, S, 21					MSP/A, 22	MURRAY R
PRETTY VALLEY CK	007	KIEWA R	X					1, S, 21						PRETTY VALLEY CK
ROCKY VALLEY CK	007	KIEWA R	X											ROCKY VALLEY CK
YACKANDANDAH CK	006	KIEWA R	X										C, 29	YACKANDANDAH CK
BASIN 3														
BARAMBOGIE CK	006	BLACK DOG CK		X									1, R, 16	BARAMBOGIE CK
BARWIDGEE CK	007	OVENS R	X	X	1, R, 20									BARWIDGEE CK
BLACK DOG CK	006	OVENS R	X	X									4, S, 16	BLACK DOG CK
BOGGY CK	007	KING R	X										2, R, 1	BOGGY CK
BUCKLAND R	007	OVENS R	P, X	X	1, R, 20	P					C, 29		1, S, 16	BUCKLAND R
(continued)	007	OVENS R											1, X, 5	(continued)
BUFFALO CK	007	OVENS R	P, X	X				1, S, 21						BUFFALO CK
BUFFALO R	007	OVENS R	X	X	2, S, 20								C, 29	BUFFALO R
(continued)					3, R, 20									(continued)
DANDONGDALE R	007	ROSE R	X	X										DANDONGDALE R
FIFTEEN MILE CK	006	OVENS R	X	X										FIFTEEN MILE CK
HAPPY VALLEY CK	007	OVENS R	X	X								3, R, 1		HAPPY VALLEY CK
HURDLE CK	006	KING R	X	X								1, R, 16		HURDLE CK
KING R	006	OVENS R	P, X	P, X	2, X, 20	P	1, S, 21	1, S, 21		0, 29	C, 29 ¹	1, X, 5	EN/S, 22	KING R
(continued)					1, R, 20							21, R, 1		(continued)
MEADOW CK	007	KING R								0, 29	C, 29			MEADOW CK
MIDDLE CK	007	FIFTEEN MILE CK	X											MIDDLE CK
MULWALA L	006	MURRAY R												MULWALA L
MURRAY R	006	MURRAY R		X									1, R, 16	MURRAY R
(continued)														(continued)
(continued)														(continued)
NINE MILE CK	006	YACKANDANDAH CK											2, S, 16	NINE MILE CK
OVENS R	006	MURRAY R	P, X	P, X	1, R, 20		2, S, 21	1, S, 21		0, 29	C, 29	4, S, 16	EN/A, 22	OVENS R
(continued)												17, R, 1	EN/T, 22	(continued)

Appendix V - River and Stream Values

Appendix V (continued)

Stream and basin	Grid No.	Tributary of	Angling Intro.	Native	Canon	Car camp	Flora	Fauna	Geo./geom.	Fish div.	Fish stat.	Cult. herit.	Scenic value	Stream and basin
REEDY CK (continued)	L06	OVERS R	X	X	1,R,20	P						4,R,16 2,S,16		REEDY CK (continued)
ROSE R (continued)	N07	BUFFALO R	P,X	X	4,R,20	P								ROSE R (continued)
SPRING CK (continued)	N06	REEDY CK										1,S,16		SPRING CK (continued)
TEA GARDEN CK	L06	OVERS R	X									1,R,1		TEA GARDEN CK
BASIN 4														
BROKEN CK	J05	MURRAY R	X				3,S,21			D,29	C,29			BROKEN CK
BROKEN R	J06	GOLDBURN R	X	X	1,R,20		1,S,21			D,29	C,29	2,S,16		BROKEN R
HOLLAND CK														HOLLAND CK
MURRAY R (BARHAM) (continued)	L06	MURRAY R			2,R,20	P							NRP/S,22 NRP/T,22	MURRAY R (continued)
MURRAY R	J05	MURRAY R		X			5,N,21 1,R,21 5,S,21	2,S,21 1,R,21						MURRAY R (continued)
RYAN CK	N07	HOLLAND CK	X	X										RYAN CK
SAMARIA CK	L07	BROKEN R	X											SAMARIA CK
SPRING CK	L06	BROKEN R				P								SPRING CK
BASIN 5														
ACHERON R (continued)	N08	GOLDBURN R	P,X	X	2,R,20 2,R,20		6,S,21 1,R,21	2,R,21 3,S,21						ACHERON R (continued)
BIG R (continued)	L08	LAKE EILDON	P,X		2,S,20 3,R,20	P					C,29		EN/S,25 EN/S,25	BIG R (continued)
BRAMKEET CK	N08	LAKE EILDON						1,L,21						BRAMKEET CK
CORNELLA CK	L08	LAKE COOPER												CORNELLA CK
DELATITE R (continued)	L08	LAKE EILDON	X	X	2,S,20 1,R,20									DELATITE R (continued)
FRENCHMAN CK	L09	BIG R					1,S,21	2,R,21						FRENCHMAN CK
GAFFNEY'S CK	L08	U. GOLDBURN R												GAFFNEY'S CK
GOGARUP CK	L07	MANALTA CK												GOGARUP CK
GOLDBURN R (continued)	L06	MURRAY R	P,X	P,X	1,N,20 8,S,20 1,R,20	P	4,S,21	3,S,21		D,29	C,29	1,S,1 1,R,16 3,S,16 1,R,16 1,S,16	NRP/A,22 TA/A,22 ER/S,22 EN/F,22 EG/F,22	GOLDBURN R (continued)
HAMILTON CK	L08	LAKE EILDON	X	X	16,R,20				1,S,8					HAMILTON CK
HANDFOR CK	L08	JAMIESON R												HANDFOR CK
HOVOLA R (continued)	L08	LAKE EILDON	P,X		1,N,20 1,S,20			2,S,21	1,N,26					HOVOLA R (continued)
HUGHES CK	J07	GOLDBURN R	X	X										HUGHES CK
JAMIESON R	L08	GOLDBURN R	X	X										JAMIESON R
KILMORE CK	L08	KURURAC CK	X	X	1,S,20			2,S,21						KILMORE CK
KING PARROT CK	J08	GOLDBURN R	X	X	1,R,20		3,N,21							KING PARROT CK
LITTE R	N08	ACHERON R	X			P								LITTE R
MOLLISON CK	J08	KURURAC CK												MOLLISON CK
MOUNTAIN HUT CK	N07	SEVEN CKS												MOUNTAIN HUT CK
MURRAY R	J08	MURRAY R												MURRAY R
MURRINDINDI R	J08	YEA R	X	P,X										MURRINDINDI R
OAKS CK	L09	BIG R					1,S,21							OAKS CK
PRANJIP CK	X07	GOLDBURN R												PRANJIP CK
SEVEN CREEKS	J06	GOLDBURN R	X	P,X										SEVEN CREEKS
SPRING CK	N07	SEVEN CKS						2,R,21		D,29	C,29	3,S,1		SPRING CK
STEVENSONS R	N08	ACHERON R	X											STEVENSONS R
SUNDAY CK	J08	GOLDBURN R	X											SUNDAY CK
TAGGERTY R (continued)	N08	STEVENSONS R	X											TAGGERTY R (continued)
TAPONGA R	L08	BIG R	X		1,R,20									TAPONGA R
TORBERRY R	L09	BIG R	X											TORBERRY R
WAKITI CK	J06	GOLDBURN R	P,X	X										WAKITI CK
WANALTA CK	J07	GOLDBURN R								D,29	C,29			WANALTA CK
YEA R (continued)	J08	GOLDBURN R	X	X										YEA R (continued)
BASIN 6														
BACK CK	I08	PLOMMAN CK												BACK CK
CAMPASPE R (continued)	I06	MURRAY R	X	X			2,S,21			D,29	C,29	1,S,16 7,S,16	FR/A,22 MCA/A,22	CAMPASPE R (continued)
GOLIBAN R (continued)	N07	LAKE EPPALOCK	X	X										GOLIBAN R (continued)
CURLY DOG CK	I07	MICIVOR CK												CURLY DOG CK
FIVE MILE CK	N08	CAMPASPE R												FIVE MILE CK
MURRAY R (continued)	I06	MURRAY R		X	1,R,20	P								MURRAY R (continued)
BASIN 7														
BACK CK (continued)	G08	TULLAROOP CK	X											BACK CK (continued)
BARKERS CK (continued)	N08	LODDON R	X											BARKERS CK (continued)
BENDIGO CK (continued)	N06	PICAMINNY CK												BENDIGO CK (continued)
BET BET CK (continued)	G07	LODDON R	X								C,29			BET BET CK (continued)
BIRCH CK (continued)	G08	TULLAROOP CK	P,X	X										BIRCH CK (continued)
BUCKEYE CK	N08	BULLOCK CK												BUCKEYE CK
BULLOCK CK	N05	PYRAMID CK					2,S,21							BULLOCK CK
COCHILL CK	G08	CRESWICK CK	X											COCHILL CK
CRESWICK CK (continued)	G08	TULLAROOP CK					1,S,21							CRESWICK CK (continued)
DAISY HILL CK	G08	NIA NIA CK												DAISY HILL CK
FIVE MILE CK	N07	BENDIGO CK					1,S,21							FIVE MILE CK
FOREST CK	N08	CAMPBELLS CK												FOREST CK
GUNDSOMER CK	N08	MURRAY R						1,S,21		D,29	C,29	1,R,16 1,S,16		GUNDSOMER CK
JIM CROM CK	N08	LODDON R	P,X	X										JIM CROM CK
KOM SWAMP	N05	KOM SWAMP												KOM SWAMP
LANGONS CK	G08	LODDON R												LANGONS CK
LITTLE MURRAY R	G04	MURRAY R		X										LITTLE MURRAY R

Appendix V (continued)

Stream and basin	Grid no.	Tributary of	Angling Intro.	Native	Canoe	Car camp	Flora	Fauna	Geo./geom.	Fish div.	Fish stat.	Cult. herit.	Scenic value	Stream and basin
LOODON R (continued)	G04	MURRAY R	P,X	P,X	2,R,20		1,R,21 1,S,21			0,29	C,29	4,K,1 1,S,16 5,R,16 2,R,16	MSP/A,22 MSP/T,22 MCH/A,22	LOODON R (continued)
MCALLUM CK (continued)	G08	TULLAROOP CK	X				1,S,21				C,29			MCALLUM CK (continued)
MT HOPE CK	H05	XOM SWAMP												MT HOPE CK
MURRASLY CK	G05	LOODON R									C,29			MURRASLY CK
MURRAY R (continued)	J06	MURRAY R	X	X		P	3,S,21					1,S,16 1,R,16	MSP/S,22 MSP/A,22	MURRAY R (continued)
MURRAY R (GUNBOWER) (GUNBOWER)	H05	MURRAY R					2,S,21	3,S,21						MURRAY R
PYRAMID CK	G05	LOODON R						1,S,21			C,29			PYRAMID CK
SAILORS CK	H08	SPRING CK										1,R,16		SAILORS CK
SERPENTINE CK	G06	LOODON R												SERPENTINE CK
STONY CK	G08	TALBOT RES	X									1,R,16 1,S,16		STONY CK
TULLAROOP CK (continued)	G07	LOODON R	X	X								1,R,16	MCH/A,22	TULLAROOP CK (continued)
BASIN 8														
AVOCA R (continued)	G05	KERANG LAKES	X	X				2,S,21		D,29	C,29	1,S,16 1,R,16	MCH/A,22	AVOCA R (continued)
LAKE MARMAL CK	G06	LAKE MARMAL						1,R,21						LAKE MARMAL CK
LALBERT CK	F04	LAKE TIMBORAM						1,R,21						LALBERT CK
MOUNTAIN CK	F08	AVOCA R												MOUNTAIN CK
MURRAY R No 2 CK	G04	MURRAY R	X	X	1,R,20	P						2,R,16		MURRAY R No 2 CK
TYRRELL CK	F08 E04	AVOCA R LAKE TYRRELL						2,R,21						TYRRELL CK
BASIN 14														
LINDSAY R (continued)	B02	MURRAY R		P,X	1,S,20		1,M,21 1,S,21	1,S,21			C,29			LINDSAY R (continued)
MURRAY R (continued)	F04	MURRAY R	X	X	1,S,20	P	32,S,21 5,R,21					5,S,16 4,R,16	MSP/S,22 MSP/F,22 MSP/A,22 MSP/T,22	MURRAY R (continued)
MURRAY R (continued)	G02	MURRAY R	P,X	P,X			1,M,21 2,S,21	2,S,21			C,29			MURRAY R (continued)
WALLPOLE CK (continued)														WALLPOLE CK (continued)
BASIN 15														
AVON R	E07	RICHARDSON R	X	X										AVON R
FYANS CK	E08	MOUNT WILLIAM CK	X	X			1,B,19						GR/S,22	FYANS CK
GOLTON CK	E07	MOUNT WILLIAM CK	X	X			1,B,19						GR/S,22	GOLTON CK
MCKENZIE R	D07	WINNERA R	X	X									GR/S,22	MCKENZIE R
MOUNT WILLIAM CK	E08	WINNERA R	X	X									GR/S,22	MOUNT WILLIAM CK
OUTLET CK (continued)	C05	LAKE BRAMBRUK					1,A,19							OUTLET CK (continued)
PLEASANT CK	E08	LAKE LONSDALE	X									1,R,16 1,S,16		PLEASANT CK
RICHARDSON R (continued)	E06	LAKE BULOKE	X	X							C,29	1,X,1 1,R,16		RICHARDSON R (continued)
WATTLE CK	E07	STATION CK										1,R,16		WATTLE CK
WINNERA R	C06	TERMINAL LAKES	P,X	P,X		P	5,X,19		1,M,19	D,29	C,29	1,X,1 2,S,16 6,R,16	MSP/S,22	WINNERA R
WINNERA R (continued)	C06	TERMINAL LAKES										3,X,1 1,S,16 2,R,16	MSP/T,22	WINNERA R (continued)
YARRIBANGACK CK (continued)	D07	TERMINAL LAKE	X				1,A,19							YARRIBANGACK CK (continued)
BASIN 21														
ADA R	Q08	ERRINDUNDR R												ADA R
BEHM R (continued)	Q09	SYDENHAM INLET	X	P,X		P	1,M,27 2,S,27	1,X,28	1,S,6	D,29	C,29	2,S,16		BEHM R (continued)
BENDORE R	S09	TASMAN SEA								D,29				BENDORE R
BETKA R	S09	TASMAN SEA								D,29				BETKA R
BOLA CK	Q08	ERRINDUNDR R												BOLA CK
CANN R (continued)	R09	TAMBOON INLET	P,X	P,X	3,S,20	P							1,R,16	CANN R (continued)
CANN R (continued)	R08	CANN R			1,S,20								FH/F,22 FH/A,22 FH/T,22	CANN R (continued)
COMBIEMBAR BR	Q08	BEHM R	X	X			1,0,13				C,29			COMBIEMBAR BR
QAWER CK	S08	GENOA R					1,0,13							QAWER CK
DOMELL CK	S08	MALLACOOTA INLET					1,H,13							DOMELL CK
EASBY CK	S09	TASMAN SEA								D,29				EASBY CK
EUGHRE CK	Q09	BEHM R					1,0,13							EUGHRE CK
GENOA R (continued)	S08	MALLACOOTA INLET					1,0,13		1,1,6 1,W,6		C,29	1,R,16	FH/W,22 FH/S,22 FH/F,22 SL/S,22 SL/A,22	GENOA R (continued)
HARRISON CK	S08	MALLACOOTA INLET					1,0,13							HARRISON CK
HENSLEIGH CK	R08	COMBIEMBAR R					1,0,13							HENSLEIGH CK
JIM WALKER CK	R08	CANN R					1,0,13							JIM WALKER CK
JONES CK	R08	GENOA R					1,0,13							JONES CK
LITTLE R	S08	MALLACOOTA INLET		P,X							C,29			LITTLE R
LOCK UP CK	R08	CANN R					1,0,13							LOCK UP CK
MARAMINGO CK	S08	GENOA R					1,H,13							MARAMINGO CK
MULLER R	R09	BASS STRAIT		P,X						D,29				MULLER R
RED CK	S09	TASMAN SEA								D,29	C,29			RED CK
THURRA R	R09	BASS STRAIT		X						D,29	C,29			THURRA R
THURRA R, WEST BR	R08	THURRA R							1,S,6				C/S,22	THURRA R, WEST BR
TONGRI CK	R09	CANN R					1,0,13							TONGRI CK
WALLAGAROUGH R	S08	MALLACOOTA INLET		P,X						D,29	C,29			WALLAGAROUGH R
WINGAN INLET	S09	BASS STRAIT		P,X						D,29	C,29			WINGAN INLET
WINGAN R (continued)	R09	WINGAN INLET		X						D,29	C,29			WINGAN R (continued)
YEERLING R	Q09	BASS STRAIT		P,X						D,29				YEERLING R
BASIN 22														
BACK CK	R08	QUEENSBOROUGH R										1,R,16		BACK CK
BERRIMA R	P07	SUGGAN BUGGAN					1,0,13							BERRIMA R

Appendix V - River and Stream Values

Appendix V (Continued)

Stream and basin	Grid no.	Tributary of	Angling Intro.	Angling Native	Canoe	Car camp	Flora	Fauna	Geo./geol.	Fish div.	Fish stat.	Cult. herit.	Scenic value	Stream and basin
BRODRIBB R BRODRIBB R, NORTH BR SUCHAN R (continued)	909 906 909	SNOWY R BRODRIBB R SNOWY R		X						D,29 D,29 C,29	C,29 C,29		EN/N,25 EN/A,25 EN/F,25	BRODRIBB R BRODRIBB R, NORTH BR SUCHAN R (continued)
BUTCHERS CK CABBAGE TREE CK DEDDICK R (continued)	906 909 906	MURRINDAL R LAKE CURLIP SNOWY R	X	X			1,N,13 1,0,13 1,0,13							BUTCHERS CK CABBAGE TREE CK DEDDICK R (continued)
INGERSOOD BEE R LILLY PILLY CK LITTLE R (continued)	907 909 906	SUGGAY BUGGAN R BRODRIBB R SNOWY R	X				1,R,20 1,0,13 1,0,13						1,5,16	INGERSOOD BEE R LILLY PILLY CK LITTLE R (continued)
MURRINDAL R NELSON CK QUEENSBOROUGH R RAYMOND CK REEDY CK RODGER R SARDINE CK SHAW CK SNOWY R (continued)	909 908 906 906 906 909 906 909	BUCHAN R DELEGATE R EAST BR DELEGATE R SNOWY R BUCHAN R SNOWY R BRODRIBB R BUCHAN R BASS STRAIT	X	X P,X X X X X			1,N,13 1,R,15 1,0,13 1,0,13 1,0,13 1,0,13 1,N,13 1,0,13 2,N,13						C,29 1,R,16 1,R,16 1,R,16 1,R,16 1,R,16 1,R,16 3,R,16 2,5,16	MURRINDAL R NELSON CK QUEENSBOROUGH R RAYMOND CK REEDY CK RODGER R SARDINE CK SHAW CK SNOWY R (continued)
SUGGAN BUGGAN R TALMY R YOUNG CK	908 908 909	SNOWY R RODGER R A219	X	X			1,5,13 1,0,13			D,29	C,29		EN/N,26	SUGGAN BUGGAN R TALMY R YOUNG CK
BASIN 23														
BOXES CK BUTCHERS CK CHINAMANS CK DEEP CK HAUNTED STREAM MARINGA CK NICHOLSON R NICHOLSON R NICHOLSON R, EAST BR PERCH CK SALT CK SHADY CK STONEY CK SWIFTS CK TAMBO R (continued)	009 009 009 008 009 009 008 009 009 009 008 009 009 008 008	GIPPSLAND LAKES SLAUGHTERHOUSE CK GIPPSLAND LAKES TAMBO R TAMBO R REEVE CH LAKE KING LAKE KING NICHOLSON R LAKE KING SLAUGHTERHOUSE CK TAMBO R LAKE TYERS TAMBO R TAMBO R					1,N,13			D,29 D,29 D,29 D,29 D,29 D,29 D,29 D,29 D,29 D,29 D,29 D,29 D,29 D,29	C,29 C,29 C,29 C,29 C,29 C,29 C,29 C,29 C,29 C,29 C,29 C,29 C,29 C,29			BOXES CK BUTCHERS CK CHINAMANS CK DEEP CK HAUNTED STREAM MARINGA CK NICHOLSON R NICHOLSON R NICHOLSON R EAST BR PERCH CK SALT CK SHADY CK STONEY CK SWIFTS CK TAMBO R (continued)
TIMBARRA R	009	TAMBO R	X							D,29	C,29			TIMBARRA R
BASIN 24														
BOGGY CK CLIFTON CK CONGLOMERATE CK CROOKED R DARGO R (continued)	009 008 008 008 009	MITCHELL R MITCHELL R WONGUNGARRA R WONGUNGARRA R MITCHELL R LAKE KING		P,X X X X			1,0,13 2,R,20 1,N,20 2,S,20 1,R,20			D,29 D,29 D,29 D,29 D,29 D,29	C,29 C,29 C,29 C,29 C,29 C,29		1,R,16 EN/N,25 EN/F,25 EN/F,25 EN/A,25	BOGGY CK CLIFTON CK CONGLOMERATE CK CROOKED R DARGO R (continued)
MITCHELL R (continued)	009	LAKE KING	X	P,X			1,N,13 2,S,20 1,R,20			1,1,7 3,S,7	D,29 D,29	C,29 C,29	4,R,16	MITCHELL R (continued)
WONKA R WENTWORTH R WONGUNGARRA R WONGUNGARRA R	008 009 008 009	WONGUNGARRA R MITCHELL R WONGUNGARRA R MITCHELL R	X X P,X	X X X			1,N,13 1,N,13			1,5,7 D,29 D,29	C,29 C,29 C,29		1,5,16 EN/F,25	WONKA R WENTWORTH R WONGUNGARRA R WONGUNGARRA R
BASIN 25														
ABERFELDY R AVON R (continued)	109 N10	THOMSON R LAKE WELLINGTON	X X	X X			1,R,20 1,R,20			D,29	C,29		4,R,16 2,S,16 2,S,16 EN/N,25 EN/S,25 EN/A,25	ABERFELDY R AVON R (continued)
BARKLY R COOPERS CK DRY CK DOLDOBROOK R FREESTONE CK JORDAN R (continued)	009 L10 L09 009 009 L09	MACALISTER R THOMSON R JORDAN R WELLINGTON R AVON R THOMSON R	X X X X X	P,X X X X X			2,S,20 1,N,20 1,R,20			1,5,7 1,5,7			1,5,16 1,5,16 1,5,16 1,R,16	BARKLY R COOPERS CK DRY CK DOLDOBROOK R FREESTONE CK JORDAN R (continued)
LATROBE R MACALISTER R (continued)	N10 009	LAKE WELLINGTON THOMSON R	X X	X X			2,S,20 4,R,20			D,29 D,29	C,29 C,29		1,X,4 2,R,16 1,5,16 EN/N,25 EN/F,25 EN/A,25	LATROBE R MACALISTER R (continued)
MORNING STAR CK PERRY R RAINBOW CK STONY CK STRINGERS CK THOMSON R (continued)	109 N10 N10 L09 L09 N10	DONNELLY CK DISHER BAY THOMSON R VALENCIA CK THOMSON R LA TROBE R	X X X X X	P,X X X P,X						D,29 D,29 D,29 D,29 D,29	C,29 C,29 C,29 C,29 C,29		1,5,16 2,R,16 3,S,16 1,5,24 1,5,16 ² 2,R,16 3,S,16 1,5,24 EN/N,25 EN/S,25 EN/N,25 EN/A,25	MORNING STAR CK PERRY R RAINBOW CK STONY CK STRINGERS CK THOMSON R (continued)
VALENCIA CK (continued)	009	AVON R	X	X						D,29	C,29		EN/N,25 EN/A,25	VALENCIA CK (continued)
WELLINGTON R	009	MACALISTER R	X	X						D,29	C,29		EN/N,25 EN/A,25	WELLINGTON R
BASIN 26														
BULL BEEF CK EAGLEHAK CK LATROBE R (continued)	L10 N10 N10	TANJIL R LATROBE R LAKE WELLINGTON	X X X	X P,X			1,5,14						1,N,16 1,5,16	BULL BEEF CK EAGLEHAK CK LATROBE R (continued)
LITTLE NORWELL R	L10	NORWELL R	X	X			1,R,20			D,29	C,29		SL/A,22	LITTLE NORWELL R

Appendix V (continued)

Stream and basin	Grid no.	Tributary of	Angling Intro.	Native	Canoe	Car camp	Flora	Fauna	Geo./geom.	Fish div.	Fish stat.	Cult. herit.	Scenic value	Stream and basin
NORMELL R	L10	LA TROBE R	X	P,X		P				D,29				NORMELL R
NORMELL R, WEST BR	L10	NORMELL R	X	X			1,S,14							NORMELL R, WEST BR
RINTOUL CK	M10	LATROBE R	X						1,S,7					RINTOUL CK
SERPENTINE CK	L10	TAMJIL R	X				1,S,14							SERPENTINE CK
TAMJIL R	L09	TAMJIL R	X	X	1,R,20								FM/S,22	TAMJIL R
TOORONGO R	L09	LATROBE R	X	X		P								TOORONGO R
TRARALGON CK	L10	LATROBE R	X	X					1,S,7	D,29	C,29			TRARALGON CK
TYERS CK	L10	LA TROBE R	X	X									1,R,16	TYERS CK
TYERS R	L10	LA TROBE R	X	X				P	1,S,14	2,S,7	D,29		FM/S,22	TYERS R
TYERS R, EAST BR	L09	TYERS R	X	X										TYERS R, EAST BR
TYERS R, WEST BR	L09	TYERS R	X	X	1,S,14									TYERS R, WEST BR
BASIN 27														
AGNES R	L11	CORNER INLET	X						1,S,8	D,29	C,29			AGNES R
ALBERT R	M17	BASS STRAIT	X	P,X		P				D,29	C,29	1,S,16		ALBERT R
BASS R	K10	WESTERN PORT							1,N,8	D,29	C,29			BASS R
BERRYS CK	L10	TARWIN R	X	P,X										BERRYS CK
BODMAN CK	M11	TARRA R	X	X					1,S,8					BODMAN CK
BRUTHERN CK	M17	BASS STRAIT	X	P,X						D,29	C,29		SL/F,22	BRUTHERN CK
CHINAMANS CK	L11	CORNER INLET								D,29	C,29			CHINAMANS CK
DARBY R	L11	BASS STRAIT					1,S,14			D,29	C,29			DARBY R
DINGO CK	L11	AGNES R	X				1,S,14			D,29	C,29		SL/F,22	DINGO CK
FRANKLIN R	L11	CORNER INLET								D,29	C,29		SL/A,22	FRANKLIN R
(continued)														(continued)
FRESHWATER CK	L12	BASS STRAIT								D,29	C,29			FRESHWATER CK
JACK R	M17	ALBERT R		X		P				D,29	C,29			JACK R
LILLIPULLY GY	L11	TIDAL R		X						D,29	C,29	1,S,16		LILLIPULLY GY
LITTLE ALBERT R	M11	ALBERT R		X						D,29	C,29			LITTLE ALBERT R
MACKS CK	M11	TARRA R		X						D,29	C,29			MACKS CK
MERRIMAN CK	M10	BASS STRAIT	X	P,X			1,N,14			D,29	C,29		SF/F,22	MERRIMAN CK
(continued)									1,S,8				SL/F,22	(continued)
POULETT R	K11	BASS STRAIT		P,X						D,29	C,29			POULETT R
ROARING MEG CK	L12	BASS STRAIT		X						D,29	C,29			ROARING MEG CK
TARRA R	M11	BASS STRAIT	X	X			1,I,14			D,29	C,29		C/A,22	TARRA R
TARWIN R	K11	ANDERSON INLET	X	P,X	1,R,20	P				D,29	C,29			TARWIN R
TARWIN R, EAST BR	K17	TARWIN R	X			P				D,29	C,29			TARWIN R, EAST BR
TIDAL R	L12	BASS STRAIT								D,29	C,29			TIDAL R
TIM WINE CK	K09	BLACKWOOD CK											1,S,16	TIM WINE CK
WARRAGUL CK	M10	BASS STRAIT											1,S,16	WARRAGUL CK
BASIN 28														
BACK CK	K09	BUNYIP R		X			1,S,15							BACK CK
BALCONBE CK	J10	PORT PHILLIP BAY								D,29	C,29			BALCONBE CK
BUNYIP R	K10	WESTERN PORT		P,X			1,N,15		1,S,8	D,29	C,29			BUNYIP R
(continued)							1,S,15							(continued)
CARDINIA CK	J10	WESTERN PORT		X			1,S,15			D,29	C,29			CARDINIA CK
DIAMOND CK	J10	BUNYIP R		X					1,S,8	D,29	C,29			DIAMOND CK
EAST CK	J10	WESTERN PORT												EAST CK
LABERTOUCHE CK	K10	TARAGO R		P,X										LABERTOUCHE CK
LANG LANG R	K10	WESTERN PORT	X	P,X					1,N,8	D,29	C,29			LANG LANG R
(continued)									1,S,8					(continued)
MAIN CK	J10	BASS STRAIT								D,29	C,29			MAIN CK
MORDIALLOCK CK	K10	LANG LANG R		P,X						D,29	C,29			MORDIALLOCK CK
O'SHANESSY CK	K09	BUNYIP R	X	X			1,N,15			D,29	C,29			O'SHANESSY CK
RYSON CK	K09	TARAGO R	X	P,X			1,X,3			D,29	C,29	1,N,1		RYSON CK
TARAGO R, EAST BR	K09	TARAGO R	X	P,X			1,N,15							TARAGO R, EAST BR
TIN CK	K09	BUNYIP R							1,N,8					TIN CK
YALLOCK CK	J10	WESTERN PORT BAY												YALLOCK CK
BASIN 29														
ARMSTRONG CK	K09	YARRA R		X			1,S,21							ARMSTRONG CK
BADGER CK	K09	YARRA R	X	X						D,29	C,29			BADGER CK
BAKER CK	K09	YARRA R							1,N,21					BAKER CK
BIG PATS CK	K09	YARRA R	X	X										BIG PATS CK
BRITANNIA CK	K09	LITTLE YARRA R	X				2,S,21	2,L,21						BRITANNIA CK
CEMENT CK	K09	YARRA R					1,M,21							CEMENT CK
(continued)							1,S,21							(continued)
CLEW CK	K09	MEYERS CK	X	X								1,X,1		CLEW CK
CLEAR CK	K09	YARRA R					1,R,21	1,N,21						CLEAR CK
CONTENTMENT CK	K09	WATTS R					1,S,21							CONTENTMENT CK
CROOKED CK	K09	YARRA R		X						1,S,9				CROOKED CK
DEEP CK	K09	O'SHANESSY R	X	X										DEEP CK
DON R	K09	YARRA R	X											DON R
GRACE BURN	K09	WATTS R					2,N,21	1,R,21					1,R,16	GRACE BURN
(continued)							1,R,21							(continued)
(continued)							3,S,21							(continued)
LITTLE YARRA R	K09	YARRA R	P,X				1,R,21	1,R,21		D,29	C,29			LITTLE YARRA R
MCCRAE CK	K09	WOORI YALLOCK CK	X	X										MCCRAE CK
MCKAY CK	K09	YARRA R	X	X										MCKAY CK
MERRI CK	J09	YARRA R					2,S,21							MERRI CK
MICKS CK	K09	WATTS R												MICKS CK
O'SHANESSY R	K09	YARRA R					3,N,21	2,N,21					1,X,1	O'SHANESSY R
(continued)							2,S,21							(continued)
OLINDA CK	J09	YARRA R		X			1,S,21							OLINDA CK
(continued)							1,S,21							(continued)
PLENTY R	J09	YARRA R					1,R,21							PLENTY R
STARVATION CK	K09	YARRA R	X				1,S,21						FM/A,22	STARVATION CK
STEELES CK	J09	YARRA R					1,S,21	2,R,21						STEELES CK
TOMAHAWK CK	K09	SHEPHERD CK					1,S,21							TOMAHAWK CK
WALKER CK	K09	YARRA R	X							1,N,21				WALKER CK
WALSH CK	K09	YARRA R								1,N,21				WALSH CK
WANDIN YALLOCK CK	K09	WOORI YALLOCK CK					1,S,21							WANDIN YALLOCK CK
WATSON CK	J09	YARRA R					1,R,21		1,S,9					WATSON CK
WATTS R	J09	YARRA R	X	X			4,S,21	1,N,21						WATTS R
(continued)							2,N,21	3,R,21						(continued)
WOORI YALLOCK CK	K09	YARRA R	X	X										WOORI YALLOCK CK
YARRA CK	J09	PLENTY R												YARRA CK
YARRA R	J09	PORT PHILLIP BAY	P,X	P,X	6,S,20		1,N,21	1,N,21	1,S,9	D,29	C,29	3,X,1	FM/F,22	YARRA R
(continued)					10,R,20		4,R,21	1,R,21	10,R,9				EN/T,22	(continued)
(continued)							9,S,21							(continued)

Appendix V - River and Stream Values

Appendix V (continued)

Stream and basin	Grid no.	Tributary of	Angling lytro.	Native	Canoe	Car camp	Flora	Fauna	Geo./ geom.	Fish div.	Fish stat.	Cult. herit.	Scenic value	Stream and basin
BASIN 30														
BOLINDA CK	108	EMU CK	X									1, X, 1		BOLINDA CK
DEEP CK	109	MARIBYRONG R	X									3, S, 16		DEEP CK
EMU CK	109	DEEP CK	P, X				1, S, 21		1, S, 10	D, 29	C, 29		MP/A, 22	EMU CK
JACKSON CK	109	MARIBYRONG R	X									2, X, 1		JACKSON CK
(continued)												1, R, 16		(continued)
MARIBYRONG R	109	PORT PHILLIP	X				1, S, 20		1, R, 10	D, 29	C, 29	2, S, 16		MARIBYRONG R
(continued)							4, R, 20					1, R, 16		(continued)
RIDDELLS CK	109	JACKSON CK	X									1, X, 1		RIDDELLS CK
SUNBURY CK	109	JACKSONS CK							1, R, 10			1, X, 1		SUNBURY CK
TAYLORS CK	109	MARIBYRONG R										1, S, 16		TAYLORS CK
BASIN 31														
CATARACT CK	N09	PYRITES CK							1, S, 10					CATARACT CK
DJERRIWARREN CK	109	MELTON RESERVOIR										1, S, 16		DJERRIWARREN CK
KORORUIT CK	109	MELTON RESERVOIR							1, S, 10			1, R, 16		KORORUIT CK
KORORUIT CK	N09	PYRITES CK RES							1, I, 10					KORORUIT CK
LENDERBERG R	109	MERRIBEE R	X	P	1, R, 20	P	1, R, 21		1, I, 10			1, R, 16	FR/S, 22	LENDERBERG R
(continued)							2, S, 21		1, S, 10			4, R, 16	FR/S, 22	(continued)
(continued)									1, R, 10				FR/S, 22	(continued)
PARHAM CK	N09	MERRIBEE R							1, S, 10				MP/A, 22	PARHAM CK
PYRITES CK	N09	COIMADAI CK												PYRITES CK
SKELETON CK	109	PORT PHILLIP BAY					1, S, 21							SKELETON CK
TOOLEM CK	109	MERRIBEE R							1, R, 10					TOOLEM CK
MERRIBEE R	109	PORT PHILLIP BAY	P, X	P, X			1, R, 21		2, S, 18	D, 29		3, R, 16	FR/S, 22	MERRIBEE R
(continued)									1, R, 10			4, S, 16	MP/A, 22	(continued)
(continued)													MCN/T, 22	(continued)
YALOK CK	N09	PARHAM CK							1, S, 10					YALOK CK
BASIN 32														
COMIE CK	N10	CORIO BAY										1, S, 16		COMIE CK
HOWELL CK	N10	PORT PHILLIP BAY							3, S, 10					HOWELL CK
LITTLE R	109	PORT PHILLIP BAY										2, S, 16		LITTLE R
MOORABOOL R	N09	MOORABOOL R	X						2, S, 10	D, 29	C, 29	2, R, 16	MP/F, 22	MOORABOOL R
(continued)												4, S, 16	MP/A, 22	(continued)
MOORABOOL R EAST BRANCH	N09	MOORABOOL R	X									1, R, 16	MCN/S, 22	MOORABOOL R EAST BRANCH
(continued)														(continued)
MOORABOOL R WEST BRANCH	N09	MOORABOOL R	X										MCN/F, 22	MOORABOOL R WEST BRANCH
STONY CK	N09	LITTLE R										2, R, 16	MCN/S, 22	STONY CK
BASIN 33														
BARNON R	G09	BASS STRAIT	P, X	P, X	4, R, 20					D, 29	C, 29	6, S, 16	MP/A, 22	BARNON R
(continued)												2, R, 16		(continued)
(continued)									1, R, 11			4, R, 16		(continued)
LEIGH R	G09	BARNON R	X									3, S, 16		LEIGH R
(continued)												2, R, 16		(continued)
MUDDY WATER MOLES CK	N09	GRUCE CK										1, S, 16		MUDDY WATER MOLES CK
HILES CK	N10	BARNON R									C, 29	1, R, 16	MP/A, 22	MUDDY WATER MOLES CK
WARRN PONDS CK	N10	BARNON R										1, S, 16	MP/T, 22	WARRN PONDS CK
YARROOEE R	N10	BARNON R												YARROOEE R
(continued)														(continued)
BASIN 34														
LITTLE MUDDY YALOK	G09	MUDDY YALOK R										1, S, 16		LITTLE MUDDY YALOK
SPRINGDALLAN CK	G09	MUDDY YALOK CK										1, S, 16	MCN/A, 22	SPRINGDALLAN CK
MUDDY YALOK R	G10	LAKE CORANGARITE	X									1, R, 16		MUDDY YALOK R
(continued)												1, S, 16		(continued)
BASIN 35														
AIRE R	F11	SOUTHERN OCEAN	X	P, X					3, S, 11	D, 29	C, 29		SU/S, 22	AIRE R
(continued)													SU/A, 22	(continued)
ANGLESEA R	N10	BASS STRAIT								D, 29	C, 29			ANGLESEA R
BARNAM R EAST BR	G11	BARNAM R	X	P, X					1, S, 11	D, 29	C, 29		SU/A, 22	BARNAM R EAST BR
BARNAM R WEST BR	G11	BARNAM R	X	P, X										BARNAM R WEST BR
CALDER R	F11	AIRE R	X						1, S, 11					CALDER R
CARISBROOK CK	G11	GELLIBRAND R	X											CARISBROOK CK
CHAPPLE CK	F11	BASS STRAIT							1, S, 11					CHAPPLE CK
CHARLIES CK	G11	GELLIBRAND R								D, 29	C, 29	2, X, 2		CHARLIES CK
CLIMBERLAND R	G11	BASS STRAIT	X							D, 29	C, 29	1, S, 16	SU/W, 22	CLIMBERLAND R
CURRIES R	E11	SOUTHERN OCEAN	P, X	P, X					1, S, 11					CURRIES R
ELLIOT R	G11	BASS STRAIT	X							D, 29	C, 29	1, R, 16	SU/W, 22	ELLIOT R
ERSKINE R	G11	BASS STRAIT	X							D, 29	C, 29			ERSKINE R
FORD R	F11	AIRE R								D, 29	C, 29			FORD R
GRASSY CK	N10	BASS STRAIT							2, S, 11	D, 29	C, 29		SU/F, 22	GRASSY CK
GELLIBRAND R	F11	SOUTHERN OCEAN	P, X	P, X						D, 29	C, 29		SU/A, 22	GELLIBRAND R
(continued)														(continued)
JOHANNA R	F11	BASS STRAIT										2, X, 2		JOHANNA R
KENNET R	G11	BASS STRAIT	X							D, 29	C, 29			KENNET R
PAIKALAC CK	N10	BASS STRAIT		X						D, 29	C, 29			PAIKALAC CK
PARKER R	G11	BASS STRAIT								D, 29	C, 29			PARKER R
SHERBROOKE R	F11	BASS STRAIT								D, 29	C, 29			SHERBROOKE R
SKENES CK	G11	BASS STRAIT	X							D, 29	C, 29			SKENES CK
ST GEORGE	G11	BASS STRAIT	X							D, 29	C, 29			ST GEORGE
THOMPSON CK	N10	BASS STRAIT		P, X						D, 29	C, 29			THOMPSON CK
WILD DOG CK	G11	BASS STRAIT	X							D, 29	C, 29			WILD DOG CK
WYE R	G11	BASS STRAIT	X							D, 29	C, 29			WYE R
BASIN 36														
BILLY BILLY CK	F08	FIERY CK										1, R, 16		BILLY BILLY CK
BROKEN CK	F09	MOUNT EMU CK										1, S, 16		BROKEN CK
BRUCKNELL CK	E10	HOPKINS R									C, 29			BRUCKNELL CK
BURCHETT CK	E09	MUSTON CK										1, S, 16		BURCHETT CK

Appendix V (continued)

Stream and basin	Grid no.	Tributary of	Angling Intro.	Native	Canoe	Car camp	Flora	Fauna	Geo./ geom.	Fish div.	Fish stat.	Cult. herit.	Scenic value	Stream and basin
FIERY CK	E09	HOPKINS CK	X	X								1, R, 16		FIERY CK
GOOD MORNING BILL CK	E08	LAKE BUNINJON										1, R, 16		GOOD MORNING BILL CK
HOPKINS R (continued)	E30	SOUTHERN OCEAN	P, X	P, X						0, 29	C, 29	5, S, 16 2, R, 16 1, N, 16	W/A, 22 W/A, 22	HOPKINS R (continued)
LUBRA CK	D09	MUSTON CK					5, R, 20					1, S, 16		LUBRA CK
MERRI R	D10	SOUTHERN OCEAN	P, X	P, X						0, 29	C, 29	1, S, 16 4, S, 16		MERRI R
MT EMU CK	E10	HOPKINS R	X				2, R, 20			0, 29	C, 29	1, S, 16 4, S, 16	W/A, 22	MT EMU CK
SALT CK	E10	HOPKINS R										1, S, 16		SALT CK
TRAMALLA CK	E08	MOUNT EMU CK										1, R, 16		TRAMALLA CK
YOUL CK	D10	SPRING CK										1, S, 16		YOUL CK
BASIN 37														
DARLOT CK (continued)	C10	FITZROY R	X	P, X			3, S, 21					1, R, 16 1, S, 16 1, R, 16	W/F, 22 W/T, 22	DARLOT CK (continued)
EUMERALLA R (continued)	D10	LAKE YAMBUK	X					2, L, 21 1, S, 21 2, L, 21	1, S, 12	0, 29	C, 29	1, S, 16 1, R, 16		EUMERALLA R (continued)
FITZROY R	C10	PORTLAND BAY	X							1, W, 12	0, 29	1, R, 16		FITZROY R
JOHNSTONE CK	B10	DISCOVERY BAY								1, S, 12		1, S, 16	C/T, 22	JOHNSTONE CK
MOYNE R (continued)	D10	BELFAST LOUGH	X									1, S, 16 1, R, 16 1, R, 16		MOYNE R (continued)
SCOTTS CK	E10	CURDIES R										1, R, 16		SCOTTS CK
SHAM R	D10	SOUTHERN OCEAN								0, 29	C, 29			SHAM R
SURREY R	D10	SOUTHERN OCEAN								0, 29	C, 29			SURREY R
BASIN 38														
BOONAHAM CK	D09	LAKE LINLITHGOW						1, S, 21						BOONAHAM CK
CRAWFORD R	B09	GLENELG R	X					1, S, 21	1, S, 12	0, 29	C, 29	1, S, 16		CRAWFORD R
GLENELG R (continued)	B10	SOUTHERN OCEAN	P, X	P, X			1, N, 20 1, R, 20	1, R, 21	1, S, 12	0, 29		3, S, 16	GR/N, 22 GR/A, 22 W/T, 22	GLENELG R (continued)
GLENGULLIN R	B09	GLENELG R												GLENGULLIN R
GRANGE BURN	C09	MANNON R	X	X			1, R, 20							GRANGE BURN
GREEN CK	D08	DYER CK						1, R, 21				1, X, 1	W/T, 22	GREEN CK
MOLESIDE CK	B10	GLENELG R	X											MOLESIDE CK
MOSQUITO CK	A08	CRAWFORD R												MOSQUITO CK
MUDDY CK	D09	GRANGE BURN								1, W, 12				MUDDY CK
STOKES R	B09	GLENELG R								0, 29	C, 29	1, S, 16	GR/S, 22	STOKES R
WANNON R (continued)	B09	GLENELG R	X				1, X, 18	1, R, 21		0, 29	C, 29		W/A, 22	WANNON R (continued)
YARRAMYLJIP CK	C08	GLENELG R												YARRAMYLJIP CK
BASIN 39														
MOSQUITO CK	A08	BOOL LAGOON (SA)						1, S, 21				C, 29		MOSQUITO CK

Notes:

- The Kiewa and King Rivers are considered to have other important fish conservation values.
- The original fabric of the Chinese Gardens site has been disturbed by earth moving equipment over the last 20 to 30 years.

Key to codes in table

The entry codes are as follows:

The last number (numbers 1 to 29) identifies the source of information, angling excepted. These are listed in the information sources section. The information sources for angling are 23 and 30, see 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

(Information Source number 23)

- Introduced species (X) undifferentiated (local, regional or State) significance
- Native species (X) undifferentiated (local, regional or State) significance

(Information Source number 30)

- 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' or 'potentially threatened' 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 River setting category

- MBP - Murray Basin Rivers
- WP - Western Plains
- SL - Southern Lowlands
- WCH - West Central Hills
- FH - Foothills
- EH - Eastern Highlands
- G - Grasslands
- U - Southern Uplands
- C - Coastline
- 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
- D - 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. McKee-Williams, M.S., Rosengren, M.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, M.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, M.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, M.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, M.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, M.J. (1984).
Sites of geological and geomorphological significance in the Shire of Otway. Ministry for Conservation - Environmental studies series report No 399.
12. Rosengren, M.J., Mellen, 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 Malah, M.G. (1981).
Sites of botanical significance in East Gippsland. Ministry for Conservation - Environmental studies series report No 322.
14. Gullan, P.K., Eart, G.E., Forbes, S.J., Berley, R.H., and Walsh, M.G. (1984).
Sites of botanical significance in Central Gippsland. Department of Conservation, Forests and Lands - Environmental studies series No 420.
15. Opie, A.M., Gullan, P.K., Van Berkel, S.C., and Van Rees, N. (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. Some classifications may be revised as a result of the impacts of water resource development, and as the details of the canoeing capability of some rivers is further established.
21. Biosis Research Pty Ltd and Ecological Horticulture Pty Ltd (1988). See references
22. Anson, Y., Sheatman, C., and Sandford, M. (1987).
A scenic assessment of Victoria's streams. Report to the Land Conservation Council.
23. Tunbridge, B.R., and Glewne, T.J. (1982).
Fisheries value and classification of fresh and estuarine waters in Victoria (1990). Arthur Ryland 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 Spectrum Pty Ltd (1989).
See references
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.com.).
28. Scotts, D., and Sebeck, J.W. (1989). See references.
29. Radzik, T.A., (in prep - draft Feb 1991)
Fish distribution records for Victorian coastal and inland drainages. Flora and Fauna Division (Freshwater Ecology Branch) Department of Conservation and Environment.
30. Ratings are based on whether the stream attracts anglers on a local, regional or State basis. The ratings were based on a 1991 review of data by the Victorian Piscatorial Council with its associate body, the Council of Victorian Fly Fishing Clubs. Key angling bodies and clubs were consulted as part of this review.

Appendix VI

CONSERVATION STATUS OF NATIVE FRESH-WATER FISH SPECIES

Status in Victoria (1990)	Fish species (common name)
Presumed extinct	Agassiz's chanda perch southern purple-spotted gudgeon ² (restricted)
Endangered	freshwater herring trout cod ² (endangered) barred galaxias (previously brown galaxias) ² (endangered) Ewens (variegated) pigmy perch ² (vulnerable)
Vulnerable	Australian grayling ² (potentially threatened) freshwater catfish Macquarie perch ² (restricted) Murray cod silver perch Tasmanian mudfish
Potentially threatened	Australian bass broad-finned galaxias dwarf galaxias spotted galaxias pouched lamprey golden perch Yarra pigmy perch ² (potentially threatened)
Indeterminate	flat-headed galaxias mountain galaxias Cox's gudgeon striped gudgeon freshwater hardyhead Lake Eyre hardyhead river blackfish
Restricted	bony bream two-spined blackfish crimson-spotted rainbowfish
Uncertain	western carp gudgeon Midgleys/Lakes carp gudgeons dwarf flat-headed gudgeon Non-parasitic lamprey
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

1. Koehn, J., & Morrison, A. (1990).

2. The Australian conservation status of these species is listed in brackets. Jackson, P. (1991)

Rivers and Streams Special Investigation

 Land Conservation Council
Victoria

FINAL RECOMMENDATIONS

VICTORIAN HERITAGE RIVERS MAPS A1 - A17

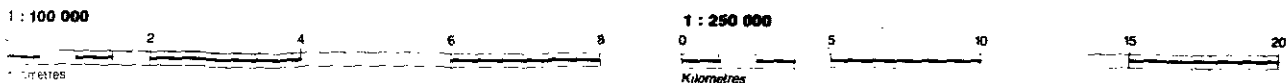
A1 - A17 Recommendation numbers



Victorian Heritage River Corridors

P.L.W.F. Public land water frontage reserves.

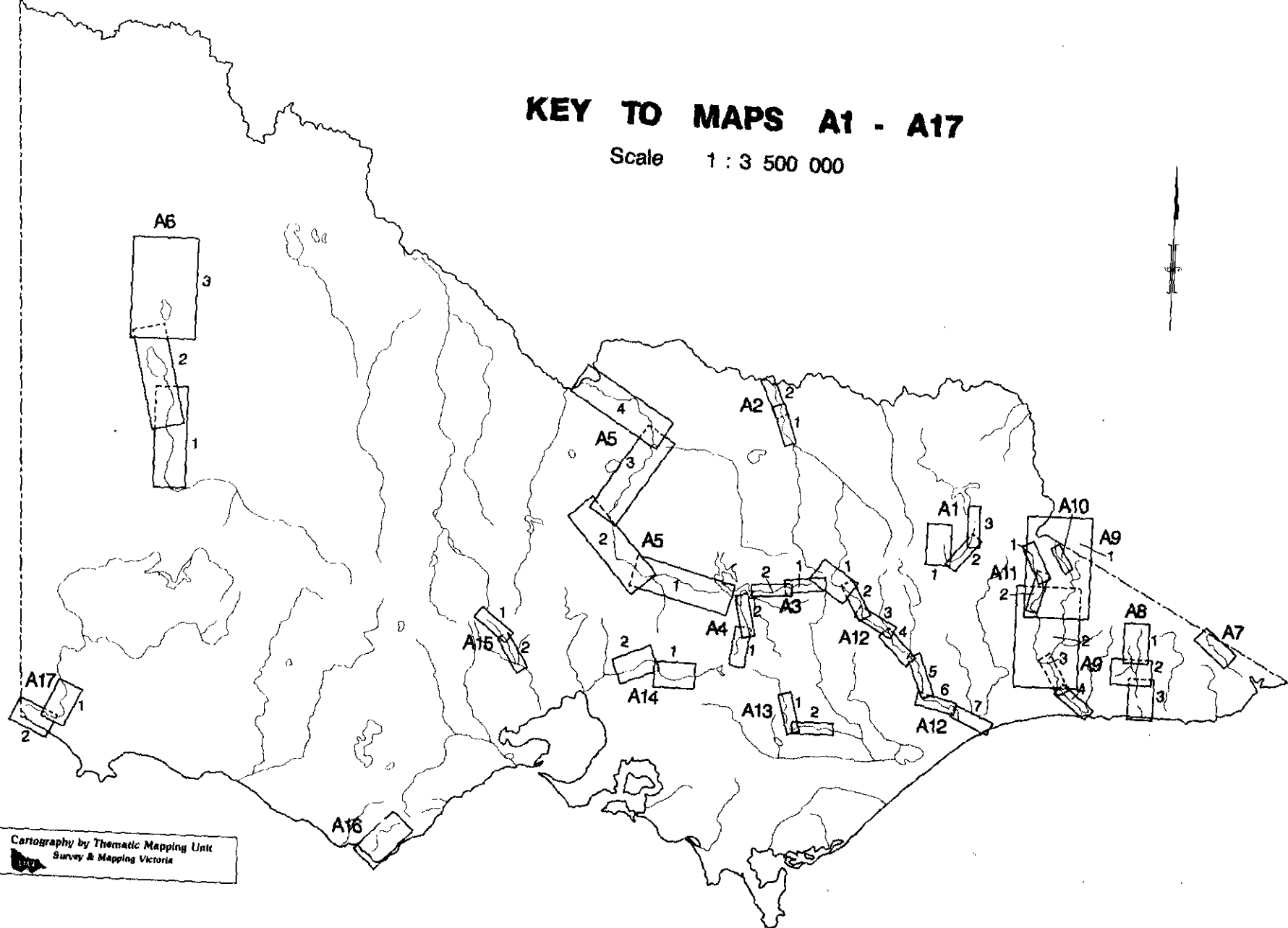
Notes: 1. Scales are either 1:100 000 or 1:250 000, as marked.



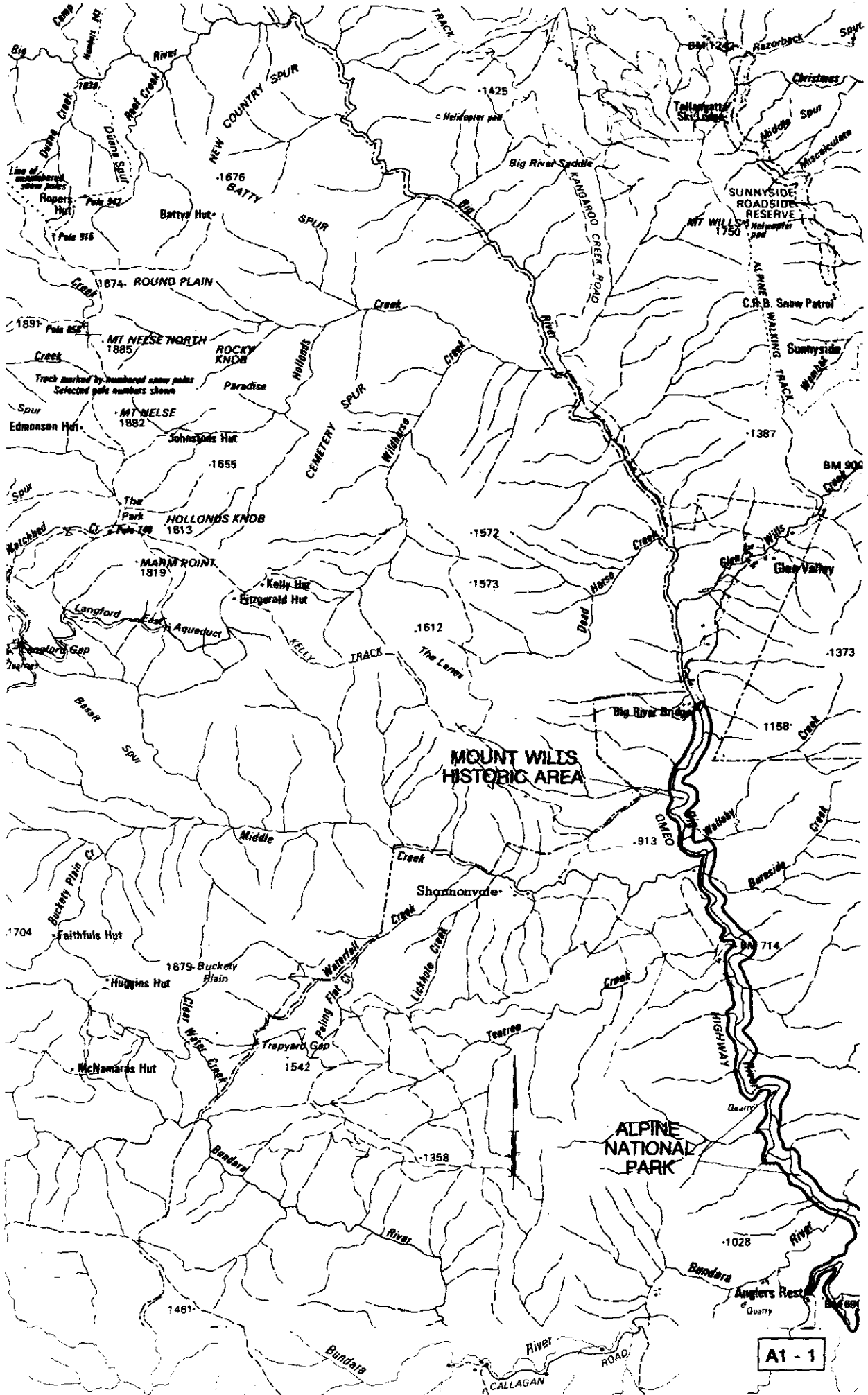
2. Orientation of maps on the page varies - note the north points.
3. River corridors are generally 200m wide on each side of the rivers, except as follows:
 - (a) where the corridor comprises a Public Land Water Frontage Reserve (narrower than 200m);
 - (b) in gorges, for example on the Snowy, Mitchell 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), or where otherwise specified.
4. Maps show the existing public land tenure along the corridor.
5. In some areas a detailed definition of the public land boundary will require reference to parish plans.
6. Private land is not included in the corridor nor are areas inside cities or rural cities.

KEY TO MAPS A1 - A17

Scale 1 : 3 500 000



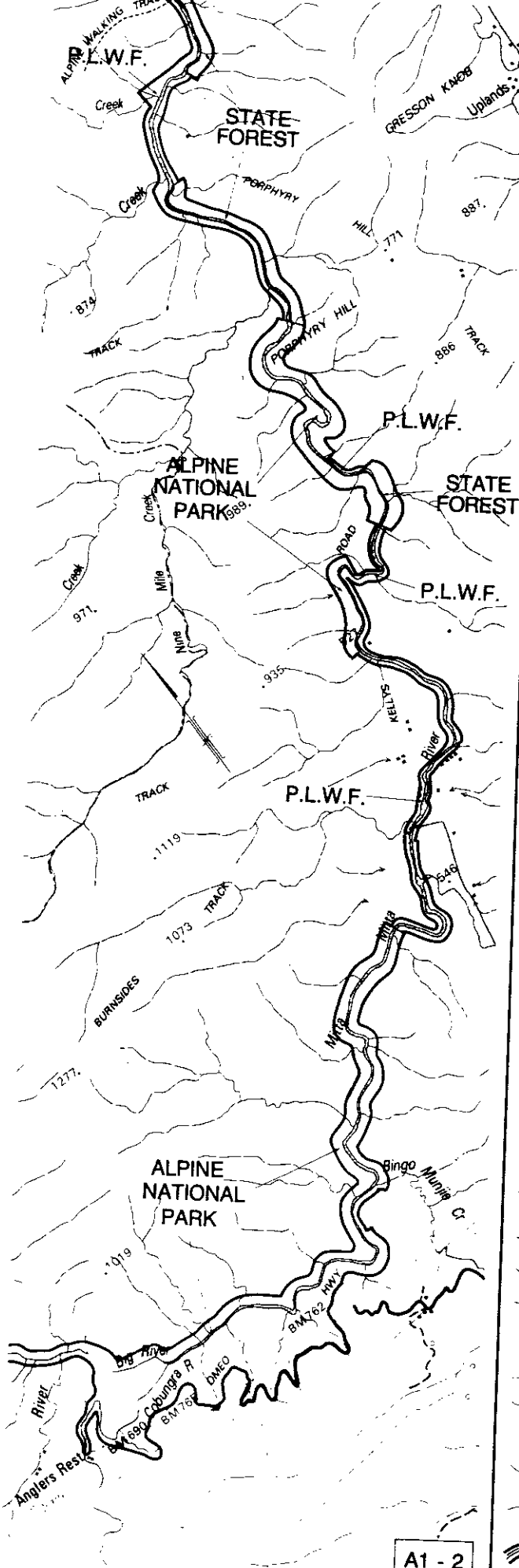
Cartography by Thematic Mapping Unit
Survey & Mapping Victoria



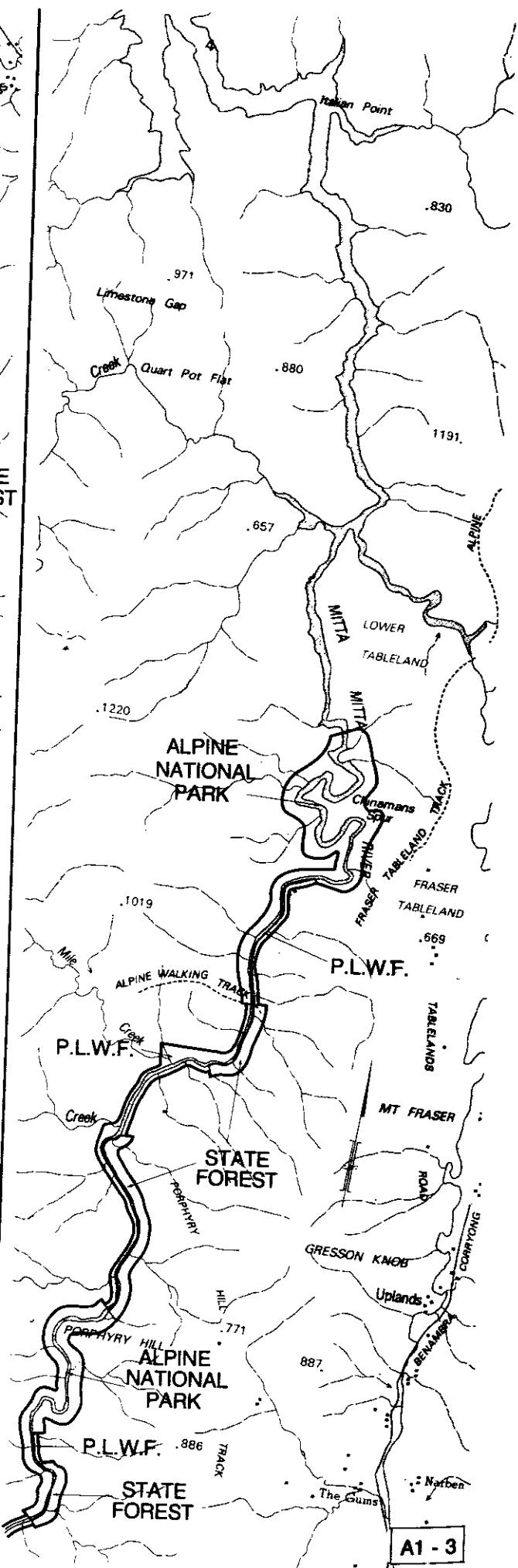
A1 - MITTA MITTA RIVER
 Scale 1:100 000

A1 - 1

MAP A1

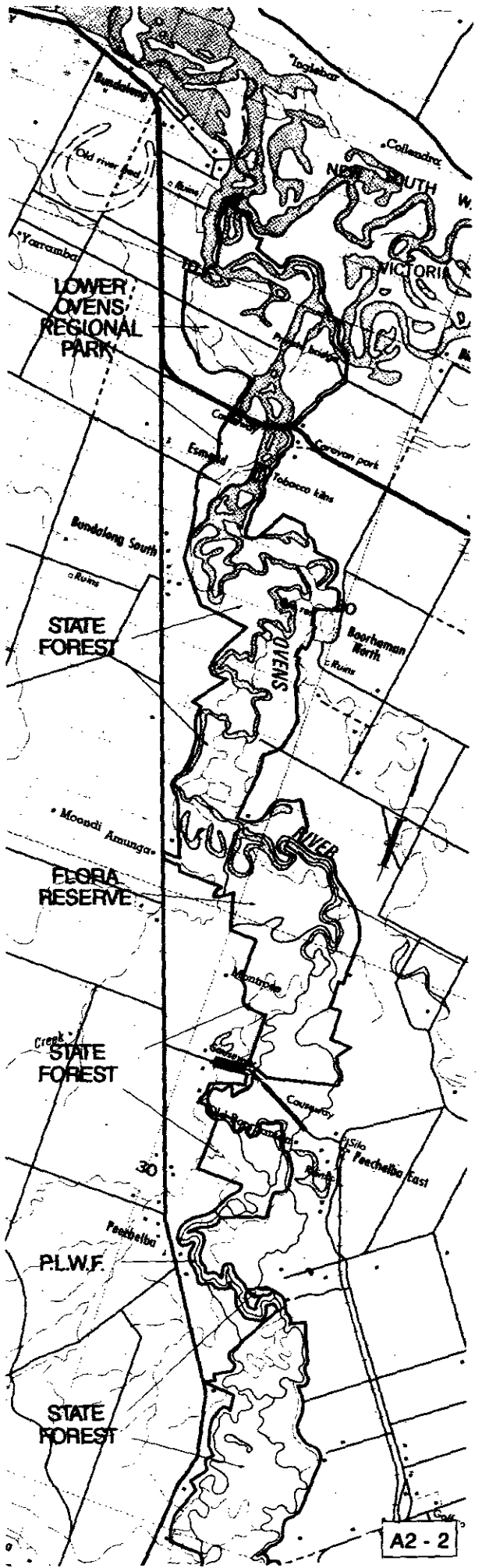
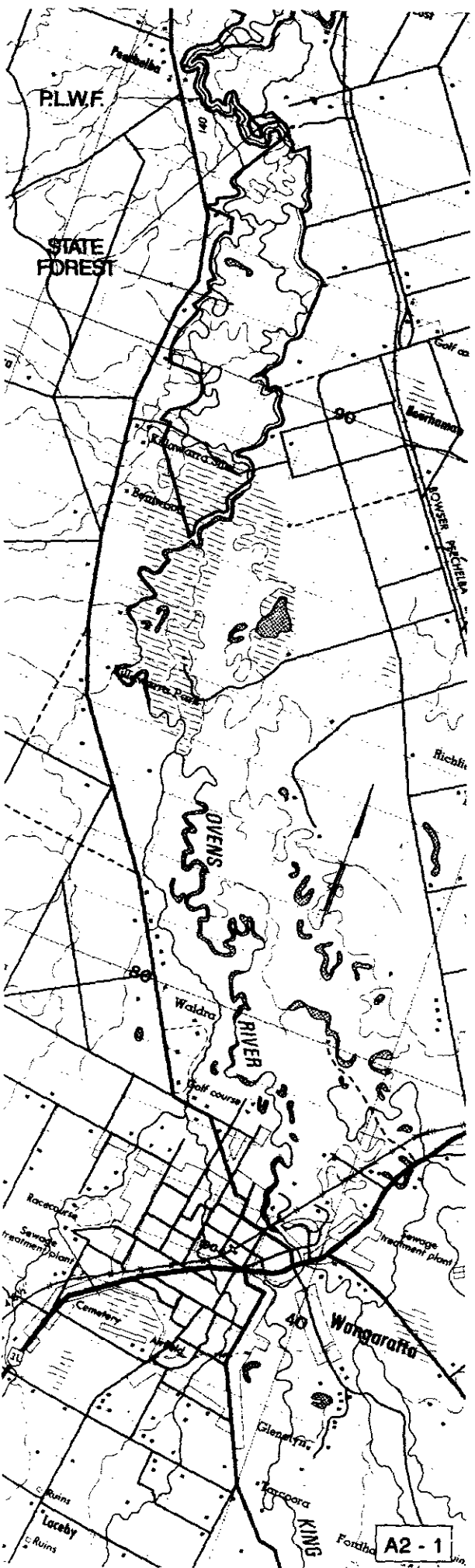


A1 - 2

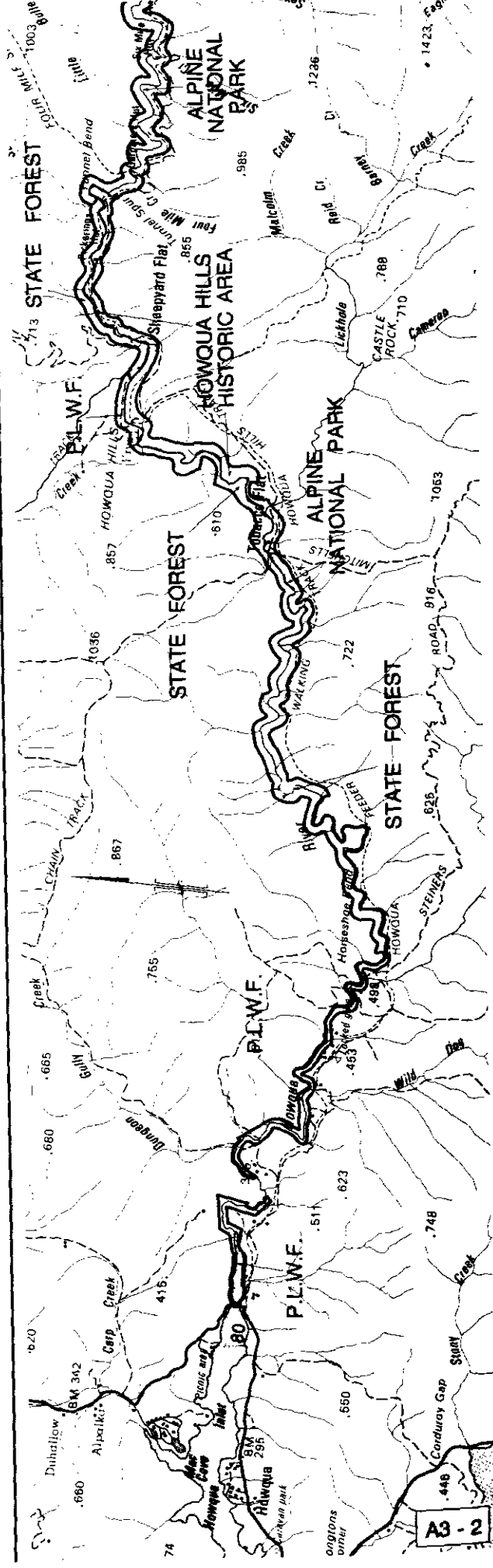
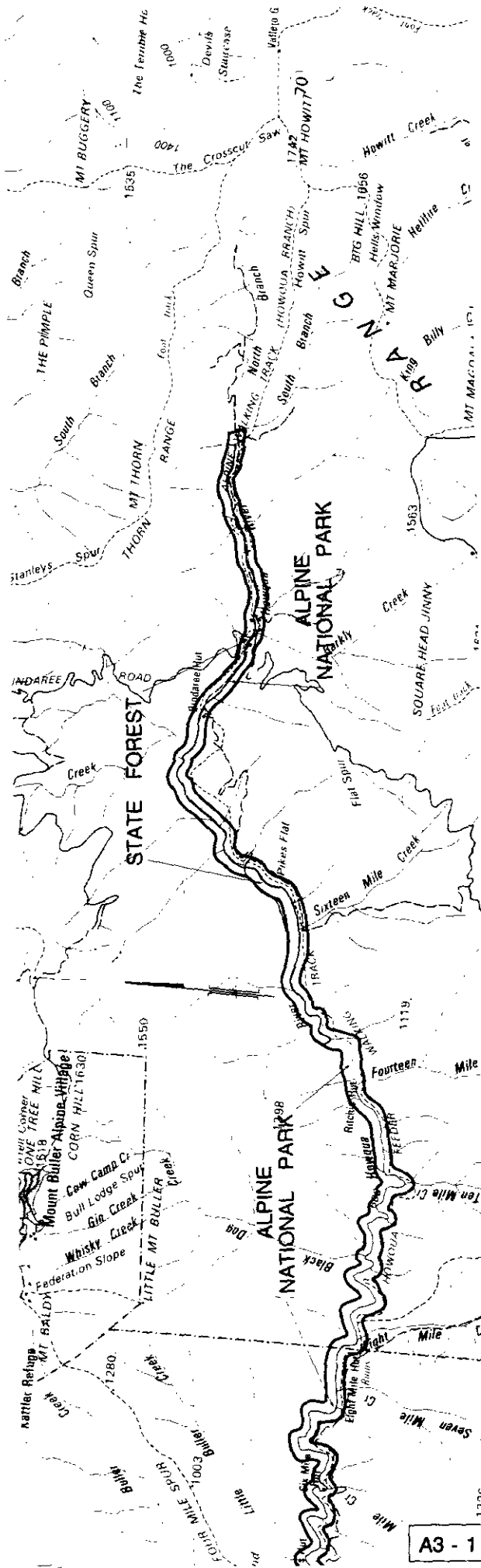


A1 - 3

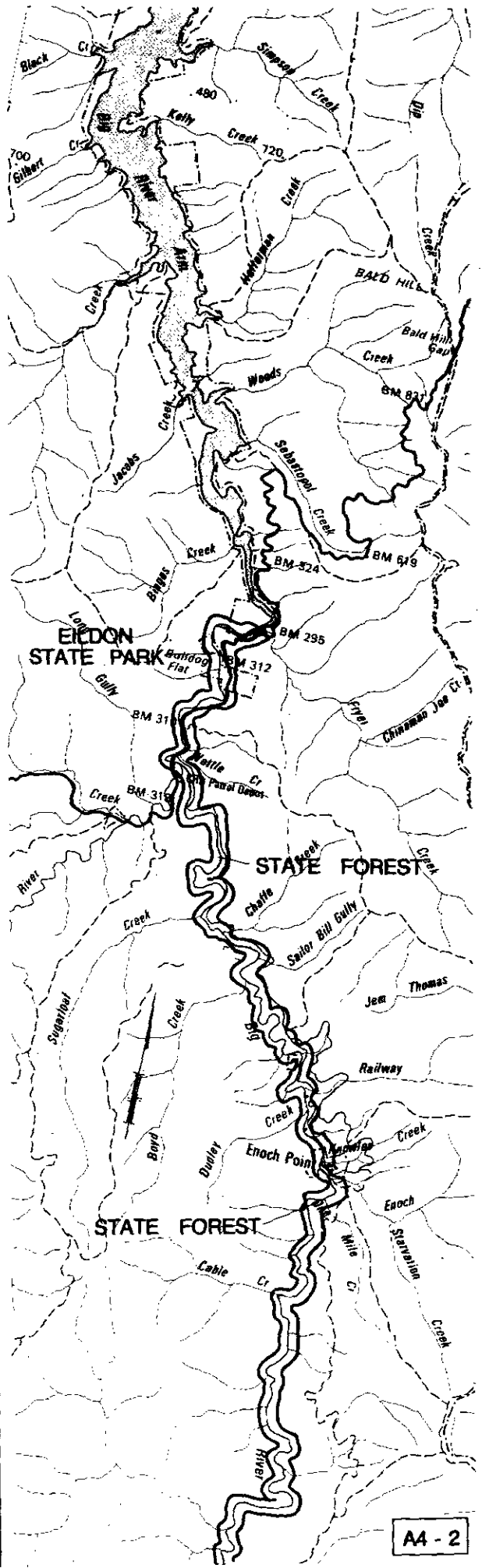
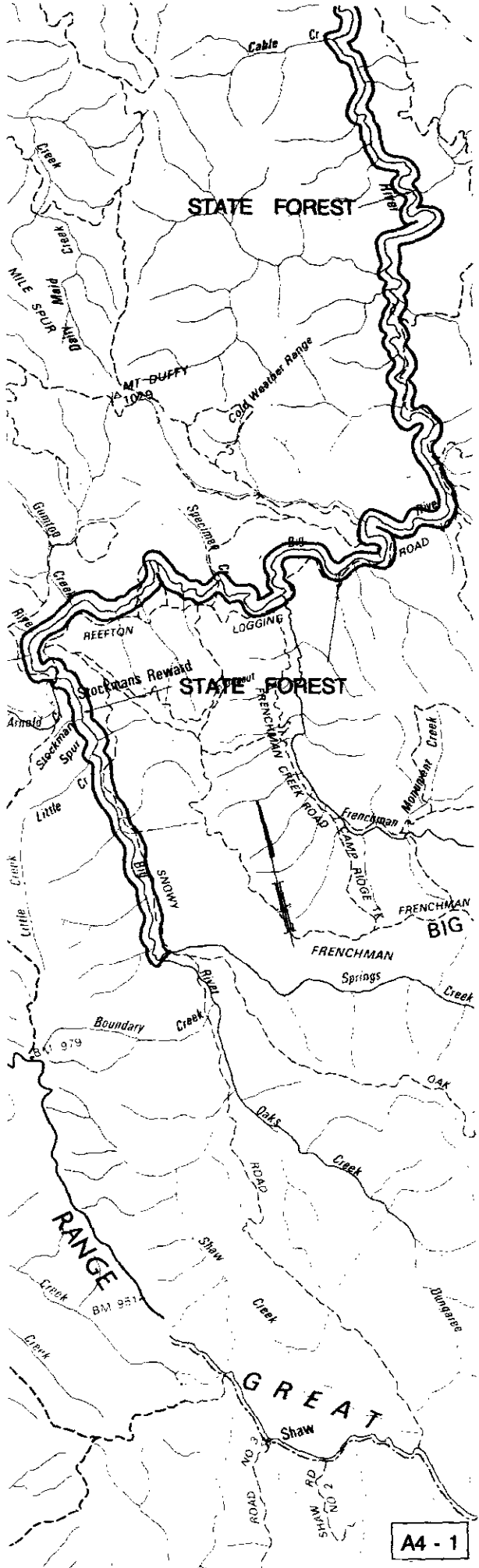
A1 - MITTA MITTA RIVER
Scale 1:100 000



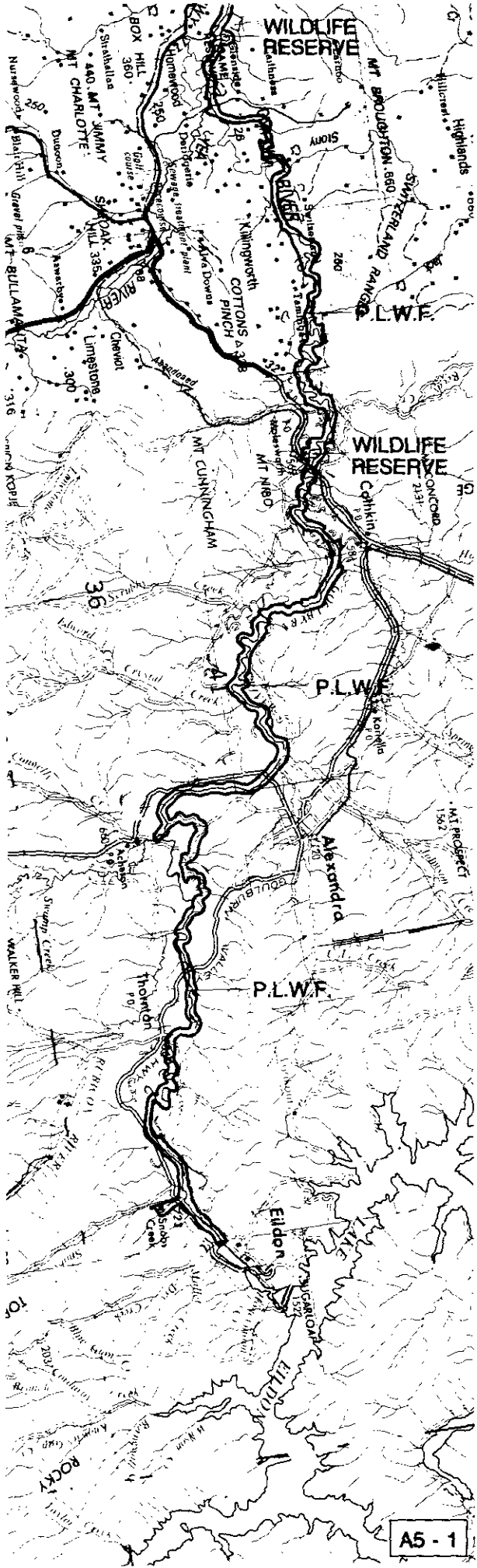
A2 - OVENS RIVER
 Scale 1:100 000



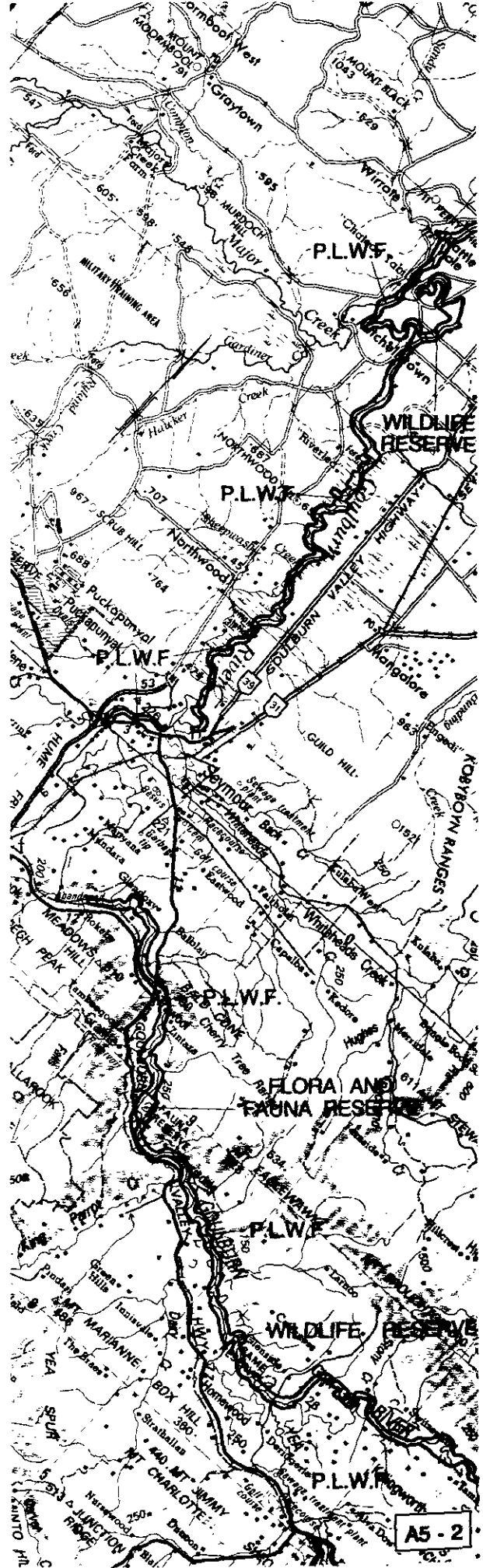
A3 - HOWQUA RIVER
Scale 1:100 000



A4 - BIG RIVER
Scale 1:100 000

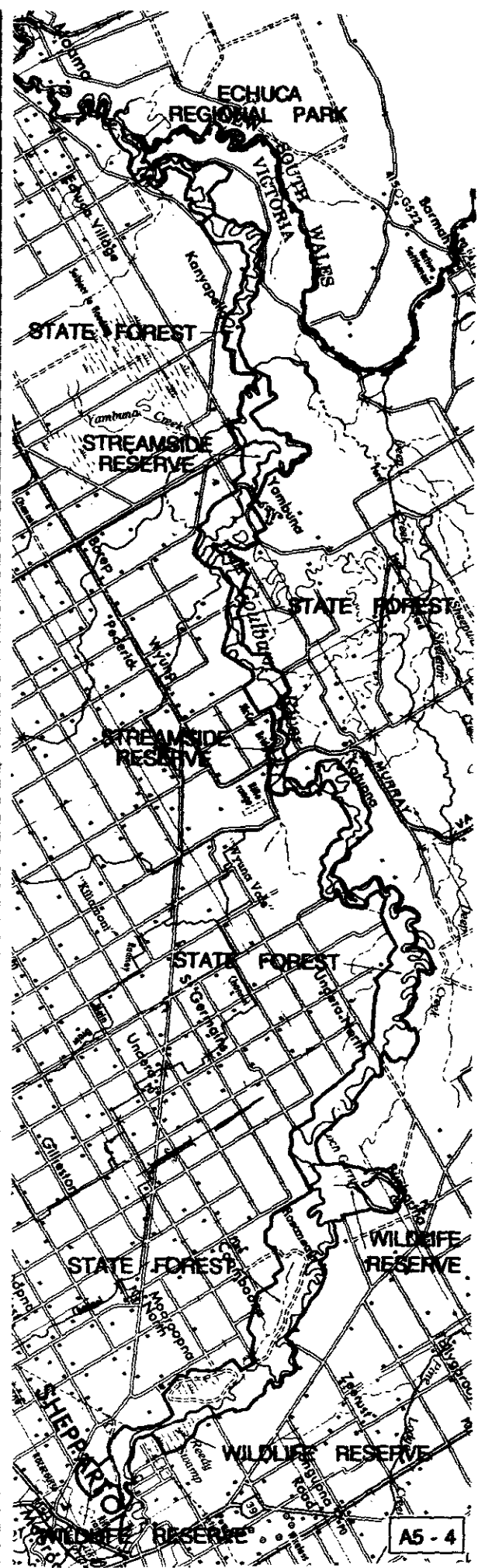
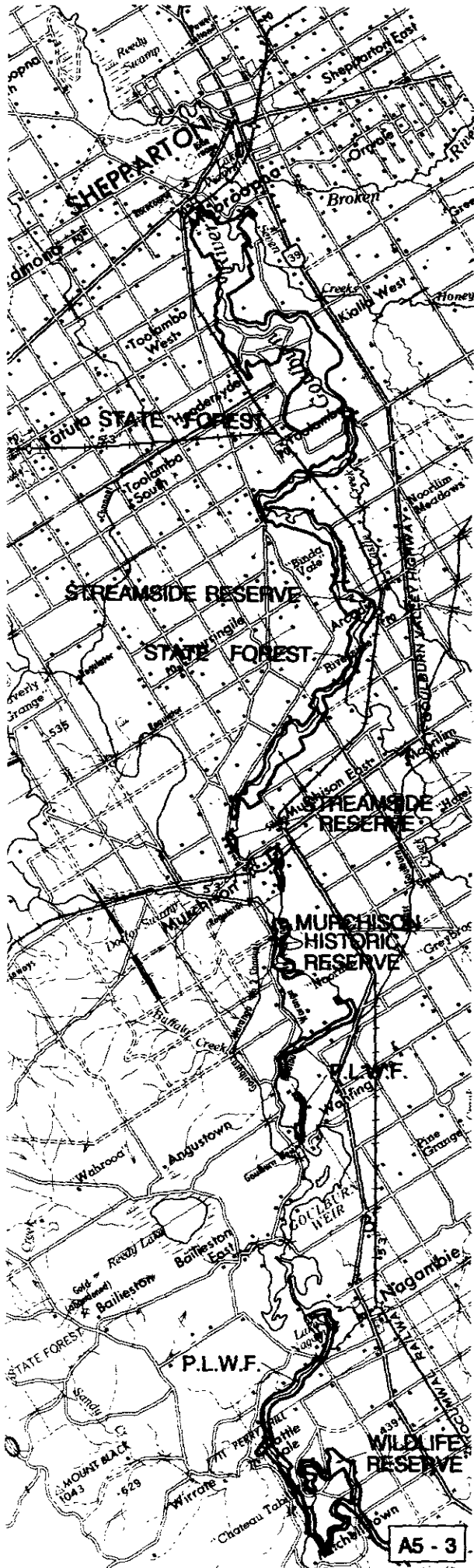


A5 - 1

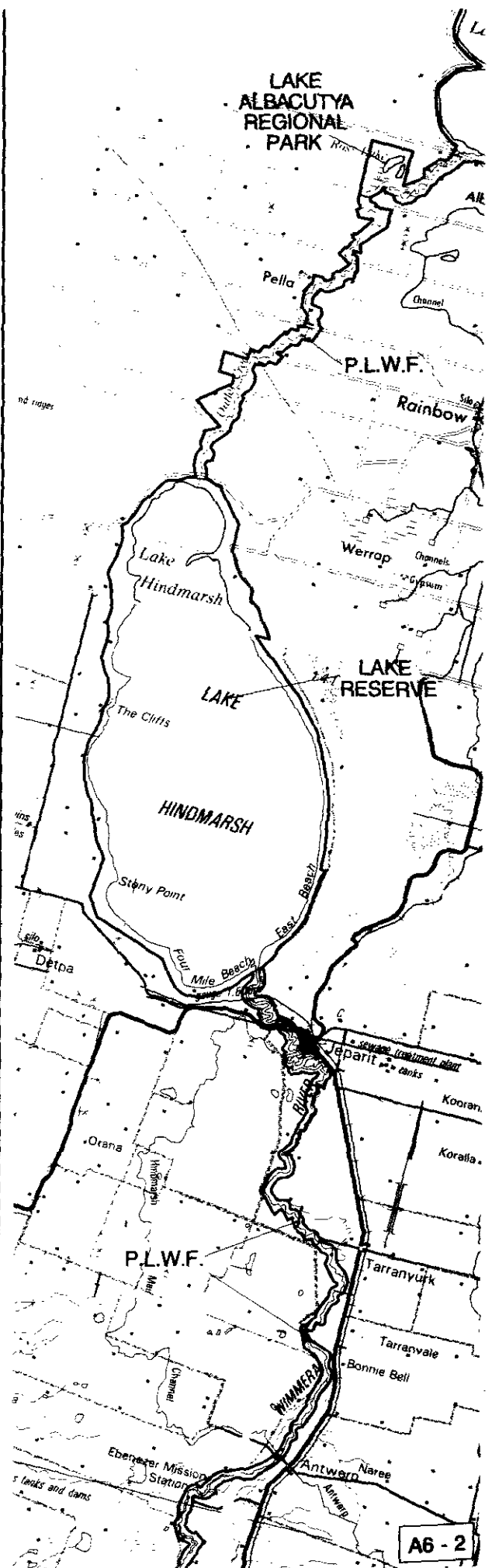
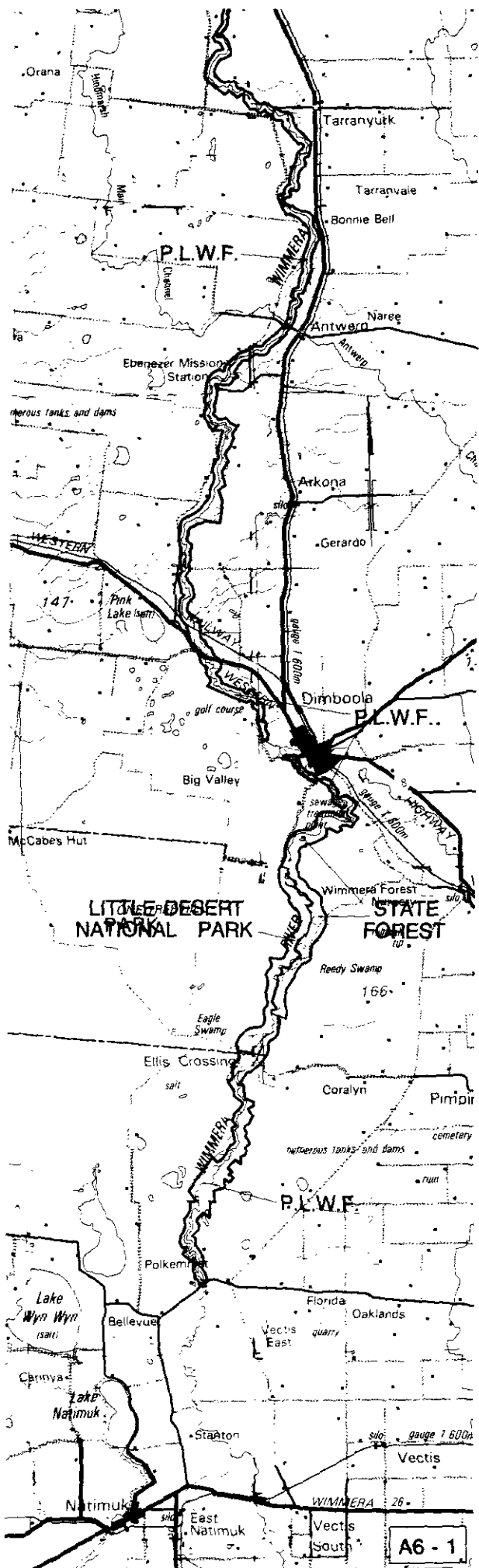


A5 - 2

A5 - GOULBURN RIVER
Scale 1:250 000

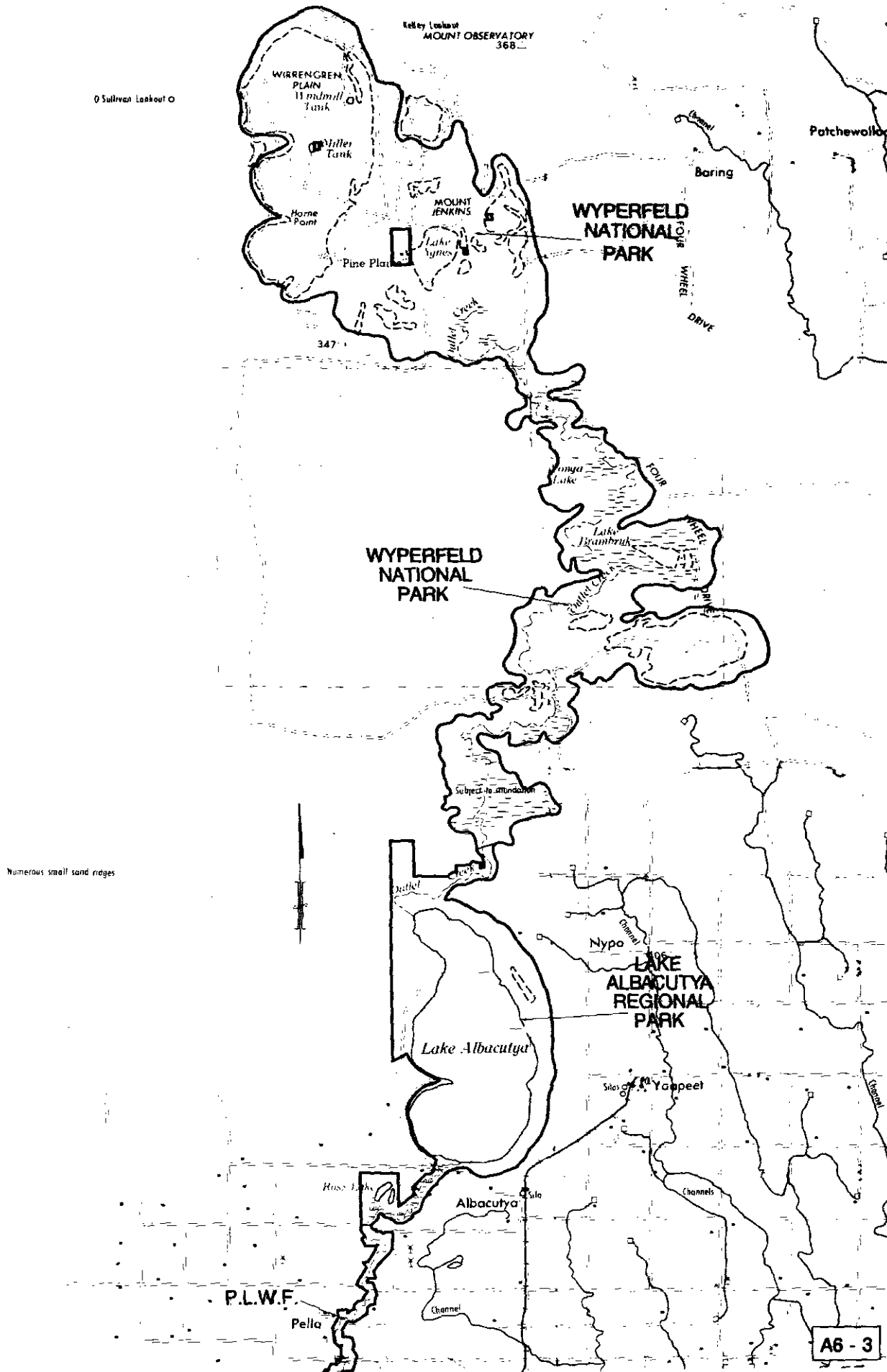


A5 - GOULBURN RIVER
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A6 - WIMMERA RIVER

Scale 1:250 000

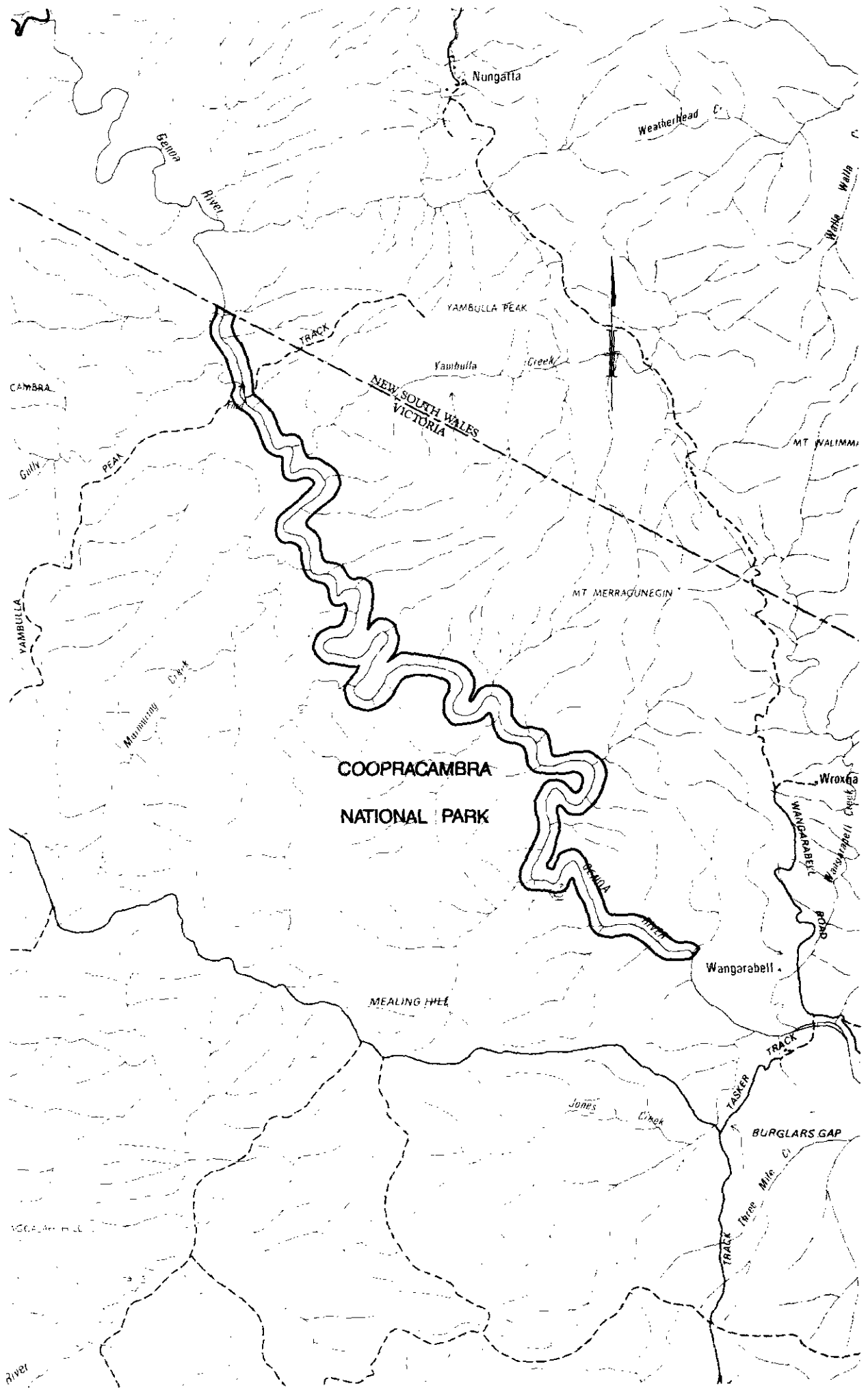


A6 - WIMMERA RIVER

Scale 1:250 000

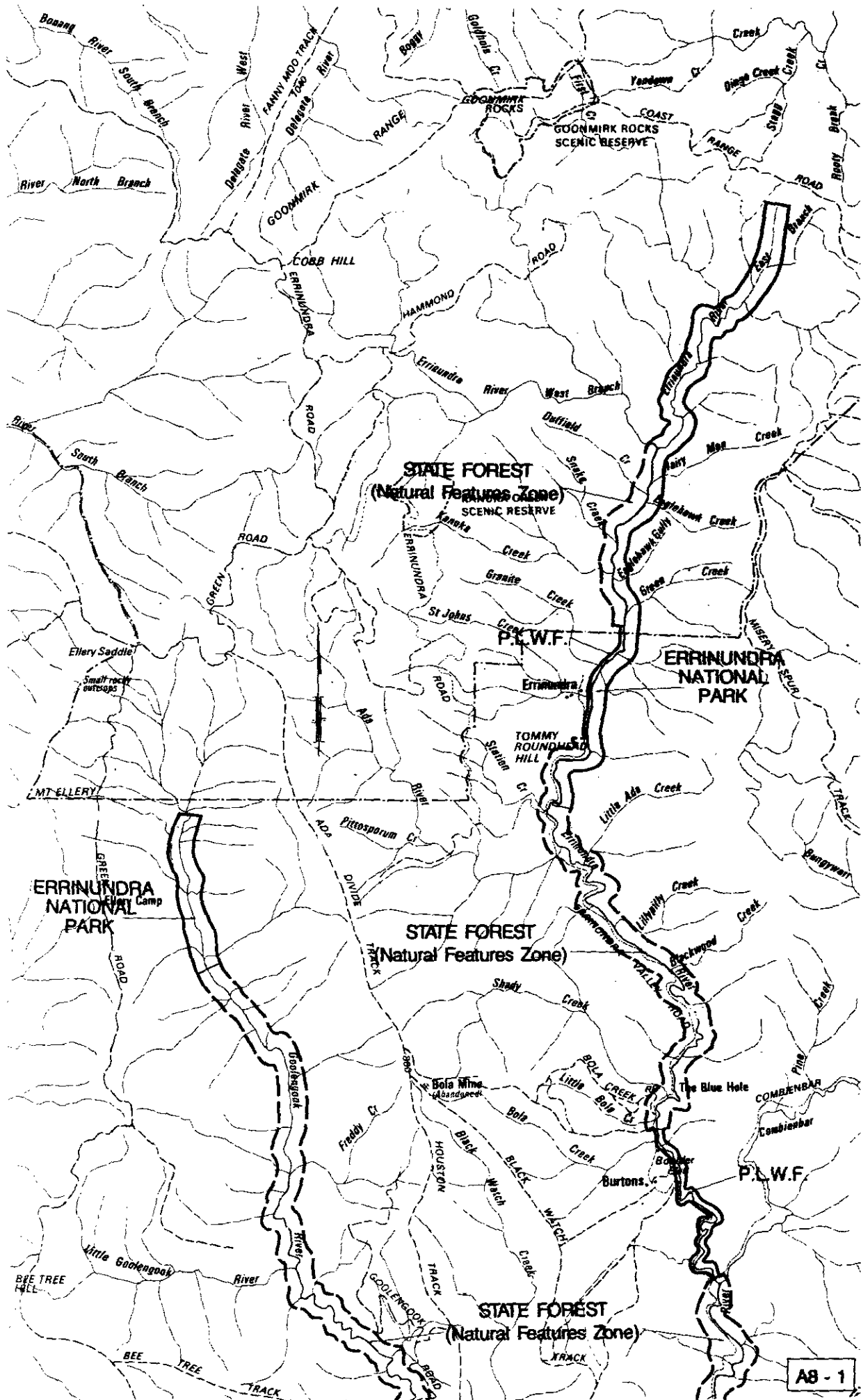
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MAP A6

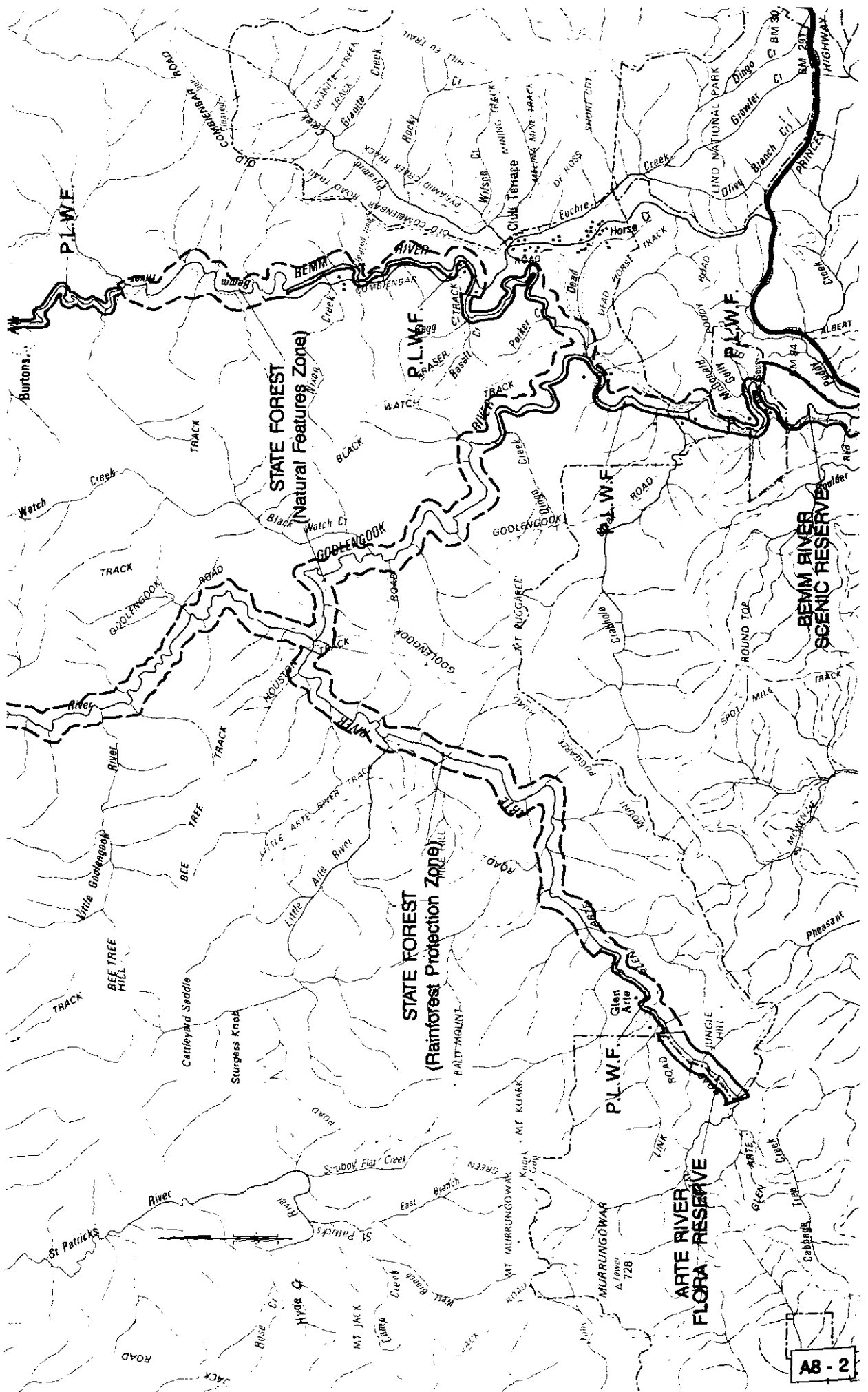


A7 - GENOA RIVER

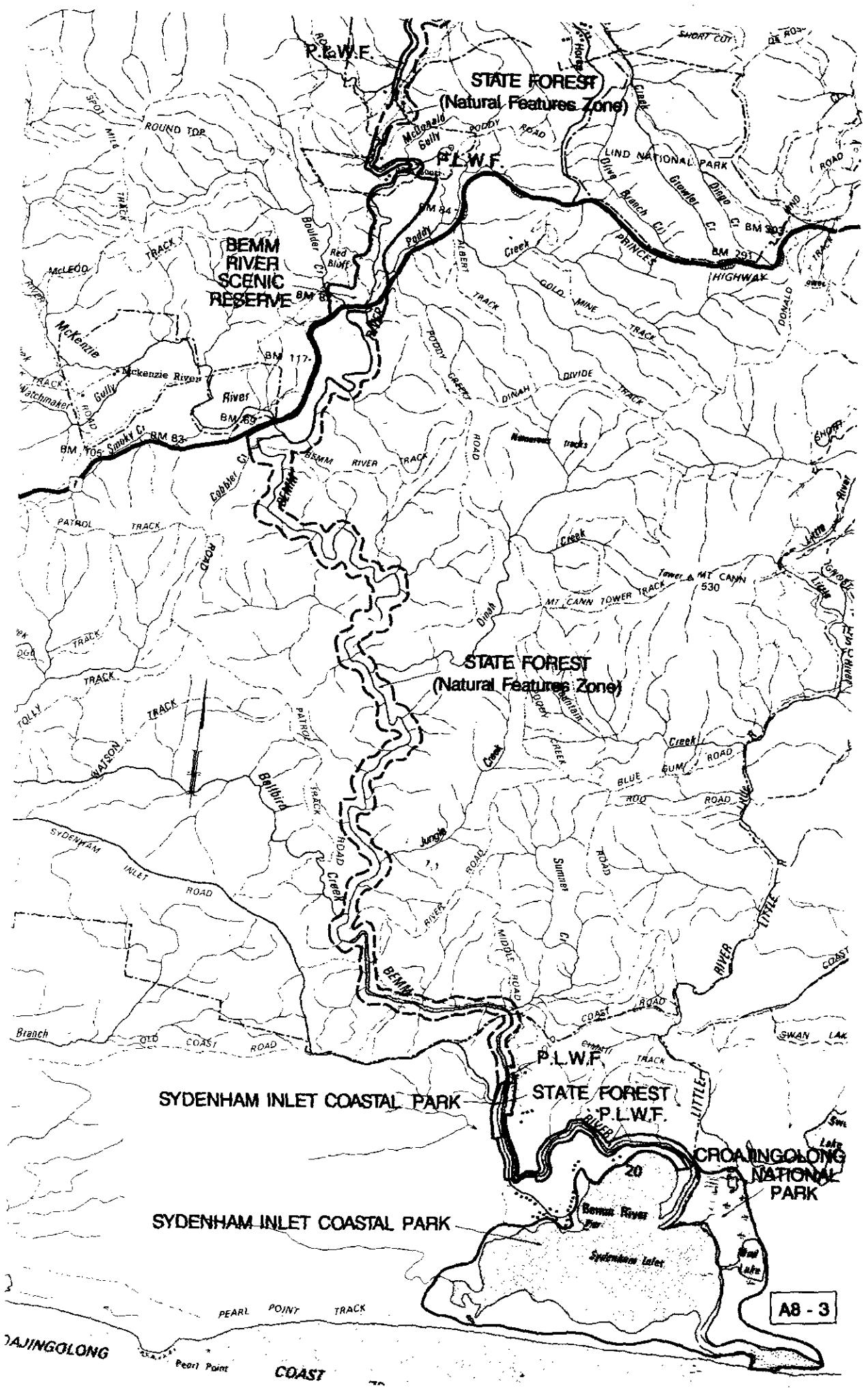
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A8 - BEMM RIVER
 Scale 1:100 000



A8 - BEMM RIVER
 Scale 1:100 000



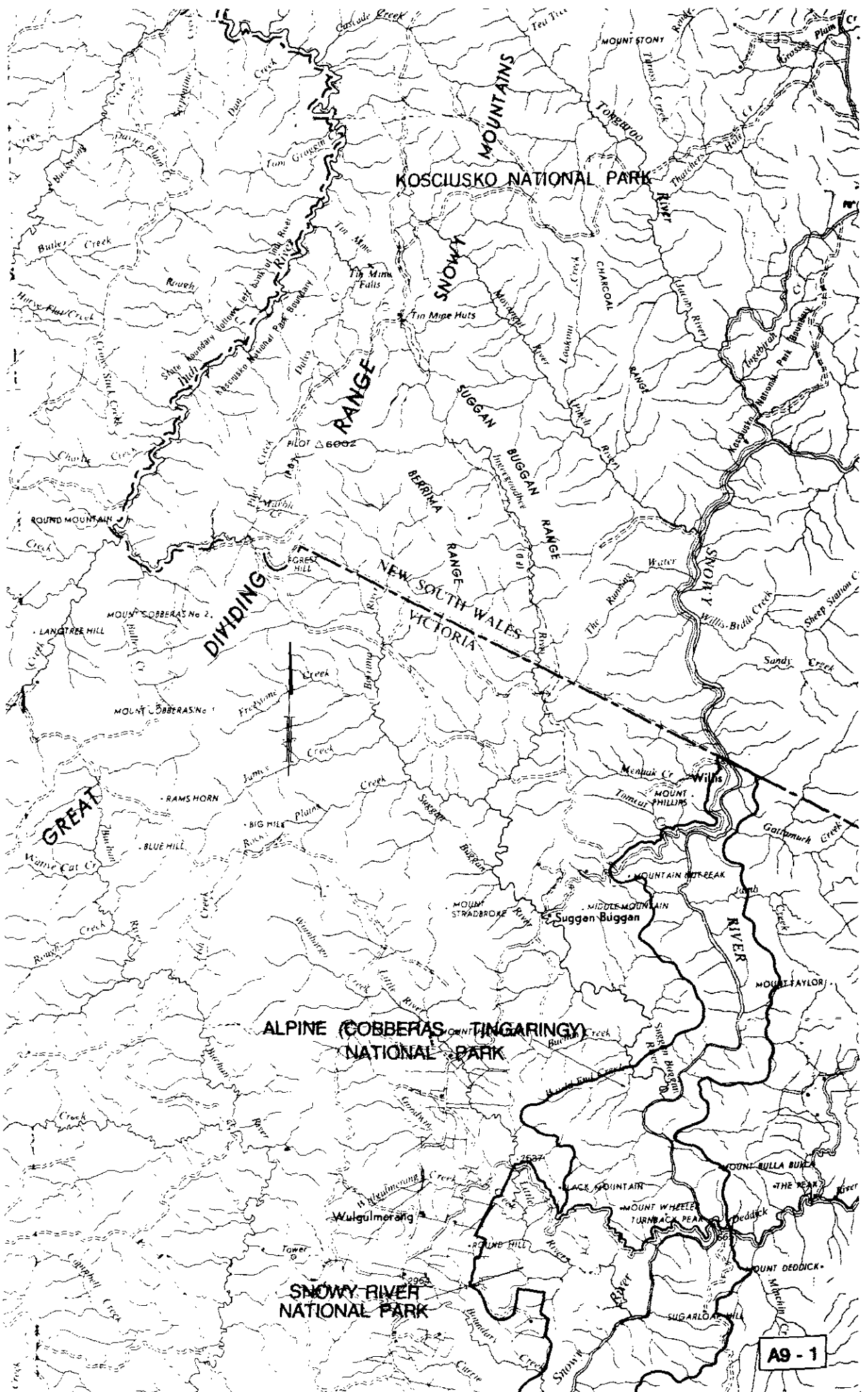
A8 - BEMM RIVER

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MAP A8

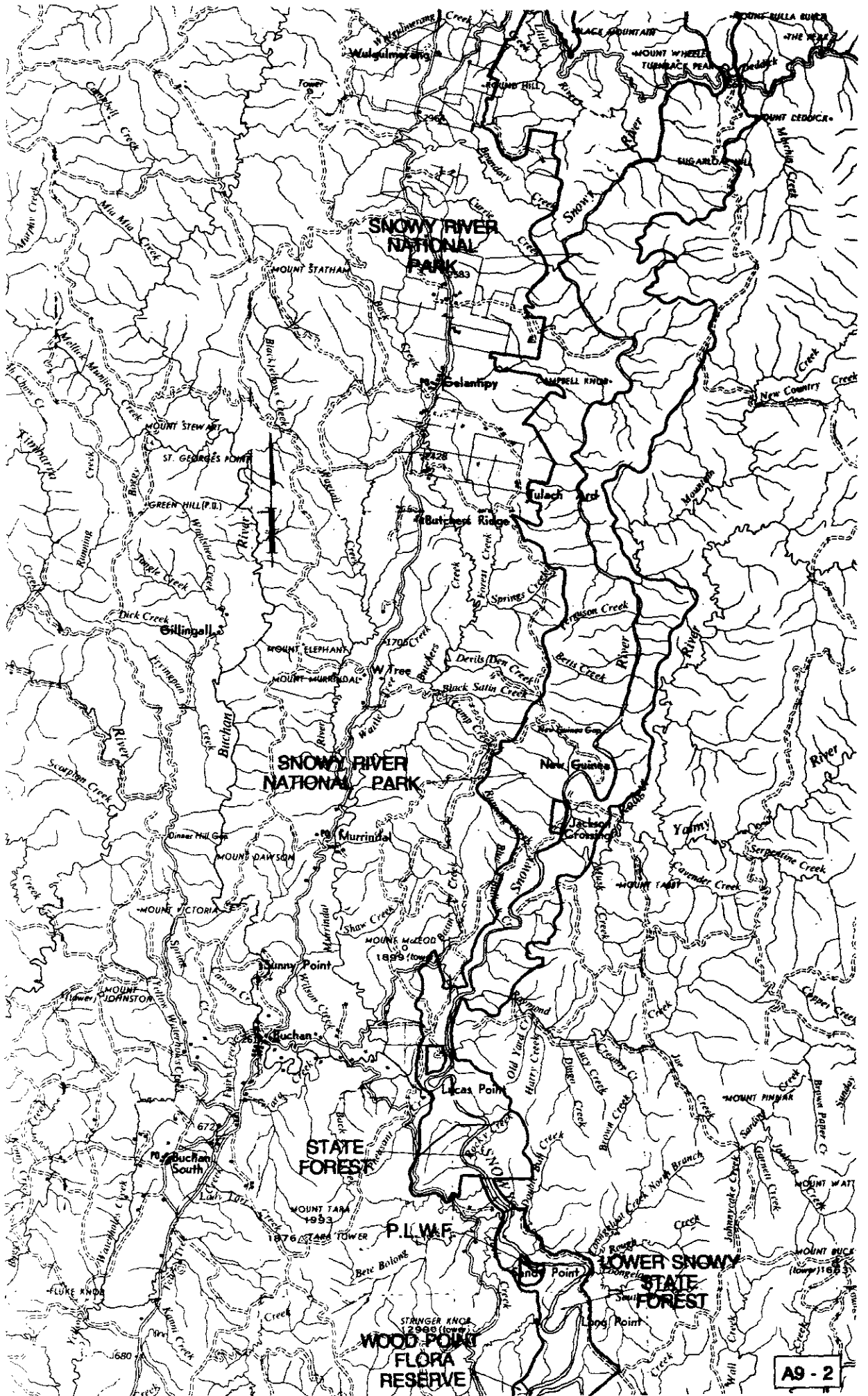
A8 - 3



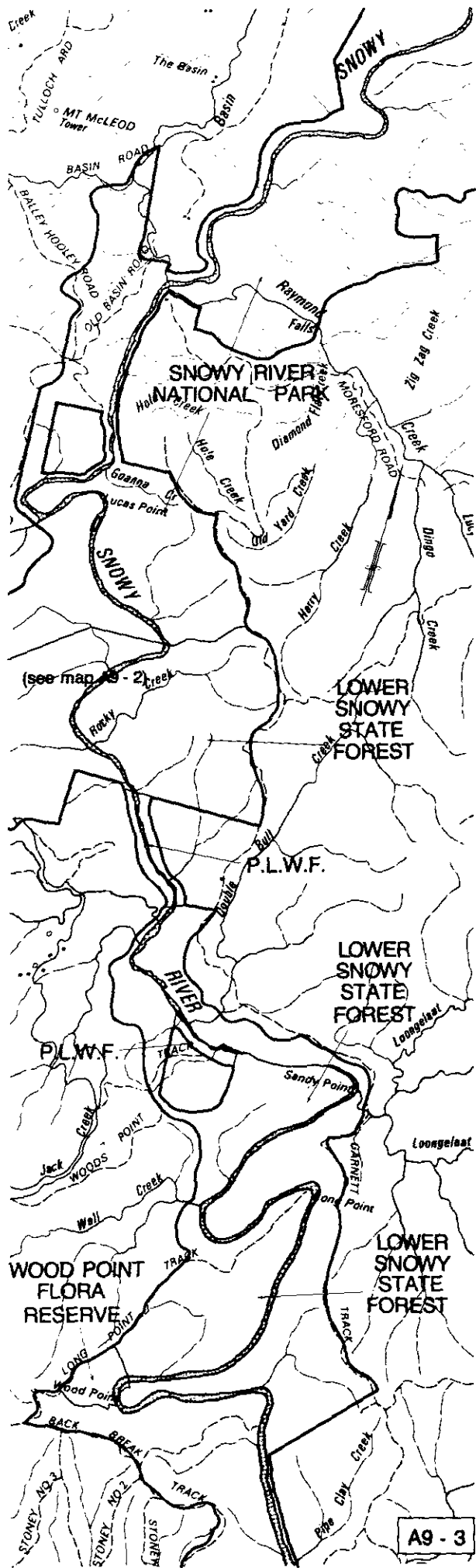
A9 - 1

A9 - SNOWY RIVER
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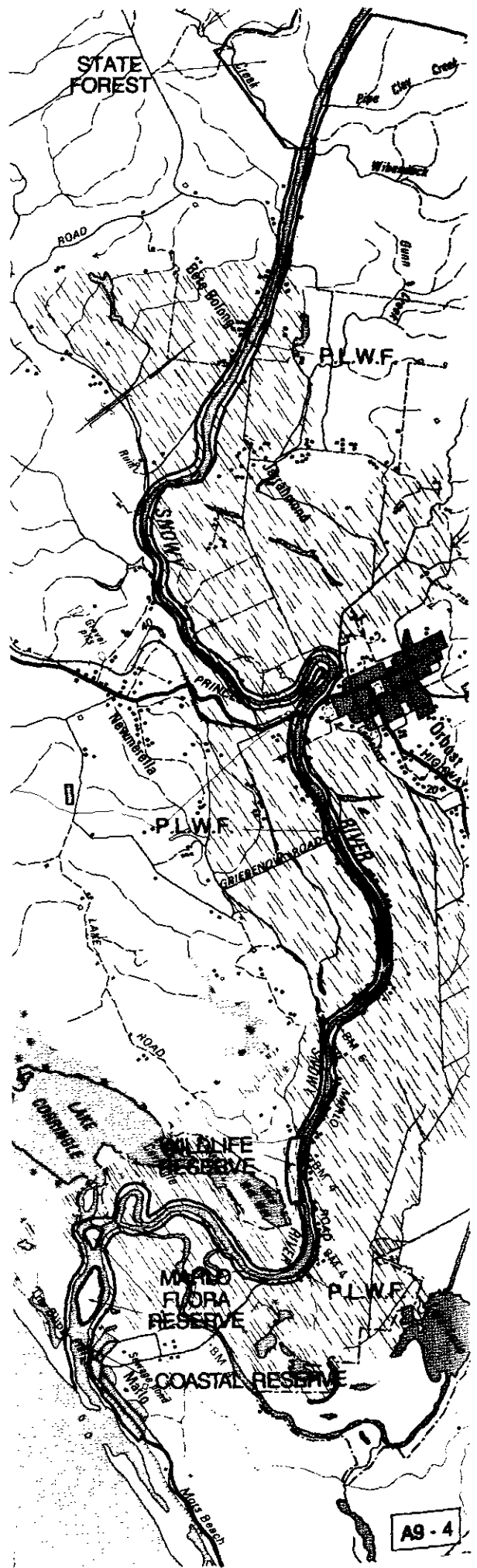
MAP A9



A9 - SNOWY RIVER
Scale 1:250 000

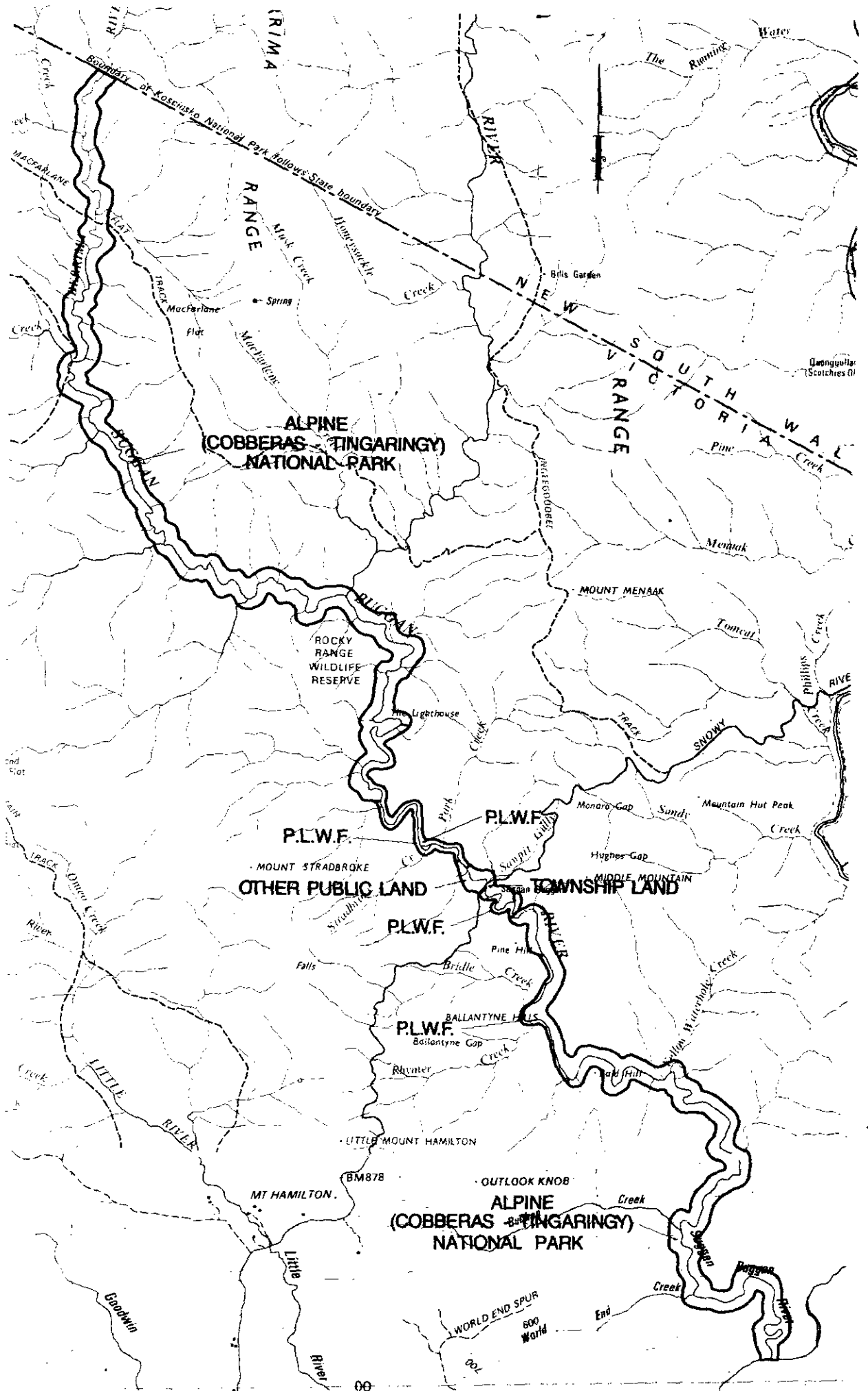


A9-3

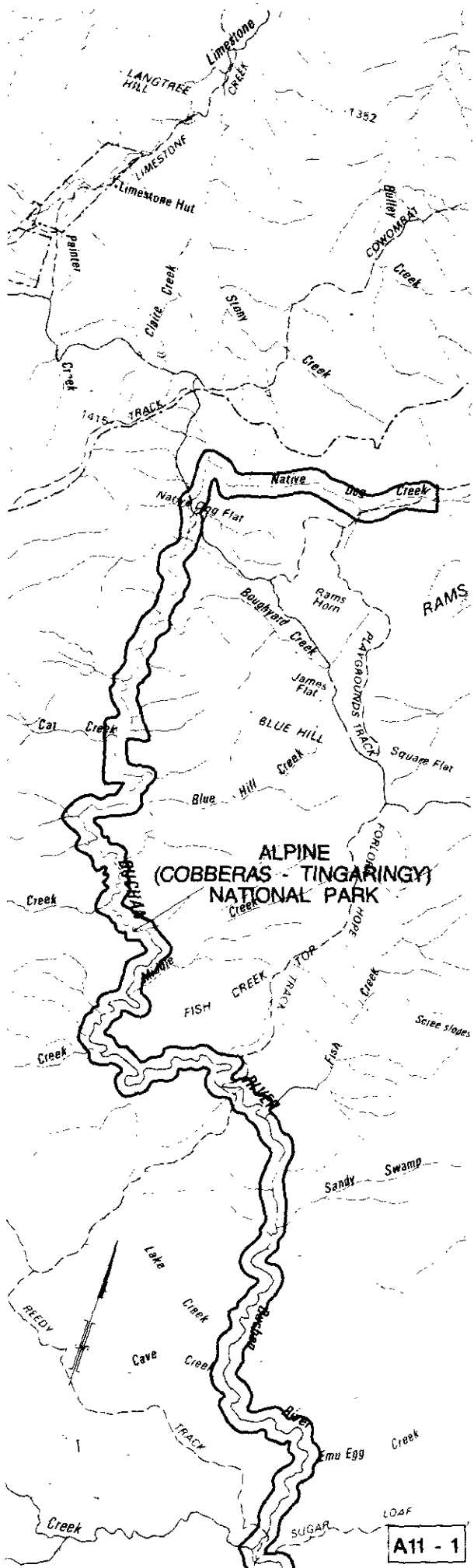


A9-4

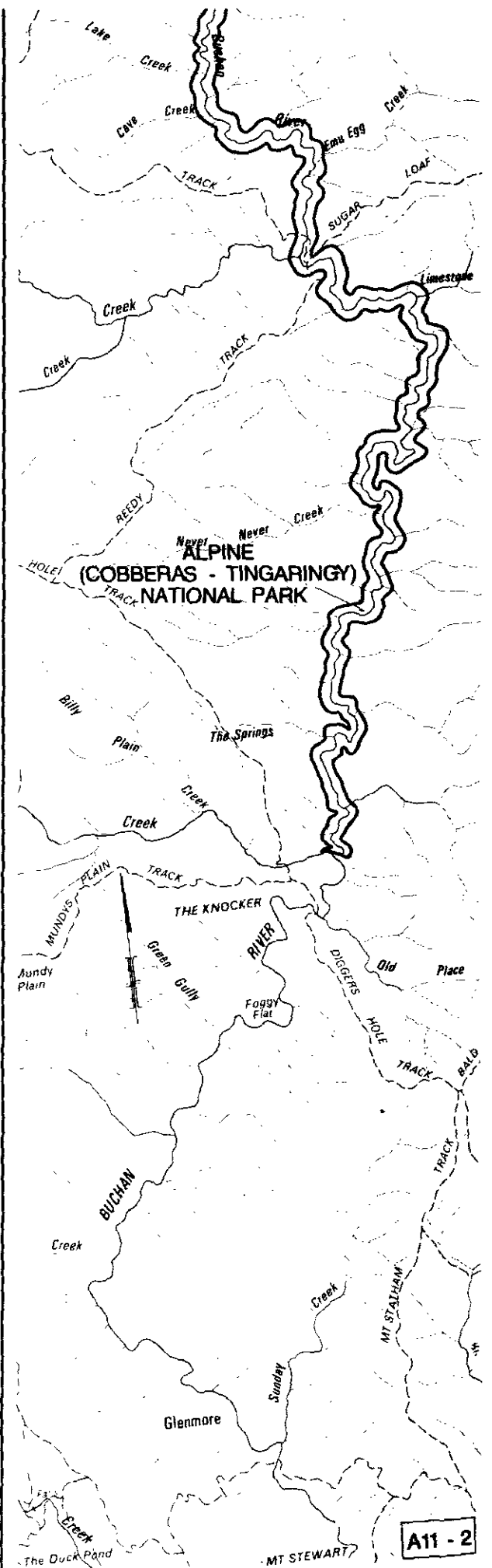
A9 - SNOWY RIVER
Scale 1:100 000



A10 - SUGGAN BUGGAN AND BERRIMA RIVERS
 Scale 1:100 000



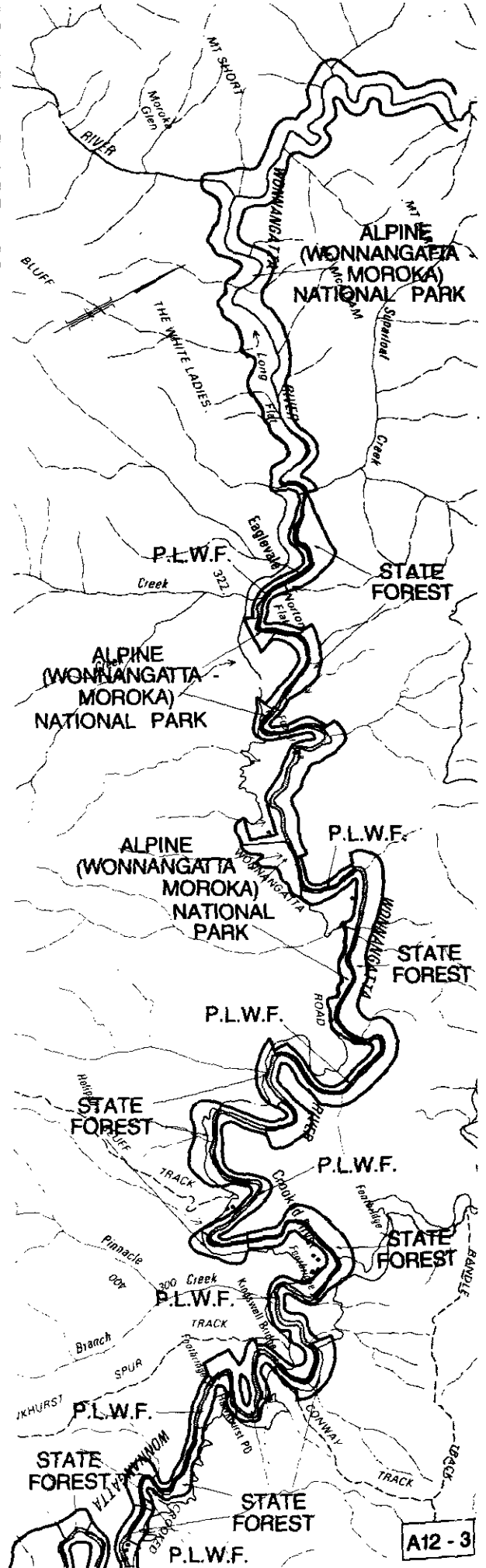
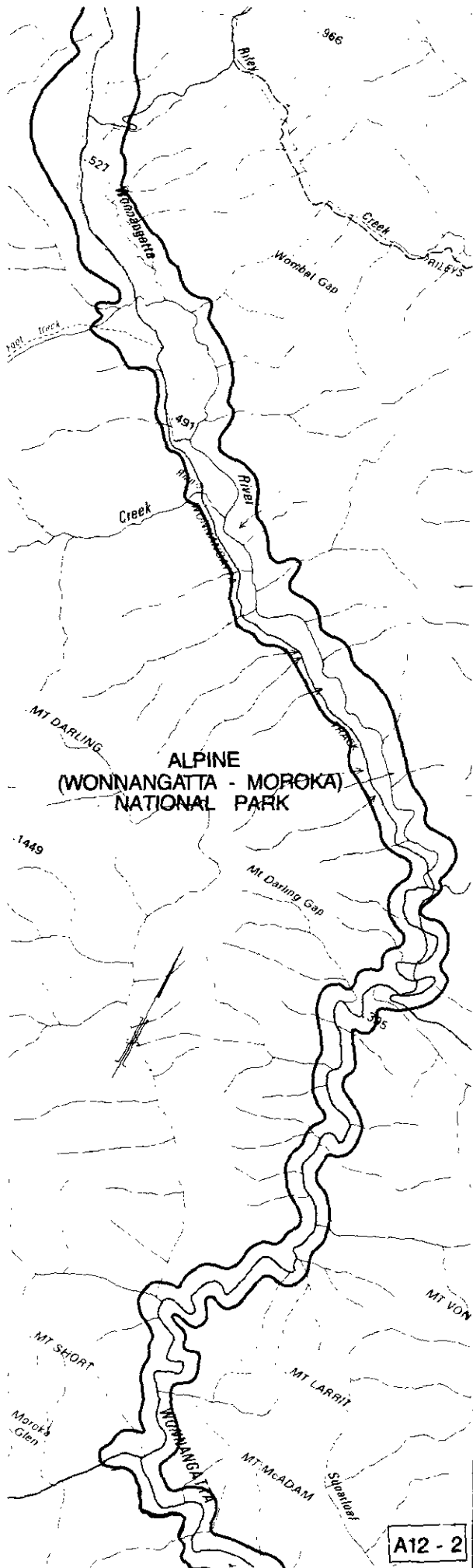
A11 - 1



A11 - 2

A11 - UPPER BUCHAN RIVER
Scale 1:100 000

MAP A11

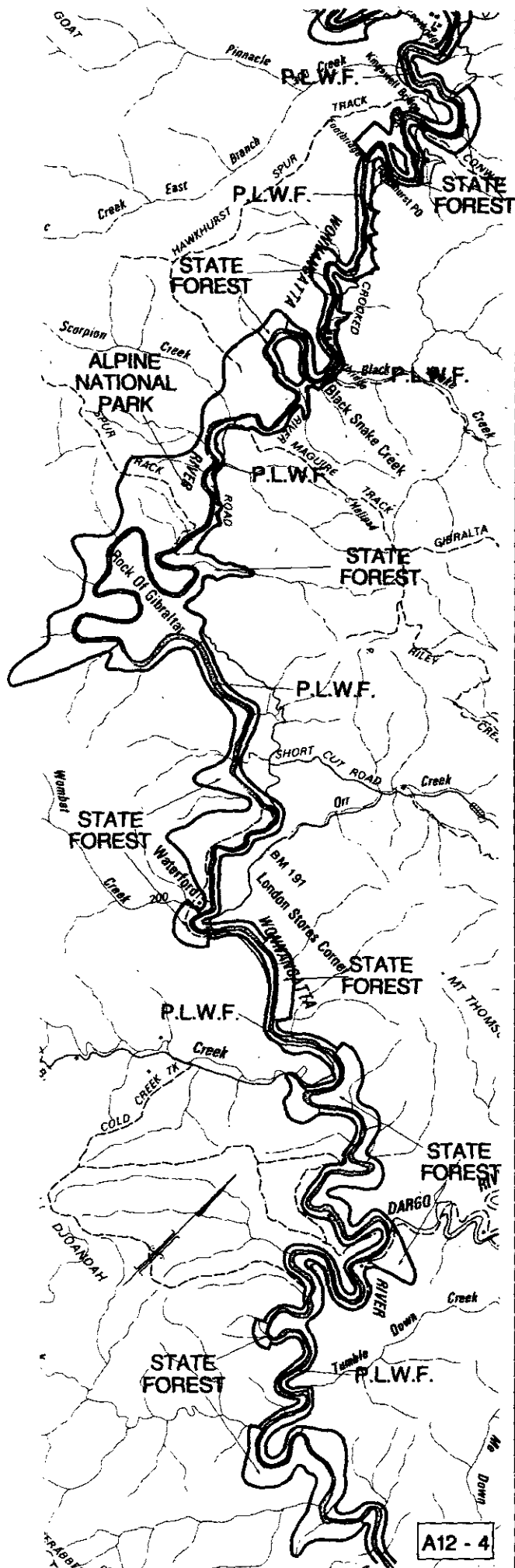


A12 - MITCHELL AND WONNANGATTA RIVERS

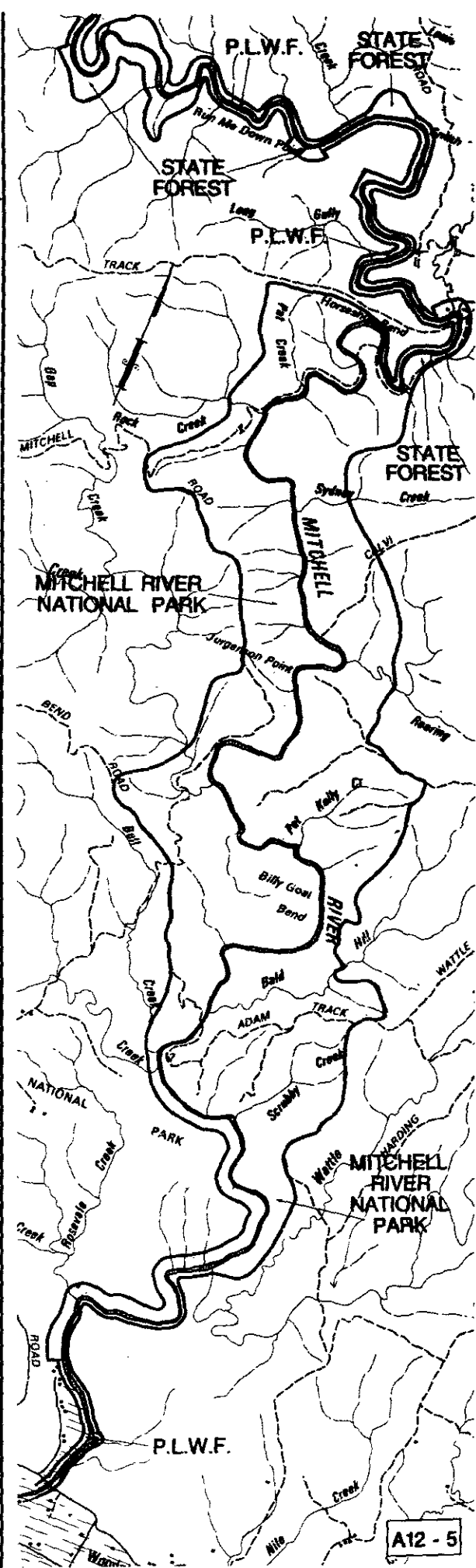
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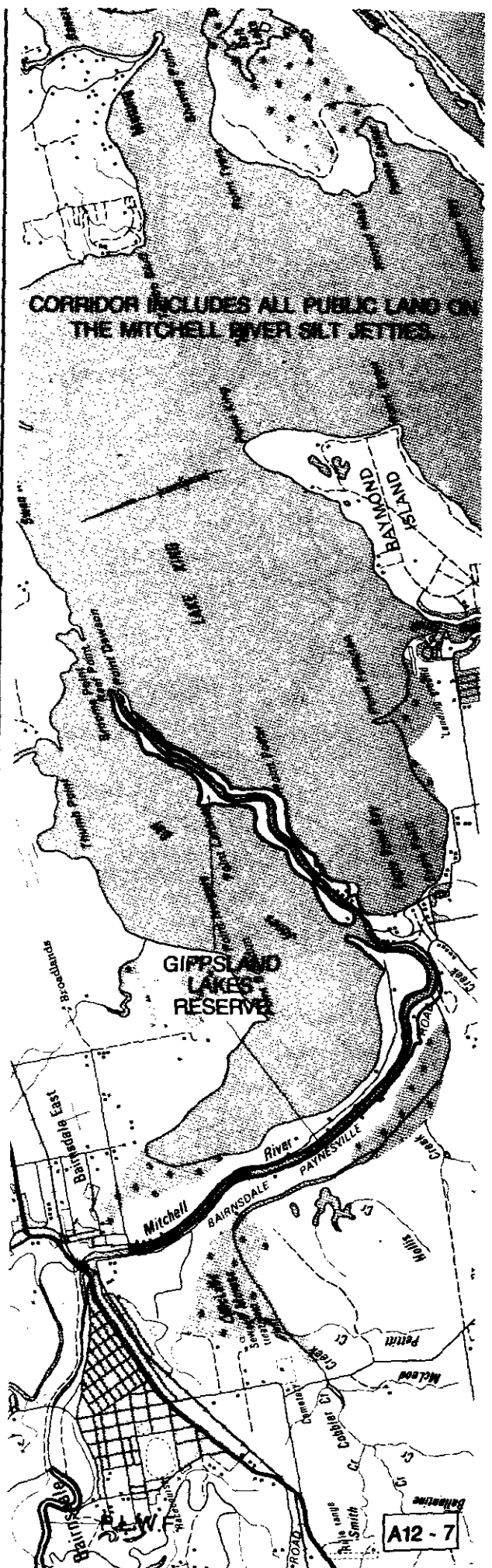
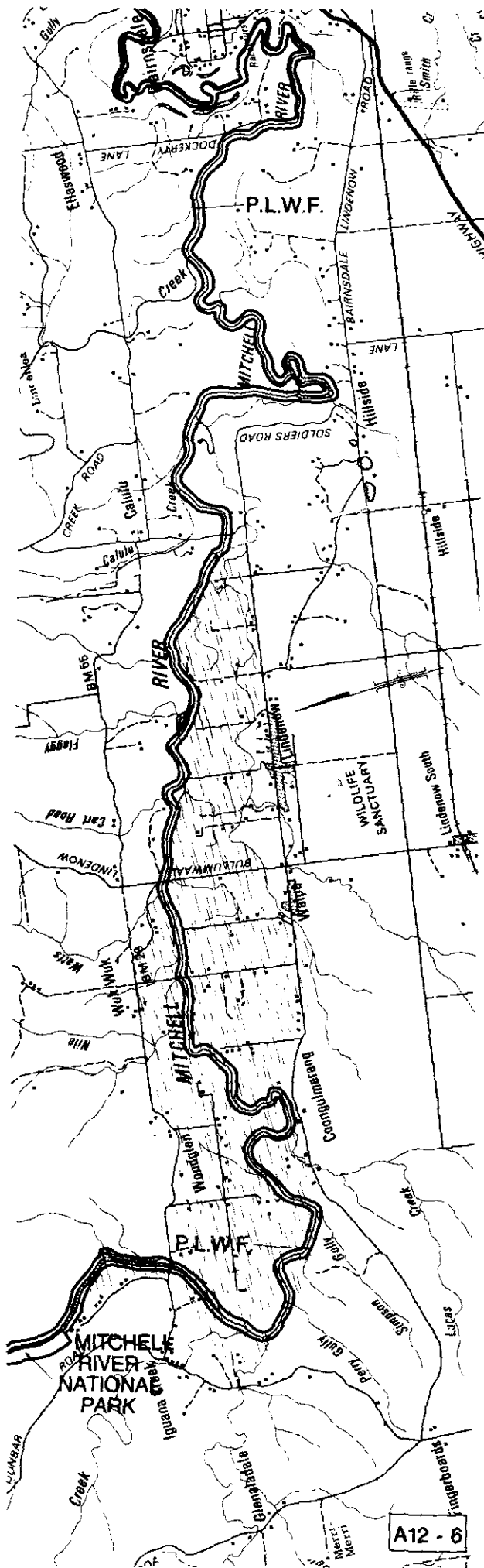
A12 - 4



A12 - 5

A12 - MITCHELL AND WONNANGATTA RIVERS
Scale 1:100 000

MAP A12

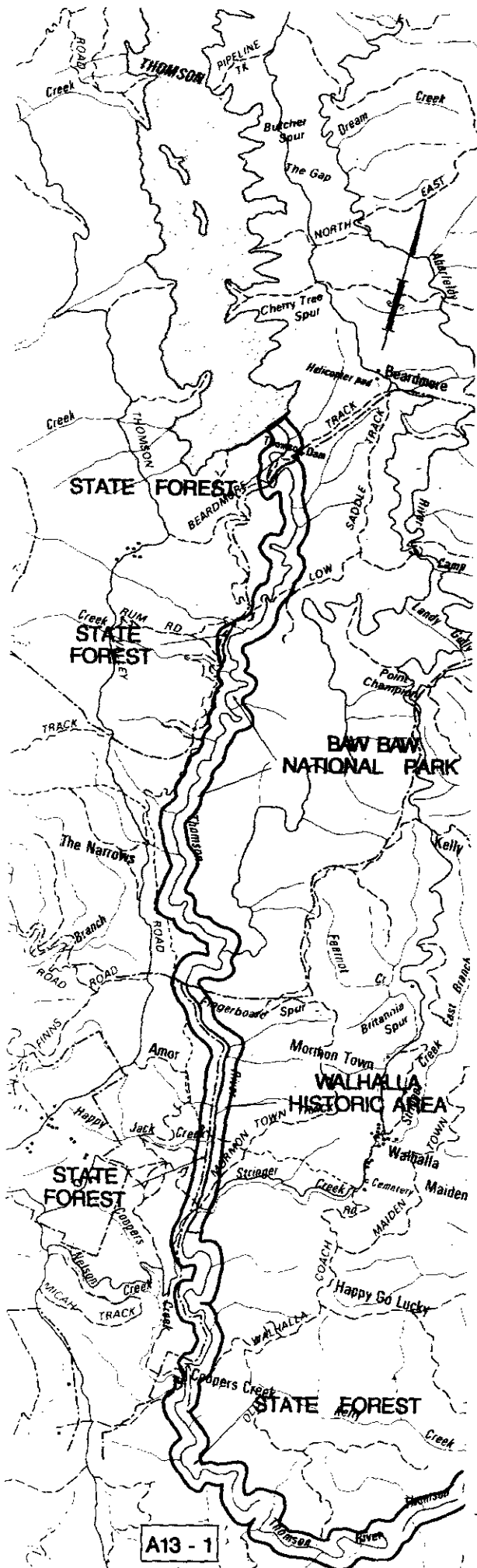


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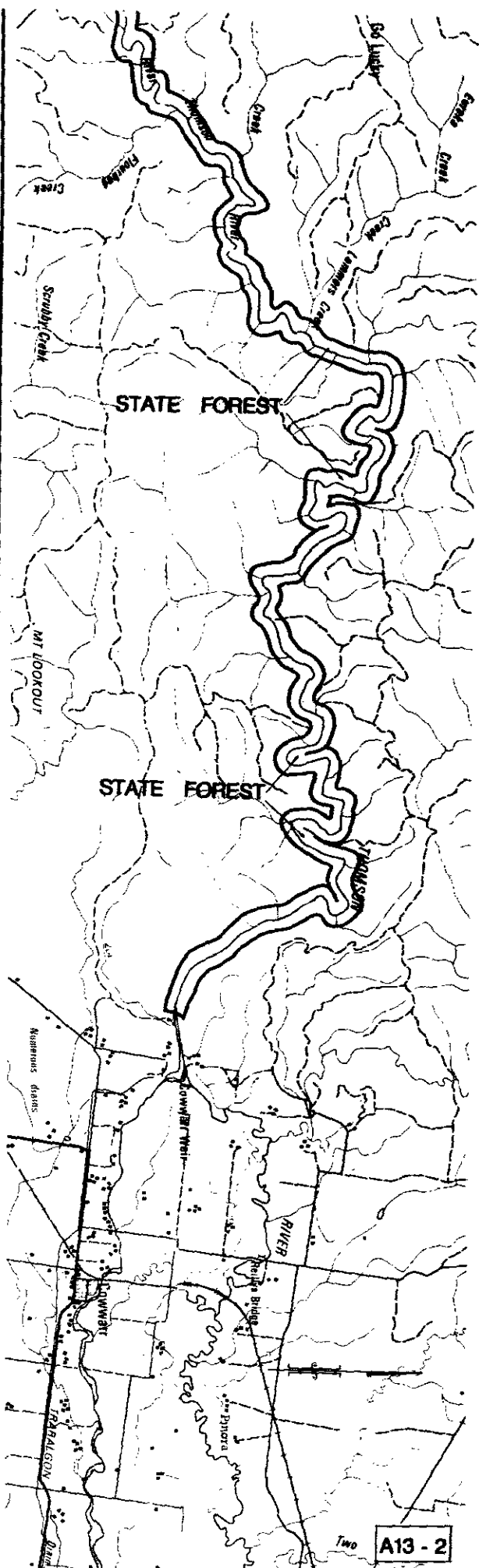
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MAP A12

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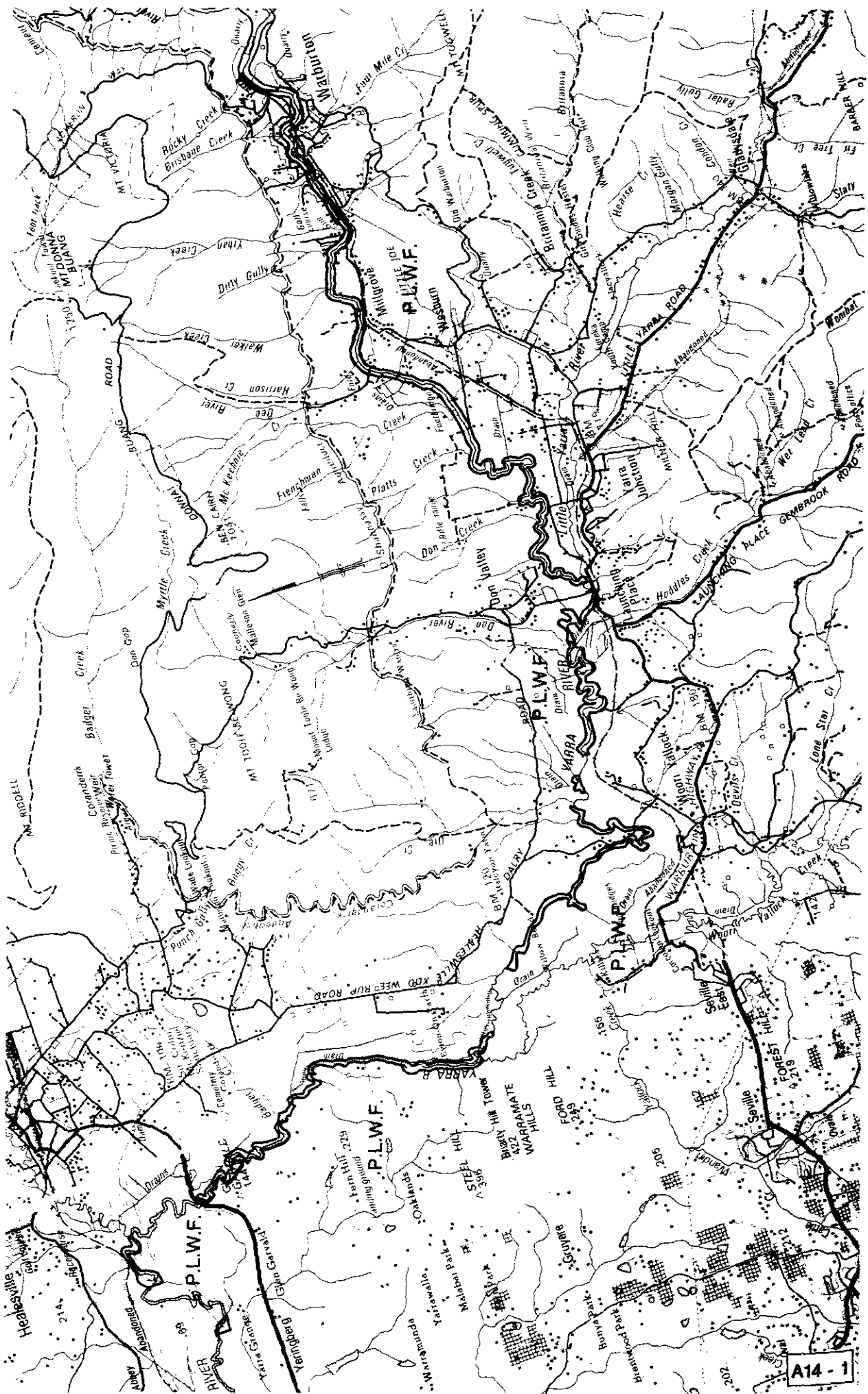


A13 - 1



Two A13 - 2

A13 - THOMSON RIVER
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A14 - YARRA RIVER

Scale 1:100 000

MAP A14

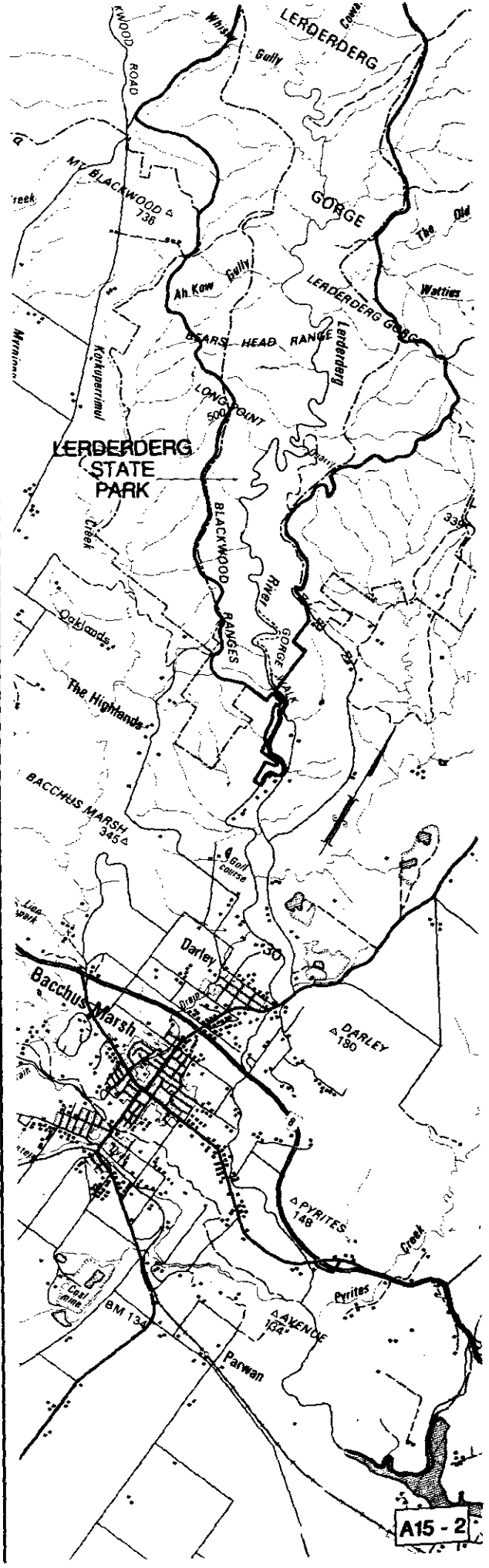
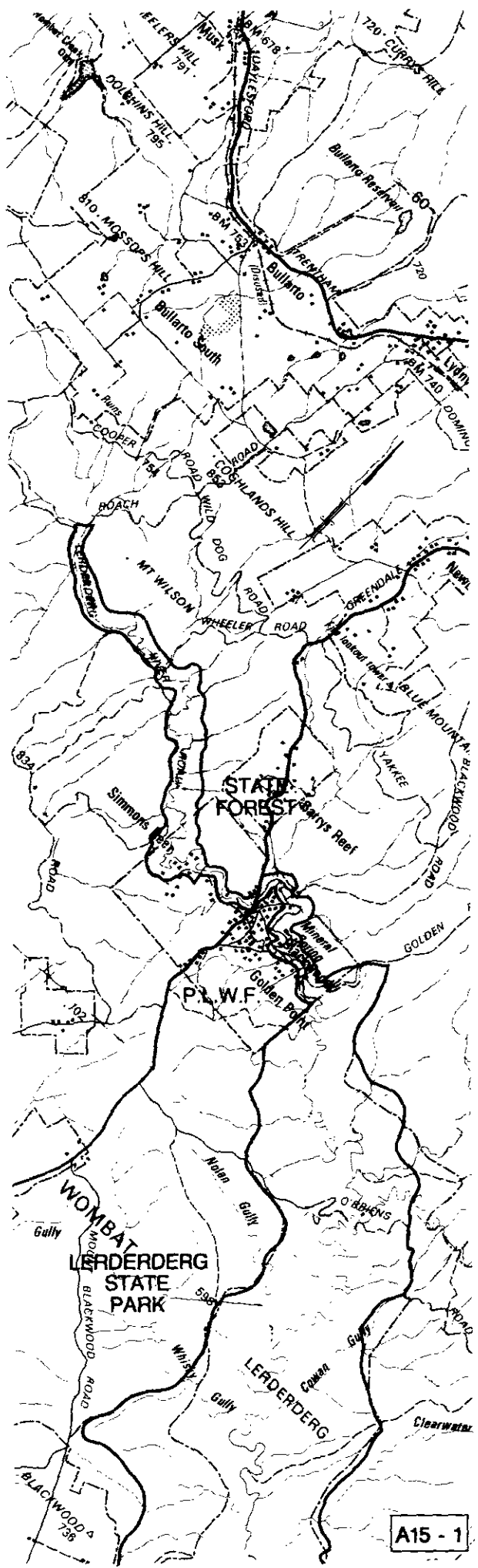


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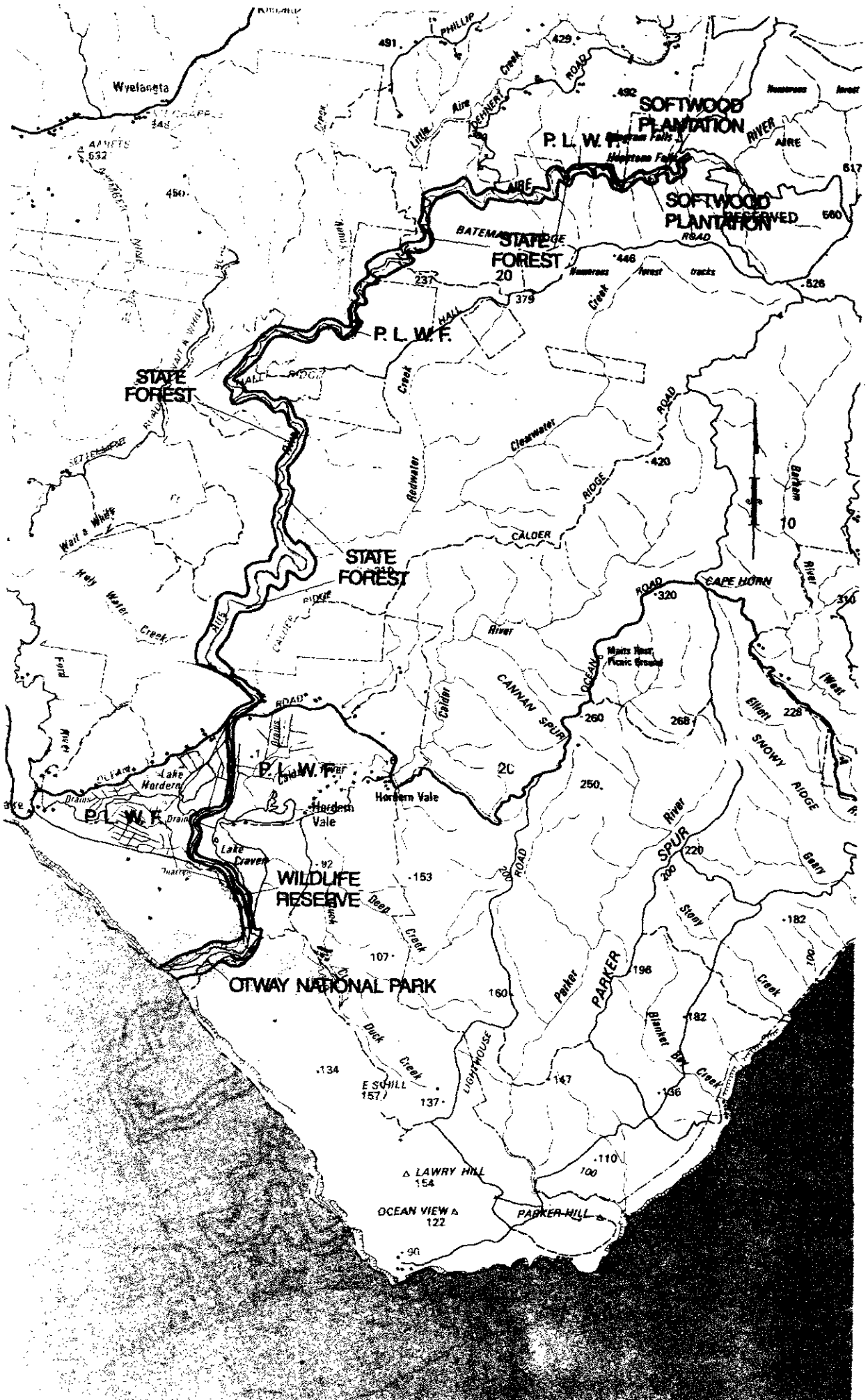
A14 - YARRA RIVER

Scale 1:100 000

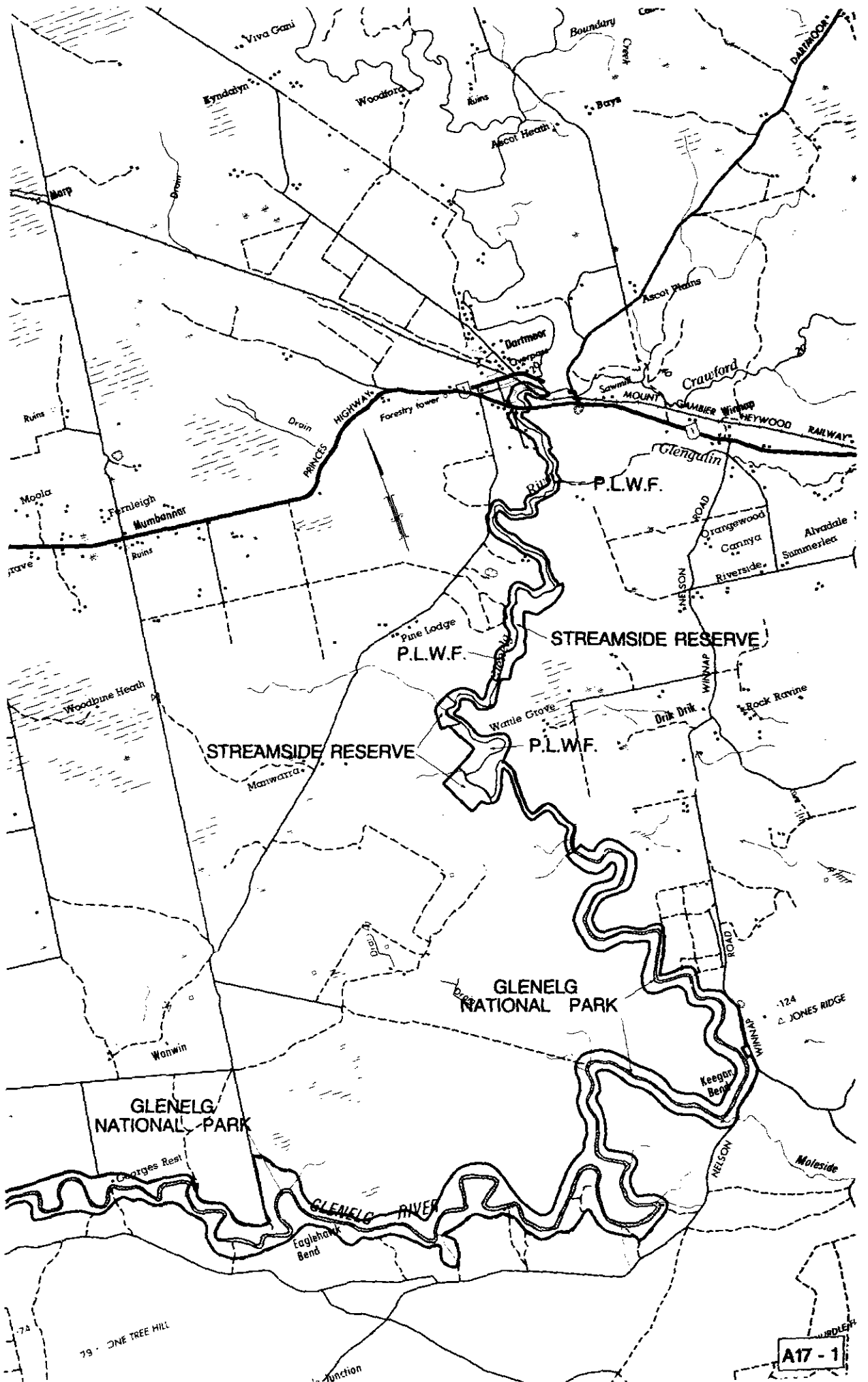
(Cont.) **MAP A14**



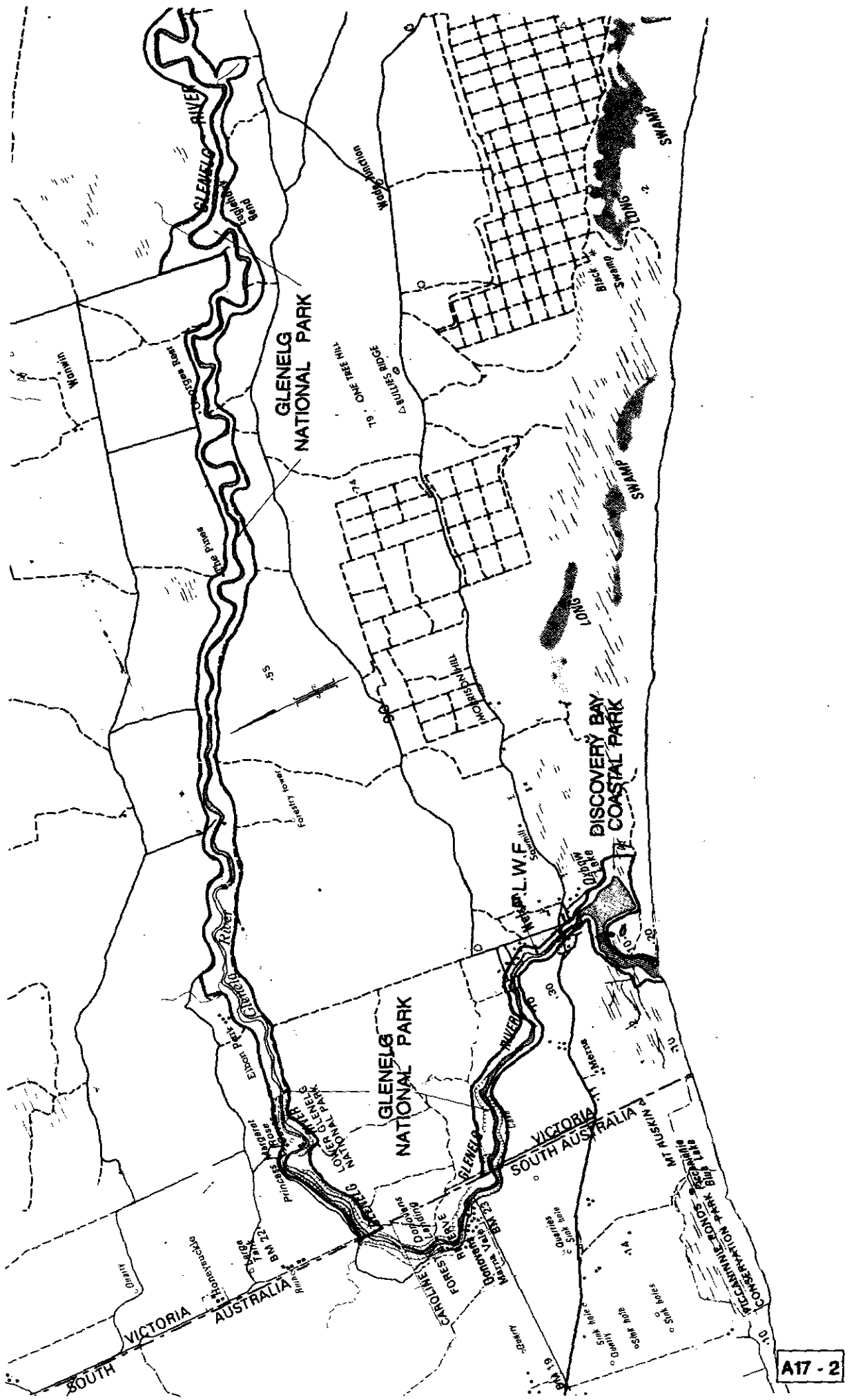
A15 - LERDERBERG RIVER
Scale 1:100 000



A16 - AIRE RIVER
Scale 1:100 000



A17 GLENELG RIVER
 Scale 1:100 000



A17 - 2

A17 - GLENELG RIVER
Scale 1:100 000

NOTES