

Integration Across Disciplines in the Living Murray: The Past And the Future Ecological Objectives

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Views expressed are those of the authors and not of the Murray–Darling Basin Commission

Abstract

The Murray–Darling Basin Commission was created by the governments of the Murray–Darling Basin to *promote and co-ordinate effective planning and management for the equitable, efficient and sustainable use of the water, land and other environmental resources of the Murray–Darling Basin*.

This paper discusses how an interdisciplinary analysis was undertaken in the Living Murray initiative (TLM), which is an important current policy initiative focussed towards achievement of a vision of *a healthy River Murray System, sustaining communities and preserving unique values*. The method to undertake the interdisciplinary analysis is described in this paper. A framework used to integrate and summarise the results of the integrated analysis is also presented. This interdisciplinary analysis was important input into one of the most important decisions in water management in Australia's history, the TLM First Step decision.

Interdisciplinary analysis to support future decision making will be undertaken via a new knowledge strategy that is briefly described in this paper.

INTRODUCTION

The Murray–Darling Basin covers an area of about one seventh of Australia. The Murray–Darling Basin Commission (the ‘Commission’) exists as a response to the need for integrated management of the Murray–Darling Basin at a governmental level. The peak decision making body is the Murray–Darling Basin Ministerial Council comprising ministers from the Australian Government, and the governments of Queensland, New South Wales, the Australian Capital Territory, Victoria and South Australia.



The Living Murray initiative (TLM) is one of the most significant policy initiatives of the Commission in its history of almost a century. TLM is of national significance, and is integrally linked to the National Water Initiative announced by the Council of Australian Governments in August 2003. TLM effectively involves the consideration of a number of ways to achieve ecological outcomes (including investment in the irrigation industry to change water sharing between consumptive use and the environment) in the context of considerable evidence of a decline in the health of the River Murray.

TLM requires integration of various types and at a range of scales as indicated below:

1. integration between government organisations (eg. decisions by the Commission and Ministerial Council are only taken on a unanimous basis);
2. integration between government organisations and the community;
3. integration between types of knowledge (eg. scientific knowledge and community knowledge, including Indigenous knowledge);
4. integration between rapid policy development processes and longer term research programs;
5. integration between disciplines of scientific knowledge (eg. hydrology, ecology, social impact analysis, and economics); and
6. integration between analytical approaches within types of scientific knowledge (eg. the hydrological modelling platform for the River Murray differs from that for each of the two main tributaries, the Goulburn and the Murrumbidgee rivers).

This paper addresses both past experiences in interdisciplinary analysis in TLM, and a new knowledge strategy to support implementation of TLM in the future.

THE PAST

Context

There has been considerable ecological analysis of the River Murray. The declining health of the River Murray and the fringing forests and wetlands has been highlighted by many ecologists in recent decades and has been a theme in many reports [such as the National Land and Water Resources Audit, *Snapshot of the Murray–Darling Basin River Condition* (2001), and reports of expert panels]. **Figure 1** is a summary of this ecological analysis at a system scale and indicates that the advice of pre-eminent ecologists is that the health of the River Murray system:

- no longer could be considered to be healthy;
 - continues to be in decline on average; but importantly
 - could be restored to ‘healthy’ with ‘major improvements to river management’.
- These major improvements were both structural and operational changes to flow management infrastructure (such as the installation of fishways, and increasing the quantity of fish habitat), and an increase in environmental water allocations that are

managed appropriately. Note that there is an important distinction between ‘healthy’ and ‘pristine or natural’ (say pre 1900), the latter being a considerably higher standard of ecological health that is not being targeted.

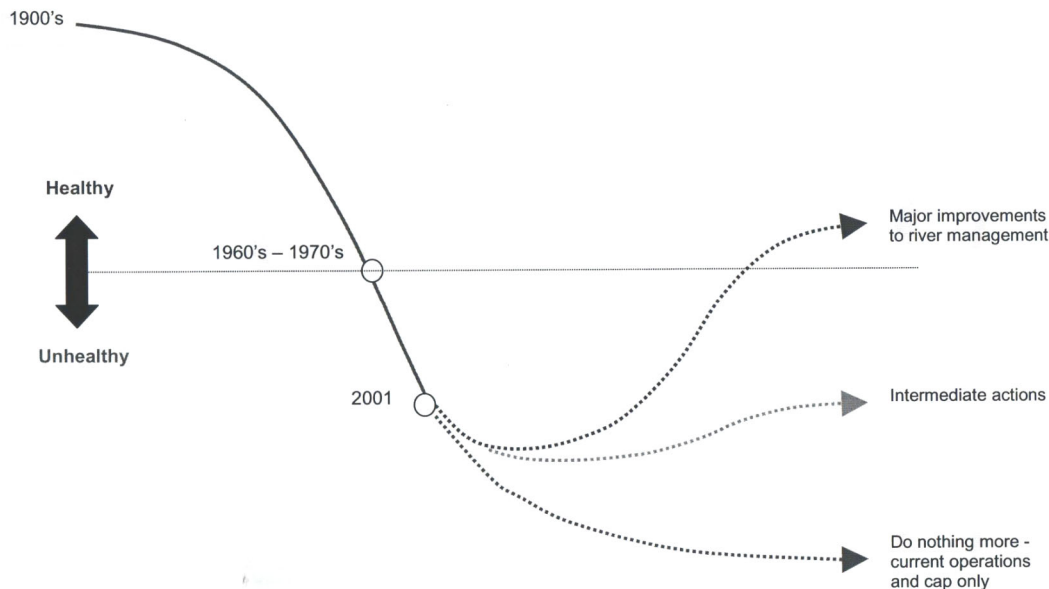


Figure 1. Conceptual model of the trend of health in the River Murray System (from the ERP report, Jones et al, 2002)

In the last decade, the Commission has undertaken a number of major initiatives to start to arrest this decline of river health including:

- the introduction of a Cap on diversions;
- the creation of a flexible environmental water account for the Barmah-Millewa Forest;
- the construction of fishways to allow the upstream migration of many species of native fish;
- the development of strategies on issues such as salinity management and native fish management; and
- the funding of ecological research, including that on the relationship between changes in flows and the associated ecological response.

At its April 2002 meeting, the Ministerial Council directed that further analysis of the impacts of recovering water for the environment was to be undertaken. Importantly, this analysis was to extend beyond the hydrological and ecological analysis that preceded it, into a more integrated analysis that included economic and social impact analysis. This paper provides a brief overview of the interdisciplinary analysis leading up to the Ministerial Council meeting on 14 November 2003, when it:

‘took a historic First Step decision to address the declining health of the River Murray system. The Council recognised that the health of the River Murray is important to maintain biodiversity and the health and economic success of the communities it supports.

The First Step marks the beginning of the Council's collective actions to return the River Murray to the status of a healthy working river'.

(The full Communiqué from this Ministerial Council meeting is provided at **Attachment A**).

How the interdisciplinary analysis was undertaken in TLM

Method

The focus of the phase of TLM leading up to the November 2003 Ministerial Council meeting was on the analysis to develop an understanding of the consequences of changing water sharing between consumptive use and the environment in TLM. In April 2002, Ministerial Council approved an investment program of \$150m over seven years to achieve ecological outcomes via structural and operational measures (eg. construction of fishways, increasing quantity of fish habitat in rivers). Importantly, this \$150m program includes innovations such as large mobile pumps to move water onto the floodplain or into wetlands during extremely dry sequences of years.

The primary driver to consider changing water sharing between consumptive use and the environment was evidence of the decline in health of the River Murray (**Figure 1**). The starting point for the integrated analysis was a set of ecological objectives at a number of internationally significant (eg. RAMSAR listed) sites along the River Murray (locations shown in **Figure 2**).



Figure 2. Significant ecological assets along the River Murray that are the focus of the First Step decision

At each significant ecological asset (eg. the Barmah Millewa Forest), the ecological outcomes (eg. achieve successful breeding of colonial waterbirds in at least three years in ten, and maintain healthy vegetation in at least 55% of the forest area—see **Attachment A**) were associated with flows:

- with an appropriate magnitude (eg. 550 GL/month);
- for an appropriate duration (eg. 4 months);
- at an appropriate time of year (eg. spring); and
- at a given frequency (eg. 3 years per decade).

Some of these significant ecological assets shown on **Figure 2** require increased flows in dry and wet years (eg. the Murray mouth, Coorong and Lower Lakes, and permanent wetlands within the Gunbower Forest). Other significant ecological assets require large flows in relatively wet years (eg. the Barmah-Millewa Forest and the Chowilla Floodplain), when water is relatively abundant and of lower value to much of the irrigation industry. The environmental water account(s) should ultimately provide a mix of water with a range of reliability of supply in a number of locations.

The characteristics (eg. location, reliability) of the flow required to achieve the ecological outcomes can be generally matched with the nature of existing water access rights (entitlements) by irrigators in the Basin. The development of other water products (eg. leases, options arrangements) that provide the irrigation industry with flexibility whilst providing water to the environment when needed will be explored in the longer term.

Environmental water allocations are changed through ‘water recovery’. As indicated in the Communique of the First Step decision (**Attachment A**), Ministerial Council has decided that water recovery will occur with an emphasis on voluntary and competitive approaches. Initially, there will be considerable emphasis on exploring the cost effectiveness of recovering water through engineering works such as water supply infrastructure improvement projects (eg. lining of sections of irrigation channels, construction of pipelines).

To allow analysis to proceed and to illustrate the scale of potential impacts associated with policy choices, assumptions on water recovery were made (eg. a reduction of the Cap on diversions). Then hydrological (computer) models of key tributaries were ran, and these outputs were inputs into a hydrological model of the River Murray. The outputs from these hydrological models in turn became inputs to:

- ecological models (eg. the Murray Flow Assessment Tool); and
- economic models (eg. the Water Policy Model).

Computer models do not exist for the social impacts associated with TLM (eg. Indigenous place meanings, non-indigenous place meanings, intrinsic environmental values, tourism and recreational values, and some consumptive water uses), and so other methods were used (eg. literature review, interviews).

A simplification of the stages in the interdisciplinary analysis is summarised in **Figure 3**. In reality, there were iterations and feedback loops within each stage.

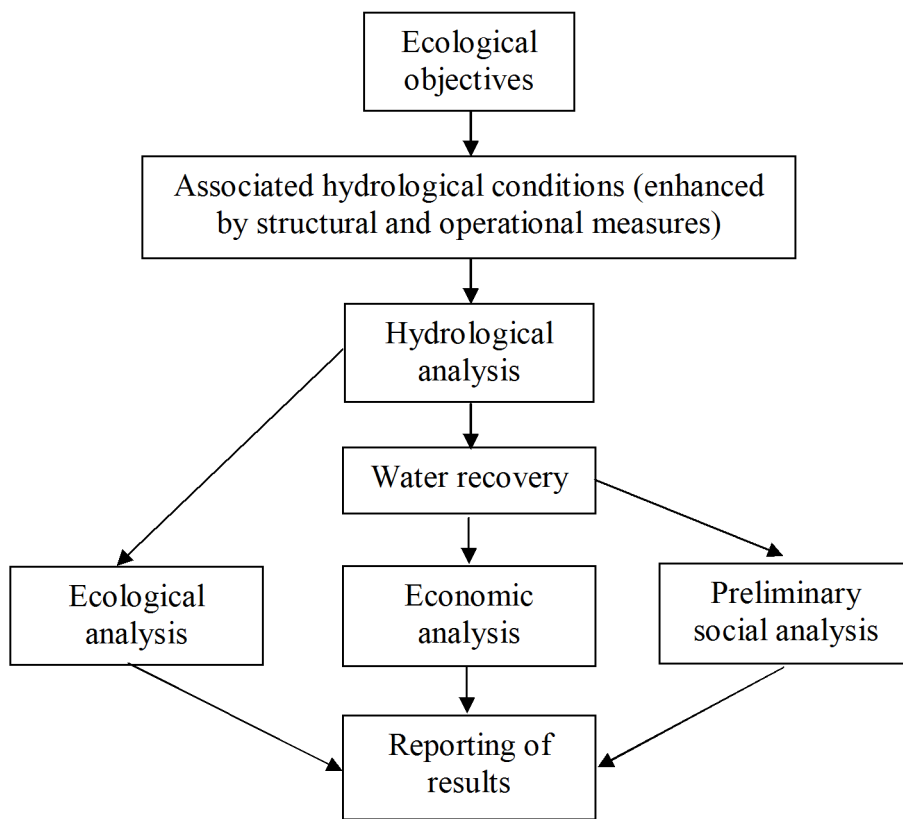


Figure 3. Simplification of the stages in the interdisciplinary analysis involving TLM

Consistent with the commitment of Ministerial Council to adaptive management, much of the analysis undertaken prior to the November 2003 Council meeting will be refined over the five years as improved knowledge about flow conditions to achieve ecological outcomes and water recovery opportunities become available.

Results

The hydrological, ecological, economic and social analyses produced a large quantity of technical information that needed to be synthesised into a form suited to the use of decision makers. The framework for integrating and communicating the analytical results is shown in **Figure 4**. Points to note are:

- the information summarised is changes associated with an assumed policy intervention rather than absolute values;
- a large quantity of interdisciplinary information corresponding to a water sharing choice was fitted on the one page, however the meaning of changes in several parameters was not intuitive and was explained elsewhere;
- error bounds are not shown—but different parameters have different error limits associated with them; and
- some results were qualitative (eg. social impacts) whilst some were quantitative (eg. ecological, economic analyses—which are strongly dependent on assumptions for water recovery).

Preliminary ecological objectives	<p>Barmah Millewa: To enhance forest, fish and wildlife values in the Barmah-Millewa Forest.</p> <p>Gunbower and Koondrook-Perricoota forests: To restore a mosaic of healthy vegetation across, and the productivity of, the Gunbower and Koondrook-Perricoota forests.</p> <p>Chowilla Floodplain: To maintain high biodiversity values of the Chowilla Floodplain.</p> <p>Murray mouth, Coorong and Lower Lakes: To create a healthier lower lakes, and a healthier Coorong estuarine environment with an open Murray mouth.</p> <p>River Murray Channel: To create a healthier River Murray environment.</p>					
Hydrology	Does not include Snowy	NSW Murray and lower Darling	Victoria Murray	Murrumbidgee River	Goulburn River	South Australia
<i>Assumed 'new environmental water' allocation (GL)</i>		A	B	C	D	E
<i>Structural and operational</i>	Assumes that the Implementation Program (\$150m over 7 years) will be completed. This includes construction of fishways from the sea to Lake Hume and of a channel to water the Koondrook-Perricoota forest, modification of the Barrages and implementation of an extended dredging regime around the Murray mouth.					
Environmental	Includes environmental benefits from the Implementation Program.					
<i>System</i>	Native fish ¹	Floodplain veg.	Wetland veg.	Waterbirds		
	Murray cod	River redgums	BG algae risk	Erosion	Mouth opening ²	
<i>Sites</i>	Barmah – Millewa	Gunbower and Koondrook–Perricoota ³	Chowilla Floodplain	Mouth, Coorong, Lower Lakes	Murrumbidgee River	Goulburn River
<i>Highlights</i>	<p>1 - Native fish: improved habitat conditions for flood spawners and for recruitment of estuarine fish, and benefits due to fishways. 2 - Reduced risk of Murray mouth opening due to the increase in entitlement to SA. 3 - Most of ecological benefits in the Gunbower and Koondrook-Perricoota forests would result from regulated flows into these forests using channels from Torrumbarry Weir pool.</p>					
Economics	Agriculture ⁴	Salinity	Tourism	Hydro-electricity	Environmental value	Flow on ⁵
<i>Highlights</i>	<p>Partial analysis. 4 - Proportionate fall in water use about 6%, proportionate reduction in gross margin of less than 2%. Based on assumptions. Largely offset by investment, and applying using voluntary and competitive approaches to water recovery. 5 - Potential negative flow on effects from reduced agricultural production. Potential positive flow on effects would result in investment in other areas, such as water use efficiency technology and ecotourism.</p>					
Social	Indigenous values	Non-indigenous place meanings	Intrinsic env. value	Recreation	Irrigators	Flooding
<i>Highlights</i>	Social impacts on irrigators likely to be strongly dependent on the instrument used for water sourcing, particularly whether it is voluntary and gradual, and offers choice and flexibility. Green shading indicates a positive impact: 'substantial benefit' was not distinguished from 'some benefit'.					
Legend	Substantial benefit		Substantial cost or disbenefit			
	Some benefit		Some cost or disbenefit			
	Unknown, neutral, or untested		No significant change			

Figure 4. Indication of how interdisciplinary results were reported in TLM (Some quantitative results have been removed here and results do not necessarily correspond to the First Step decision. This Figure is more meaningful when printed in colour)

Some concluding comments on past analysis

The information produced as a result of the interdisciplinary analysis described was part of the basis of one of the most significant water resources management decisions in Australia's history: the TLM First Step decision (**Attachment 1**).

At the outset of the analysis, it was assumed that the senior decision makers required a comprehensive, integrated “triple-bottom line” output to help them decide whether to allocate funding to acquire water for environmental water allocations. Between

November 2002 until November 2003, the Commission office managed contracts with over 100 analysts, and invested over \$1 million in knowledge generation, spanning the disciplines of hydrology, ecology, economics and social impact assessment. Within the time available, there was a large effort within each discipline and some effort to develop understandings between disciplines. This analysis was synthesised in about two thousand pages of final source reports that were shared with partner governments.

When informing a policy decision, there is a balance between how much effort should be made in producing technical information (the outputs) and how much should be spent in communicating and exploring the results (the process). In the phase of TLM leading up to the First Step decision, and certainly relative to much of the Commission's history involving large amount of work over long periods by inter-jurisdictional committees, the emphasis in this case was (perhaps too much at times) on outputs. However, the detailed analysis did provide confidence and was communicated to senior decision makers through advisers.

The point here is that there is a need to tailor the supply of information to meet the demands of senior decision makers and their advisers, and not to necessarily strive for the 'big bang' comprehensive integrated analysis that may provide a little more confidence at the risk of obscuring the key messages.

As a final remark, it is important to be aware of the different perspectives that representatives of different disciplines are likely to bring to 'the interdisciplinary table'. For example:

- economists tend to focus more on efficiency at a regional or greater scale, on what people are likely to do if they are profit maximising, and on long-run outcomes (not focussing so much on the perceptions associated with, and issues of, adjustment);
- social scientists tend to focus more on distributional issues, including very local issues in the short-run, and on beliefs and perceptions. Qualitative and procedural issues are a much greater focus of social scientists than economists; and
- environmental scientists focus on environmental outcomes in the long-run, with often relatively little weighting for social, economic, and political implications or constraints.

Therefore, consideration needs to be given as to how to faithfully reflect the different perspectives from different disciplines into an integrated picture of sufficient detail for decision makers.

THE FUTURE

The recent experience in undertaking interdisciplinary analysis and integration more generally in TLM will be drawn on in further in developing a work plan to implement the First Step. Moving into the implementation phase of TLM, there are three pillars of TLM:

- environmental management (including hydrology and ecology);

- water recovery (including economics and social impact analysis); and
- community consultation and communications (including social science at a larger scale encompassing a broader array of issues, Indigenous and community knowledge, and communications).

A knowledge strategy to support the next five years' implementation of the Living Murray is currently being developed in a new partnership between MDBC, research providers and other providers. CSIRO's flagship program "Water for a Healthy Country" is concentrating new research effort on the Murray–Darling Basin, and the CRC for Freshwater Ecology and the CRC for Catchment Hydrology, have strong capacity in water research. Land and Water Australia are a strategic partner and other knowledge providers, such as state agencies and local and indigenous communities, will also be invited to be involved in the integration of knowledge in TLM.

While the knowledge strategy is still being shaped, it is clear that increasingly integrated approaches will be essential during the implementation of the TLM First Step. Research that integrates across disciplines and that integrates various kinds of knowledge will be prominent in the program.

One such proposal for integrated research comes from the "Water Accounts and Benefits" project in CSIRO's "Water for a Healthy Country" program. Water provides a wide range of benefits to people and to ecosystems, but we don't have a full predictive understanding of where the benefits are located and their relationship to each other. A quantitative understanding of water benefits will enable us to seek synergies and opportunities for water sharing that results in a benefit for our country in ways not apparent when the focus is on partial analyses with limited linkages between disciplines.

CONCLUSION

This paper described how an interdisciplinary analysis was undertaken in the Living Murray initiative (TLM), which is an important current policy initiative focussed towards achievement of a vision of *a healthy River Murray System, sustaining communities and preserving unique values*. The method to undertake interdisciplinary analysis was described in this paper. A framework used to integrate and summarise the results of the integrated analysis was also presented. It is important that the supply of knowledge from integrated analyses is tailored to the demand for it from decision makers and their advisers.

To more effectively support interdisciplinary analysis into the future of TLM, a new knowledge strategy is being created, and was briefly described in this paper.

ACKNOWLEDGEMENTS

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REFERENCE

Jones, G., Hillman, T., Kingsford, R., McMahon, T., Walker, K., Arthington, A., Whittington, J. and Cartwright, S. 2002. *Independent report of the Expert Reference Panel on environmental flows and water quality requirements for the River Murray System*. Cooperative Research Centre for Freshwater Hydrology. Murray–Darling Basin Ministerial Council, Canberra, A.C.T. URL: <http://www.mdbc.gov.au/TLM/pdf/ERPreport.pdf> (accessed 28 Feb 2003).

ATTACHMENT A

Murray–Darling Basin Ministerial Council Communiqué 14 November 2003

The Murray-Darling Basin Ministerial Council today took a historic First Step decision to address the declining health of the River Murray system. The Council recognised that the health of the River Murray is important to maintain biodiversity and the health and economic success of the communities it supports. The First Step marks the beginning of the Council's collective actions to return the River Murray to the status of a healthy working river.

In mid 2002 Council established its Living Murray initiative in response to substantial evidence that the River Murray system is degraded, and its concern that this degradation threatens the Basin's agricultural industries, communities, natural and cultural values, and national prosperity.

Council has built its knowledge base on these issues. It has also engaged the community to promote discussion of the issues and increase mutual understanding of them.

The key elements of the First Step decision are:

- an initial focus on maximising environmental benefits for six significant ecological assets — Barmah-Millewa Forest; Gunbower and Koondrook-Perricoota Forests; Hattah Lakes; Chowilla Floodplain (including Lindsay-Wallpolla); the Murray Mouth, Coorong and Lower Lakes; and the River Murray channel – locations are shown **Attachment A**;
- specific ecological objectives and outcomes for each significant asset as set out in **Attachment B**, including:
 - *Barmah-Millewa*: Achieve successful breeding of colonial waterbirds in at least three years in ten, and maintain healthy vegetation in at least 55% of the forest area;
 - *Gunbower, Koondrook-Perricoota*: Reinstate at least 80% of permanent and semi-permanent wetlands and maintain at least 30% of total river red gum forest area;
 - *Hattah Lakes*: Restore the aquatic vegetation zone around at least 50% of the lakes and increase successful breeding events of threatened colonial water birds and native fish;
 - *Chowilla (including Lindsay-Wallpolla)*: Water high value wetlands and maintain health of the current area of river redgums, and at least 20% of the original area of black box;
 - *Murray Mouth, Coorong and Lower Lakes*: Keep the Murray mouth open, provide more frequent conditions for estuarine fish spawning, and enhance migratory wading bird habitat in the Lower Lakes; and
 - *River Murray channel*: Enhancing native fish recruitment and habitat, and maintain current levels of channel stability;
- to achieve these objectives through:
 - recovered water being built up over a period of five years to an estimated average 500 GL/ year of 'new' water after five years, with the volume to be used each year depending on a range of factors such as droughts and flood events;
 - funding commencing from 1 July 2004, subject to finalisation of a COAG intergovernmental agreement;

- this funding to be available under the \$500 million to address water over-allocation in the Basin announced by the Council of Australian Governments (COAG), that can minimise adverse social and economic impacts; and
- realignment of the previously announced capital works program of an additional \$150 million over 7 years to effectively manage the water to the six significant ecological assets;
- an adaptive management approach (“learning by doing”);
- a commitment to identifying opportunities for Indigenous partnerships in planning and management under The Living Murray; and
- continuing work on appropriate further actions required to restore the River Murray system to healthy working condition, with longer-term actions building on the First Step to be presented to Council in October 2004.

The Council agreed that:

- the First Step for the Living Murray and the foundation work behind it will be a major input to the COAG intergovernmental agreement in respect of targeting available funds, and the institutional arrangements in the National Water Initiative, including water recovery, environmental management, water markets, the operative date for accounting for ‘new’ water, and monitoring and reporting;
- an environmental water account will be established that includes existing environmental flow allocations, backdated to the 1993/94 Cap on diversions and the ‘new’ water for the First Step;
- the water for this First Step will come from a matrix of options with a priority for on-farm initiatives, efficiency gains, infrastructure improvements and rationalisation, and market based approaches, and purchase of water from willing sellers, rather than by way of compulsory acquisition; and
- as part of the First Step, there is a comprehensive, responsive and accountable community engagement and communications strategy that has the following characteristics:
 - informing communities on the nature and rationale of the First Step, the links to the National Water Initiative (NWI) and the intergovernmental agreement on funding;
 - seeking community input to the elements of the First Step, including the environmental objectives to be targeted, where the water will come from and how it will be recovered and managed in a manner consistent with the NWI; and
 - involving communities in planning and arrangements for implementing the First Step.

The Council directed the Commission:

- in consultation with the Community Advisory Committee to develop this community engagement and communications strategy using independent expertise if required for consideration by Council by 15 December 2003;
- to prepare and implement a work plan to give effect to the First Step that:
 - refines the elements of the First Step based on the outcomes of the community engagement and communications strategy;
 - assists the development of the intergovernmental agreements;
 - develops a robust monitoring, reporting and accountability framework;

- further analyses the cost-effectiveness and social and economic impacts of investment in the various options for water recovery; and
- includes timelines and identifies actions and responsibilities in the lead up to the next meeting of Council; and
- to prepare a proposal for Council and COAG for a range of options for management of water recovery and the environmental water account, including the State and Commission roles.

Interstate Water Trade

The Council recognised that expansion of permanent water trade, including interstate, is critical for achievement of the objectives of the National Water Initiative within the Murray-Darling Basin.

It further noted that the Commission is assembling a package of measures and will progressively report progress to Council and to the Senior Officials Group on Water to the Council of Australian Governments.

Sustainable Rivers Audit

The Council noted the successful completion of the Pilot Sustainable Rivers Audit (SRA), which has developed the first cross border comparable river health assessment covering the Lower Murray, Ovens, Lachlan and Condamine catchments and assessing a suite of biological and physical indicators.

They also agreed in-principle to implement the SRA subject to resolution of funding arrangements and directed the Commission to develop a funding package and delivery arrangements for implementation of the Audit in 2004/05 financial year, for consideration at the next meeting of Council.

Community Advisory Committee

Following a review of the Community Advisory Committee, Council agreed to a revised structure and operational arrangements to commence from March 2004. The CAC will now comprise 21 members, including an independent Chairman, two Indigenous members and 13 members nominated by the States and the ACT, covering geographic areas across the Basin. There will also be five skills based members with expertise in local government, environment, dryland farming, irrigation industry and urban. Across the membership there will be the following range of skills: governance, natural resource planning and management, community engagement, business, scientific expertise, social and economic expertise, conflict resolution and leadership.

Attachments:

- A. Map Showing the Location of the six Significant Ecological Assets for The Living Murray.
- B. Significant Ecological Assets for a First Step to Achieving a Healthier River Murray.

Attachment A

MAP SHOWING THE LOCATION OF THE SIX SIGNIFICANT ECOLOGICAL ASSETS FOR THE LIVING MURRAY



Attachment B

Significant Ecological Assets for a First Step to Achieving a Healthier River Murray

Initial Asset	Description of Significant Ecological Asset	Interim ecological objectives, and expected outcomes
Barmah–Millewa Forest	<p>The Barmah–Millewa Forest covers an area over 66,000 hectares. The Barmah Forest is a Wetland of International Importance under the Ramsar Convention and the Millewa Forest is included in the NSW Central Murray State Forests Ramsar site.</p> <p>The Barmah–Millewa Forest provides habitat for numerous threatened plant and animal species, including birds, fish and reptiles, and supports colonies of breeding waterbirds during appropriate seasonal conditions.</p> <p>There are important and significant land associations and connections to the Barmah–Millewa Forest amongst Indigenous peoples and the broader community.</p>	<p>Enhance forest, fish and wildlife values.</p> <ul style="list-style-type: none"> • Successful breeding of thousands of colonial waterbirds in at least three years in ten. • Healthy vegetation in at least 55% of the area of the forest (including virtually all of the Giant Rush, Moira Grass, River red gum forest, and some River red gum woodland).
Gunbower and Koondrook–Perricoota Forests	<p>The Gunbower and Koondrook–Perricoota Forests have a combined area of about 50,000 hectares.</p> <p>The Gunbower Forest is designated as a Wetland of International Importance under the Ramsar Convention and the Koondrook and Perricoota Forests are included in the NSW Central Murray State Forests Ramsar site.</p> <p>These sites are important breeding areas for colonial waterbirds, contain threatened plant and animal species, and are visited by migratory birds listed under international treaties with Japan (JAMBA) and China (CAMBA).</p> <p>The forest has strong social and cultural meaning for Indigenous groups of the region.</p>	<p>Maintain and restore a mosaic of healthy floodplain communities.</p> <ul style="list-style-type: none"> • 80% of permanent and semi-permanent wetlands in healthy condition. • 30% of River red gum forest in healthy condition. • Successful breeding of thousands of colonial waterbirds in at least three years in ten. • Healthy populations of resident native fish in wetlands.
Hattah Lakes	<p>Hattah Lakes is part of the 48,000 hectare Hattah-Kulkyne National Park which contains 17 freshwater lakes. It is a very valuable site, with international, national and State significance.</p> <p>It is part of a Biosphere Reserve and is Ramsar listed, used by migratory birds listed under the JAMBA, CAMBA and Bonn conventions.</p> <p>It has a significantly diverse range of wetlands in one system (i.e., semi-permanent, ephemeral) which means it can support a very diverse array of flora and fauna and has good red gum communities.</p>	<ul style="list-style-type: none"> • Restore healthy examples of all original wetland and floodplain communities • Restore the aquatic vegetation zone in and around at least 50% of the lakes to increase fish and bird breeding and survival • Increase successful breeding events of threatened colonial water birds to at least two in ten years (Spoonbills, Little, Intermediate and Great egrets, Night herons and Bitterns). • Increase the population size of and breeding events of the endangered Murray Hardyhead, Australian smelt, Gudgeons and other wetland fish

Initial Asset	Description of Significant Ecological Asset	Interim ecological objectives, and expected outcomes
<p>Chowilla Floodplain (including the Lindsay–Wallpolla system)</p>	<p>Chowilla Floodplain has an area of 17,700 hectares and is one of the last remaining parts of the lower Murray floodplain that has not been used for irrigation. It retains much of the area's natural character and attributes.</p> <p>It is part of the South Australian Riverland area which is designated as a Wetland of International Importance under the Ramsar Convention, and is also recognised as being nationally significant.</p> <p>It has a high diversity of vegetation communities and contains wetlands in a semi-arid environment.</p> <p>The Lindsay–Wallpolla floodplains comprise almost 20,000 hectares of floodplain with a high diversity of vegetation communities and native fish populations, and support many species of threatened biota. Lindsay Island is listed as a wetland of National significance.</p>	<p>Maintain high biodiversity values of the Chowilla Floodplain:</p> <ul style="list-style-type: none"> • High value wetlands maintained. • Current area of River red gum maintained. • At least 20% of the original area of Black box vegetation maintained.
<p>Murray Mouth, Coorong and Lower Lakes</p>	<p>The Murray Mouth, Coorong and Lower Lakes, covering an area of about 140,000 hectares, are nationally significant wetland areas also recognised as being of international importance under the Ramsar Convention.</p> <p>It is one of the ten major areas for large concentrations of waders in Australia, and one of the few south of the Tropic of Capricorn.</p> <p>Thirty-three of the bird species present in the area are listed under international treaties.</p> <p>With some 78 species of marine and freshwater fish inhabiting the area it is an important nursery and feeding area for key commercial and non-commercial fish species.</p> <p>The Coorong, which is 140 km in length, has been ranked within the top six waterbird sites in Australia based on the diversity and abundance of species found there.</p> <p>The area represents significant intrinsic value for the broader community and has strong spiritual and cultural meaning for Indigenous peoples.</p>	<p>A healthier lower lakes and Coorong estuarine environment.</p> <ul style="list-style-type: none"> • Open Murray mouth. • More frequent estuarine fish spawning. • Enhanced migratory wader bird habitat in the Lower Lakes.

Initial Asset	Description of Significant Ecological Asset	Interim ecological objectives, and expected outcomes
River Murray channel	<p>The River Murray holds iconic status and is arguably the nation's most important river.</p> <p>The River Murray channel is the 'main artery' of the River Murray System and forms the link between forest, floodplain, wetland and estuarine assets.</p> <p>It provides in-stream habitat for many aquatic plants and animals, including the Murray cod and other threatened species (eg trout cod, Murray hardyhead).</p> <p>Its banks support River red gum forests, which have strong natural and cultural values and provide the aesthetic backdrop for the river and human activities associated with it.</p>	<p>To increase the frequency of higher flows in spring that are ecologically significant.</p> <p>To overcome barriers to migration of native fish species between the sea and Hume Dam.</p> <p>To maintain current levels of channel stability.</p> <ul style="list-style-type: none"> • Expanded ranges of many species of migratory fishes. • Similar levels of channel erosion to those currently.