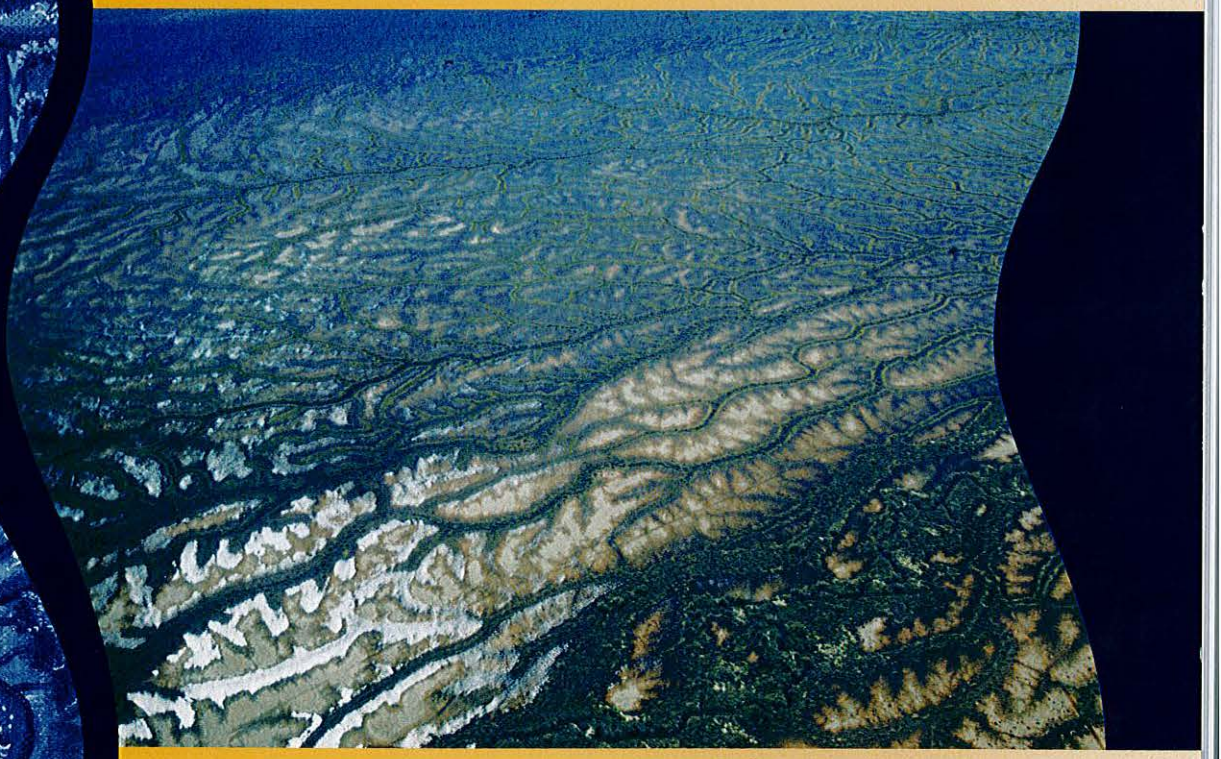
Report of the Inland Rivers Workshop

27–28 March 2001 — Alice Springs, Northern Territory, Australia



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27–28 March 2001 — Alice Springs, Northern Territory, Australia

Renee Webster
in association with
Michael Williams and Associates Pty Ltd

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The **National Rivers Consortium** is a consortium of policy makers, river managers and scientists. Its vision is to achieve continuous improvement in the health of Australia's rivers. The role of the consortium is coordination and leadership in river restoration and protection, through sharing and enhancing the skills and knowledge of its members.

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Cover photo: Inundated microchannels of the Cooper Creek Floodplain, south–west Queensland, April 2000. Source: ARIDFLO

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Executive summary

Introduction

"The paths to the future are made not found". With these inspiring words, seventy participants gathered at a workshop in Alice Springs, Northern Territory, in March 2001 to create a future for Australia's inland rivers.

The workshop sought to achieve a number of outcomes including to:

- increase national attention on inland rivers;
- converge ideas from the numerous people involved in inland river management;
- guide the emergence of principles, issues and actions on which to base policy development, research and future river management; and
- produce a report of workshop proceedings to disseminate the outcomes.

The National Rivers Consortium vision is to achieve continuous improvement in the health of Australia's rivers

Sponsored by the National Rivers Consortium, the two-day Inland Rivers Workshop focused on three broad but integrating themes.

Knowledge – What do we know about the driving forces behind Australia's inland river systems? Is this knowledge being used effectively in management and policy decision-making?

Management – Is research addressing the issues that managers need to know to manage inland rivers? What are the impediments to improved decision-making?

Future strategic directions – What are our strategic directions to improve inland river management? What are the opportunities and impediments to improve our ability to manage these systems?

Objectives

With these themes forming the basis for discussion, the objectives of the workshop articulated a desire to:

- explore how research and other knowledge shapes river policy and management;
- seek solutions and common ground; and
- develop principles on which to base improvements in future river management.

The workshop approached its task by:

- sharing information on the ecological and geomorphological functioning of inland rivers and on how current research is addressing some of the research gaps;
- sharing information on how inland rivers are currently being managed and the community's aspirations for their future management;
- facilitating small-group workshops to draw out the principles and values on which management of inland rivers should be based and the knowledge needed to improve their management;
- sharing an understanding of how communities and institutions are positioned to address the needs of inland river management; and
- facilitating small-group workshops to document how the participants would invest in knowledge generation to improve inland river management.

This approach was supported by detailed interrogation of various panels of presenters from the spectrum of institutions and communities involved in inland river management. The workshop benefited from a series of challenging 'thought-provokers', strategic summaries of workshop progress and a formidable synthesis of the workshop's achievements.

An inspirational keynote address provided an international perspective from South Africa and gave encouragement to the participants with the words: "If Nelson Mandela can merge a country's vision with reality then our challenge in comparison is easy".

Defining the scope of inland rivers

While the workshop agreed on the need to define Australia's inland rivers with more precision it struggled with a definition and an agreed characterisation of the spatial extent of 'inland rivers'. The breadth and scope of the management challenges remain spatially undetermined, although the focus was on rivers of highly variable flows and their associated floodplains.

An agreed definition of inland rivers is required so that the scope of the management challenge can be clearly articulated.

Knowledge

The relative importance of gaps in research, and how we reconcile science and knowledge, especially indigenous/ local knowledge, were themes that were consistently raised throughout the workshop.

"It seems remarkable that the very same people who handed out (water) rights on the basis of no science are now reluctant to change those rights without perfect or near-perfect science."

"There is a critical need is to create knowledge, not churn knowledge."

The outcomes of the small group workshops on the first day provided a useful basis for assessing knowledge requirements and the policy base for knowledge management. Participants expectations of knowledge were extensive and included the need for knowledge to:

- explain how systems work, and the implications and consequences of decisions and actions, especially thresholds and irreversible actions, at different spatial and temporal scales;
- be accessible to users (language, form, technology);
- seek to understand users' needs (eg. timeliness for policy and management);
- utilise, access and critique existing knowledge;
- be defensible, independent and peer-reviewed;
- embrace different types of knowledge and values, especially local and indigenous knowledge; and
- be adequately resourced and constantly updated.

Small workshop groups focused on the need for knowledge to be seen to be part of the strategic planning process which was underpinned by the development of community–science–government partnerships. The workshop groups stressed that:

- knowledge is part of a holistic and integrated strategic planning process;
- knowledge requirements are predicated on the assumption that an agreed vision is in place;
- knowledge generation requires institutional arrangements to be in place for:
  - participation in the identification of knowledge needs, and delivery mechanisms for knowledge to users and policy-makers, and
  - community based partnerships;
- knowledge should focus on undisturbed catchments—the least impacted but most threatened;

The ARIDFLO Project

The **ARIDFLO** project provides a useful case study example of many of the knowledge issues faced by inland rivers. ARIDFLO is a predictive tool in the assessment, management and monitoring of water use projects in the Lake Eyre Basin, and in the restoration of arid zone rivers already affected by water resource use.

The research is based on ample evidence that:

- inland rivers are different hydrologically—they are more variable and there is an inadequacy of hydrological data; with a limited understanding of ecological water requirements and environmental water provisions;
- geomorphologically they are less stable;
- there is an inadequacy of ecological data and biologically species are more opportunistic;
- management needs to be based on locally specific information and not extrapolated from findings in more temperate environments or from other continents.

ARIDFLO is attempting to fill the major research gaps of inland rivers through:

- field-data-based modelling of hydrological–biological interactions as a valuable predictive management tool;
- informing management for both unmodified and modified systems;
- sampling and analysis being structured at many spatial and temporal scales; and
- being able to predict the likely outcomes of different water allocation options.

- strategic plans need to incorporate knowledge requirements;
- local and indigenous knowledge was stressed and the need for partnerships between people with sometimes very different values, base on good communication between scientist and landowners;
- scientists need to work with managers to obtain a clear understanding of what managers need;
- knowledge should be part of the adaptive management approach; and
- program funding should encompass the continuum of knowledge acquisition and knowledge transfer.

Institutions

The need for better institutional arrangements with clearer roles and responsibilities was a key finding of discussions. Barriers include distance, and lack of communication infrastructure, with the community already contributing significant unpaid inputs. Project financing must incorporate the requirements of consultation and participation, acknowledging the difficulty of landowners in large catchments being able to actively participate.

The lessons for institutions developing partnerships are:

- *It is about creating opportunities for shared learning and growing.*
- *It is more about future building, than the present or past.*
- *It is about co-evolution of: values, vision, needs, goals, rewards.*
- *It takes time, it takes practice and it involves change.*

Institutions need to:

- be aware that the devolution of responsibility to the community has been occurring without the resources required. Community groups are in favour of devolved block funding, not centrally managed grant-based funding;
- be clear on who actually has decision-making responsibility and be clear about rights and responsibilities of all players in the institutional arrangements;
- not necessarily expect communities to come with a unified view, and take account of the sociology of the community—engage those who don't like to be part of groups or highly socialised processes;
- embrace regional accreditation and investment in regional bodies in a targeted manner;
- use existing community and other institutional structures where they exist.

"The smoke and mirrors of government are never far below the consultation surface."

Policy

"The actions we are now taking will determine what kind of future we will have — we can make choices to change or we can be satisfied to drift."

Given the uniqueness of Australian inland rivers there is a need for specialist policies for the management of these ecosystems.

The formulation of policies based on our present knowledge may seem premature, especially because we cannot easily extrapolate from experiences gained in systems overseas. However, the demand is urgent and we must learn from our management actions.

Specialist policies for inland systems must address the following:

- the importance of no flow (the dry phase), and of variable duration and timing, to inland rivers in dryland regions;
- the need for integrated flow management on a whole-of-catchment scale;
- maintenance of flow variability to promote a diversity of habitat types on large time and spatial scales;
- explicit recognition that the public perceive no flow (the dry phase) as a problem, and educational programs to remedy this concern;
- access to unregulated water needs to reflect ecological systems values; and
- surface and groundwater flow interactions.

Small group workshops identified eight common themes that underpin good policy development:

- be informed by the best available science—knowledge is the prerequisite for intelligent policy;
- be adaptive, and be informed by good monitoring;
- "protect the best first"—based on naturalness and high conservation values;
- "do the important before the urgent";
- involve the community—be representative and have agreed, transparent processes;
- learn from the past, do not continuously repeat mistakes, and track the impact of policy changes;
- high risk ventures should be matched by greater monitoring and funding; and
- use clear and honest processes, where agendas are explicit.

"Local and Indigenous knowledge is a vital component in the knowledge required to underpin policy development."

The workshop agreed in general that the policy for knowledge priorities should be broadly based on the issues of particular river basins and the knowledge needed to predict the consequences of proposed development decisions. These included the following:

- *Inventory investments*. Some participants felt that an inventory of existing resources was the first step, especially to document the biodiversity in a region, and to identify undisturbed areas that might be important to protect.
- *Monitoring investments*. Another approach was to establish a monitoring approach that enables a "State of the Rivers Report" to be produced periodically. This involves periodic measurement of key indicators. It was accepted that state-of-the-art monitoring programs were built around hypotheses being tested rather than just collection of data.
- *Process understandings*. There was a view that we should be aiming to protect key ecological processes at a variety of scales, rather than particular groups of biota. It was seen as important to understand the relation between stream flow and river biota, and of flooding and floodplain and river health. Others thought there were possibilities to take an experimental approach rather than a descriptive approach to this work.
- *Management tools*. Some thought it was important to collate and synthesise existing knowledge as the first step. Others felt the development of decision-support systems might be possible. Several people thought a risk analysis was an early step to help focus the knowledge priorities onto likely threatening processes. Others felt it was important to integrate social science research with the biophysical from the start.

DAY 1: TUESDAY 27 MARCH 2001

Knowledge — What do we know about the *driving forces* behind Australia's inland river systems? Is this knowledge being *effectively utilised* in the management and policy decisions?

Management — Is research *addressing the issues* that managers need to know to manage these systems? What are the *impediments* to improved decision making?

Welcome and opening

Mr Brendan Edgar, Program Coordinator for the National Rivers Consortium, welcomed participants to the Inland Rivers Workshop, noting that this was an important workshop, with a specific focus on the management of inland rivers. Mr Edgar noted that this is probably the first time a workshop on this issue has taken place in Australia, and managed to bring such a wide range of people together from varied backgrounds. Alice Springs was considered to be an appropriate place in which to hold the event, being located on a river in inland Australia, and especially in light of the recent rain and the uncommon sight of a flowing Todd River.

Mr Edgar began proceedings by introducing the Mayor of Alice Springs, Ms Fran Erlich.

Official welcome

Ms Fran Erlich
Mayor, Alice Springs Town Council

Ms Erlich was born in Alice Springs, has a Degree in Archaeology and Geology, and also a Diploma of Education. She has a strong interest in promoting Alice Springs and the surrounding area.

Before beginning her official welcome, Ms Erlich acknowledged the traditional Aboriginal people of the area.

Ms Erlich welcomed everyone to the conference and to Alice Springs, especially those who had travelled over a long distance.

Ms Erlich began by providing a brief history of the settlement of Alice Springs and an explanation of both the origins of the name Alice Springs and the Todd River. Alice Springs was named after Alice Todd, the wife of Sir Charles Todd, the surveyor-general working on the overland telegraph line. The Todd River was named after Sir Charles Todd.

Ms Erlich explained that the Todd River rises in the low hills to the north of the town and flows over the floodplain before it dissipates in sands to the south of the town centre.

Ms Erlich commented on the difficulties of ensuring a secure freshwater resource for the town of Alice Springs, and noted that the level of the current bore has dropped significantly since it was first pumped. She also commented on the ironic dilemma of living in an extremely arid catchment (average rainfall 250 mm with a high evaporation rate of 2.5 m) where the most common disaster was likely to be caused by flooding. The Todd River has a very small catchment area of approximately 450 km^2, consisting of steep-sided, well-vegetated hills which encourage the onset of rapid flooding events during heavy rainfall.

The major management issues with the Todd River are both environmental and physical in nature including:

- weed infestation (couch grass agreement signed under Native Title legislation is evidence of this);
- litter around the river and damage to red gums by fire;
- illegal camping (which is now being managed by recently employed River Wardens);
- flood mitigation; and
- provision of infrastructure for access to the town during times of flooding.

Ms Erlich also emphasised that the Todd represents more than an infrastructure issue to the people of Alice Springs. It is both a geographically central point for the town as well as a cultural nucleus for many people. It is an attractive and unique environmental feature that adds to the town's *sense of place*, and the community as a whole has a significant interest in its aesthetics. Ms Erlich stated, "These are not merely flowing bodies of water but are important culturally and economically and people are intimately involved with rivers."

Mrs Erlich ended her welcome by warning participants of the Alice Springs legend that prophesises — if you see the Todd River flowing three times you will remain in Alice Springs forever!

Official opening

Mr Brendan Edgar
Program Coordinator, National Rivers Consortium, Land & Water Australia

Brendan is the Program Coordinator for the National Rivers Consortium, under contract to Land & Water Australia. He also works for the National Land and Water Resources Audit as the technical coordinator for the Australia-wide Assessment of River Condition project. Brendan previously worked with Environment Australia as the manager of the wetlands program and has worked at the regional level in Victoria on land and water resource management.

The objective of the workshop is to explore how research and other knowledge shape river policy and management, to seek solutions and common ground, and to develop principles on which to base an improvement in future river management.

We have brought together a diverse group of people with strong credentials and interest in the management of Australia's inland rivers, spanning research, policy, management, community and industry.

I would specially like to welcome Kevin Rogers from the University of the Witwatersrand, Johannesburg. I am looking forward to hearing Kevin speak about river management in Kruger National Park and in South Africa more generally. Kevin seeks to make sure that science is used, not just useful!

It is important to give credit and recognition to the sponsors of the workshop. Major sponsors include the World Wide Fund for Nature and Environment Australia. The other four sponsors — Land & Water Australia, the Western Australian Water and Rivers Commission, CSIRO Land and Water, and the Murray–Darling Basin Commission — collectively form the major partners of the National Rivers Consortium.

National Rivers Consortium

As I have the floor, I would like to briefly outline the National Rivers Consortium to which I am contracted. The National Rivers Consortium is a new initiative, formed in the year 2000 to give a greater focus to river protection and management at the national level. The Consortium's vision is *to achieve continuous improvement in the health of Australia's rivers.*

Major funding partners of the Consortium as mentioned, include Land & Water Australia, the Murray–Darling Basin Commission, the Western Australian Water and Rivers Commission, and CSIRO Land and Water. Recfish, Wetland Care and the Australian Water Association are also members.

Very briefly, the Consortium's main work is to fund a range of projects based on the following priorities:

- protecting rivers with retained natural values — because protection is more cost-effective than restoration;
- restoring degraded rivers — because many rivers are in poor shape and there is growing community expectation for action to repair damage;
- training river managers — because there is a great demand for specific river-based training opportunities at the graduate and community level;
- turning research into practical river management solutions and communicating these to river managers; and
- undertaking demonstration catchment projects at the regional level — because it is important to have case studies to show results and achievements to inspire others.

There is additional information on the Consortium in your conference papers. Please contact me if you want further advice or to discuss opportunities for collaboration.

Inland rivers

Turning back to the theme of this workshop: what is it that characterises Australia's inland rivers? In developing a program, the organising committee focused on a number of elements to define the scope of the workshop.

Australia's inland rivers have highly **variable** flows. In many rivers, flows are commonly very low or there is no flow, with flow regimes dominated by high rainfall events. They may be terminal and inland draining, or flow to the sea.

Australia's inland rivers function at a landscape **scale**, influenced by geography, time, distance, the extensive nature of flood events, and the large size of rural properties. River flows and floodplain wetting can occur at great distances and long lag times from where rainfall occurs.

Inland river systems often span State and Territory borders. Implementing effective **management** arrangements is difficult in the absence of formal agreements between States, notwithstanding the recent signing of the Lake Eyre Basin Inter-governmental Agreement. Institutional arrangements are not well developed with the responsibility, capacity and legislative basis to act.

Water resource **developments** based on diversions, regulation, floodplain development, off-stream storage and interception of overland flows are increasingly moving out into previously unregulated river systems.

Pastoralism, rangeland grazing and Indigenous lands are extensive, with the most productive areas located on the floodplains. Oil and gas extraction, mining, and tourism are also major owners and users of land.

Inland Australia has low population densities, with people living on remote rural properties and stations, or in scattered settlements and towns. The Australian **community** living outside the region exercises a strong influence on policies affecting inland river systems.

Research and contemporary ecosystem theories derived from permanent streams in temperate climates do not apply to inland rivers. Answers are needed that are specific to the management needs of these systems.

The organising committee also set some other specific objectives for the workshop. These were to hold the workshop at a location in regional Australia of relevance to river management, to keep the numbers to about 60 people, and for the majority of the attendees to be specifically invited. We wanted to ensure that participants felt involved, and we have set aside about half of the time to panel discussions and small working groups.

We originally planned the workshop for late last year in Longreach, but unfortunately we had to postpone the date, and subsequently change the venue. I would like to take the opportunity to thank the staff from the Lake Eyre Basin Catchment Coordinating Group and others in Longreach who gave their assistance and strong support for the workshop.

Introductory information was provided to participants in advance of the workshop in the form of an Inland Rivers Workshop Discussion Paper, by Brendan Edgar (Appendix 1).

Introduction by the workshop facilitator

Mr Mike Williams
Michael Williams & Associates Pty Ltd

Mike combines the skills of an earth scientist (geomorphologist), an environmental strategist and a facilitator with over two decade's experience in managing environmental strategy development. He holds a BA in geomorphology and geology from Macquarie University where he taught for some years after graduating in 1976. Since 1988, he has been the principal of the environmental consultancy firm Michael Williams & Associates Pty Ltd, a firm that specialises in public consultation, facilitation and strategic environmental planning in New South Wales, Victoria, Queensland, South Australia and Tasmania.

As an environmental strategist and facilitator, Mike develops and delivers outcomes to help clients in understanding, managing and resolving the differing motivations and aspirations of key stakeholders involved in resource management issues. His skills in delivering positive outcomes across a wide range of environmental, social and political value systems are testimony to his innovative approach to environmental and community planning. He has a wide variety of clients including Commonwealth, State and local governments, non-government organisations as well as large and small private companies. Mike enjoys a team-based consultative and strategic approach to resource management issues. He revels in the development of innovative partnerships and alliances.

Mr Williams re-emphasised the theme of the workshop to turn information and knowledge from being useful to being used. Mr Williams briefly went through the agenda for the next two days, the focus for the first day being on knowledge — what do we know about the *driving forces* behind Australia's inland river systems? Is this knowledge being *effectively utilised* in the management and policy decisions? And management — is research *addressing the issues* that managers need to know to manage these systems? What are the *impediments* to improved decision making

Session 1, Day 1

How do inland river systems function and how are they being managed?

Dryland river ecosystems and forest river ecology: implications for management

S.E. Bunn* **and P.M. Davies†**

Professor Stuart Bunn
Director, Centre for Catchment and In-Stream Research, Griffith University

Stuart is Director of the Centre for Catchment and In-Stream Research at Griffith University, and Professor in Ecology in the Faculty of Environmental Sciences. His major research interest is in the ecology of river and wetland systems with a particular focus on aspects of ecosystem function, having published widely on this topic.

Stuart is Program Leader of the Restoration Ecology program in the Cooperative Research Centre (CRC) for Freshwater Ecology and leads a major collaborative project on the role of refugia in dryland rivers. He is currently a member of the Scientific Committee for Water Research for the International Council of Science and has previously served on several State Government advisory committees on water-related issues. Stuart is also a member of the Board of Land & Water Australia.

Background

Many of our general principles about stream ecosystem function have been derived from studies of small, temperate forest systems in North America and Europe which dominate the ecological literature. Understandably, this has fostered a strong 'eurocentric' view of Australian rivers that has found its way into policy and management. While these ecological principles seem to be appropriate for similar-sized, coastal forest streams in Australia, they are unlikely to provide a robust scientific basis for the management of our large river systems, especially those in the more arid regions of the country. On the whole, our ecological knowledge of large rivers is quite poor and there is considerable debate about even the most fundamental ecosystem processes. For example, three current models of ecosystem processes in large rivers (River Continuum Concept, Flood Pulse Concept, and Riverine Productivity Model) differ markedly in their predictions of the importance of the direct influence of riparian and floodplain vegetation.

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Given that most Australian rivers flow through semi-arid or arid landscapes, how relevant is this knowledge base likely to be to the management of dryland river ecosystems? Many inland rivers feature extensive floodplains and a network of anastomosing channels and distributaries that provide a far greater terrestrial–water interface than would occur with a single, large channel. They have highly variable and unpredictable flow regimes and, when they do flow, they often occupy vast floodplains. Although renowned for these episodic floods, they exist for much of the time as a string of disconnected and highly turbid waterholes that act as refugia for fully aquatic organisms and other wildlife dependent on permanent water. The river water remains highly turbid, even during the long periods between flood flows. Given these features, we might predict that the aquatic ecosystem would be driven by fluxes of energy and nutrients derived from extensive floodplain exchange during floods, and by continual input from fringing vegetation along the vast network of channels during the dry. We might also predict that aquatic plant production should be limited by low light penetration in the turbid water and thus make a minor contribution to the aquatic food web.

In this presentation, we draw on our recent work in western Queensland to examine these predictions and to highlight some of the likely management implications. In particular, we wish to contrast ecosystem processes

during times of 'boom' and 'bust', drawing on data from permanent waterholes during extended dry periods and from an inundated floodplain during a major flood event. We conclude with some comments on the role of minor flow events, which may serve to connect and sustain permanent refugia between major flood events.

Ecosystem processes in waterholes

Despite the high natural turbidity, permanent river waterholes have a highly productive band of filamentous algae restricted to the shallow littoral margins. Rates of primary production in this zone are among the highest recorded for streams and rivers in Australia and remain high even during the winter months. Stable isotope analysis has revealed that this 'bathtub ring' of algae is the major source of energy driving the food web in the permanent waterholes and supports large populations of snails, crustaceans and fish.

Factors that influence the distribution and productivity of the bathtub ring of algae are likely to have a pronounced effect on ecosystem function. For example:

(i) Rapid drawdown of water in river waterholes (eg. pumping for irrigation) may expose the shallow band of algae. Although algae appear to be tolerant of desiccation, repeated exposure is likely to limit primary production and also reduce availability of this food resource to aquatic grazers.
(ii) Uncontrolled access of stock and feral animals to the margins of river waterholes can physically disturb the algal zone. We have found that even a moderate level of disturbance significantly lowers algal production, and recovery to pre-disturbance levels takes many days. Extensive and repeated disturbance of the margins of waterholes by stock and feral animals could limit algal production and threaten the very food base of snails, crustaceans and fish.
(iii) The toxic effects of agricultural herbicides on aquatic algal are poorly understood, even though several chemicals (eg. atrazine) are routinely found in inland rivers. Sub-lethal effects (eg. reduced primary production) may also be important.

Ecosystem processes during floods

Large floods transform a dryland river into a vast, slow-moving wetland, triggering benthic (and pelagic) algal production across the inundated floodplain. At the height of a recent flood on the Cooper, we estimated that the amount of algal carbon produced on the floodplain during a single day of inundation was equivalent to 82 years of aquatic production in the permanent waterholes during the dry. This boom of production on the floodplain was accompanied by a proliferation of aquatic invertebrates, especially small crustaceans. We recorded ten species of fish on the floodplain of the Cooper reaching an average biomass of over 1 tonne/km^2. The diets of all fish species were dominated by aquatic sources (not terrestrial as might be expected) and with a greater range of dietary items than that recorded in the dry. Some of this floodplain production undoubtedly returns to river waterholes as fish biomass once floodwaters recede. However, given the small area of permanent waterholes (3.2 km^2) in this region compared with inundated floodplain (several thousand km^2), much of the aquatic production must either be exported downstream or retained on the floodplain.

We suspect that algal production is a major driver of the food web on the floodplain, though this remains to be confirmed. Whatever the ultimate carbon source, however, production on inundated floodplains undoubtedly has a massive influence on aquatic and terrestrial food webs at local and possibly even landscape scales. Altering the frequency, duration and area of inundation of large flood events is likely to have a marked influence on this subsidy.

Concluding remarks on the role of small floods

Although our attention is immediately drawn to the 'boom or bust' extremes of dryland rivers, we must be careful not to overlook the role of small floods and in-channel flows that may also have an important influence on ecosystem processes. The relative importance of groundwater and surface water to the persistence of waterholes and their associated aquatic biota is poorly understood. Similarly, we have little appreciation of the importance of surface flow (versus groundwater) inputs of nutrients to waterholes. Which of these sources of nutrients sustains the high production observed in waterholes?

In addition to their effect on ecosystem processes, small floods and in-channel flows also periodically connect populations of aquatic organisms and provide an opportunity for dispersal. Altered flow regimes and changed land management affect patterns of connectivity of waterholes (refugia), and are likely to lead to population declines and loss of biodiversity. The role of permanent waterholes as refugia for aquatic organisms and the biophysical factors that sustain them is a key research area of the Cooperative Research Centre for Freshwater Ecology.

Australian inland rivers

M. Thoms

Associate Professor Martin Thoms
Fluvial Geomorphology, CRC for Freshwater Ecology

Associate Professor Martin Thoms is a fluvial geomorphologist with the Cooperative Research Centre (CRC) for Freshwater Ecology at the University of Canberra. His main area of research has been at the interface between fluvial geomorphology and freshwater ecology and he has been actively involved in multi-disciplinary research for over 15 years. The setting for most of his research has been the large dryland floodplain rivers of western New South Wales and southern Queensland. Martin has also collaborated with a variety of water management agencies, especially on the issue of environmental water allocations in our inland river systems.

There have been very few multi-disciplinary studies that have provided detailed descriptions of the character of these systems in Australia. Most inland rivers in Australia are allogenic, originating in the relatively wet upland areas, but flow for the majority of their length through semi-arid to arid landscapes that produce little or no additional discharge. Indeed, these rivers experience large-scale losses through extreme rates of evaporation, evapotranspiration and groundwater recharge.

Australian river systems have been mapped at a 1:250,000 scale by Stein et al. (1998). Using these data, it is calculated that there are approximately 3127 million kilometres of lowland rivers in Australia, which make up 97% of the total length of Australian rivers. Of this, the majority, 83%, are inland systems and have semi-arid to arid (dryland) climatic regimes; many cease to flow for periods of time.

Traditional geomorphological models of river systems assumed that an alluvial river channels maintains a relatively uniform change in morphology along its length whereby its dimensions follow the rules of hydraulic geometry and its gradient and pattern reflect the type of sediment load and the valley characteristics. However, these assumptions are often erroneous for Australian inland rivers — they generally display a great deal of variability in their longitudinal structure and function and between different systems. This is because of the influences of tributaries, tectonics, bedrock outcrops and valley slope. Subtle changes in valley configuration have been shown to significantly influence inland floodplain sedimentation patterns and river channel responses to altered flow regimes. In general, relatively lower channel gradients and smaller particle sizes of sediment load and bed material distinguish inland reaches from higher energy upland areas. Long-term sediment storage commonly occurs in inland regions because flows are insufficient to carry the sediment load from the high-energy headwater reaches.

Australian inland systems can be classified into four broad forms, based upon their degree of confinement and hence the extent of their floodplain development. Confined sections generally have relatively narrow valley floor troughs (1–2 km wide) fringed by type C1 floodplains. There are two types of unconfined inland reaches: the upper sections have slightly steeper valley gradients and are associated with type B floodplains; hence lateral accretion is a relatively prominent formation process. In comparison, the lower, unconfined sections have reduced valley gradients and associated stream powers, and type B and C1 floodplains. Here, vertical accretion dominates. Open inland sections are often associated with large, low-angle alluvial fans or the deltaic distributary systems of inland Australia. These systems can be more than 60 km in width, eg. Cooper Creek, and are characteristic of type C2 floodplains.

Floodplains are a characteristic of Australian inland rivers (Pickup, 1986; Thoms, 1995). Although they are associated with a wide range of river forms, they are dominated by sinuous anabranching and distributary systems. Because of their lateral instability, inland floodplain regions contain complex geomorphic features with a diverse array of physical habitats, including anabranches, backwaters, cutoffs, shallow floodways and flat plains. Those features that retain water for any period

of time have been termed 'wetlands' (Williams, 2000). The abundance of wetlands in Australia is not well known, although Blackley et al. (1996) list 744 in a directory of important Australian wetlands. Of these, 263 are located in inland regions. They have high biodiversity (Williams, 1988) and have an important function as sites for the feeding, breeding and refuge of water and migratory birds (Kingsford, 1999), fish and other animals.

Hydrological variability

Hydrological variability is a feature of Australia's inland river systems and has been described by many writers; see, for example, Erskine and Warner (1988), Finlayson and McMahon (1988) and Puckridge et al. (1998). The range of flows is often associated with highly variable effective rainfall and with low rainfall–runoff ratios. Puckridge et al. (1998), in a multivariate analysis of the hydrographs of 52 rivers with similar catchment character, showed Australia's dryland rivers to be among the most hydrologically variable in the world. The average coefficient of variation (CV) for annual run-off for dryland regions is 0.99 — much higher than for the humid regions of North America (0.3), Europe (0.2) and Asia (0.2) (Finlayson and McMahon, 1988). Key hydrological features of dryland rivers include a non-linear temporal response of run-off to rainfall and basin size, and highly variable seasonal flow (McMahon, 1979). This variability may be further amplified by climatic conditions such as El Niño–Southern Oscillation events, because the discharges of rivers in south-eastern Australia correlate significantly with the Southern Oscillation Index (Simpson et al., 1993).

Flow variability is important in a number of ways. Geomorphologically, variable flows maintain the complexity of the in-stream environment in some inland rivers. Thoms and Sheldon (1997) used historical flow and channel survey data that pre-date significant water resources development in the Barwon–Darling River, Australia, and showed that the cross-sectional morphology of the unregulated river was complex and characterised by a series of flat surfaces or 'benches'. The benches provided aquatic habitats during high flow events and were sites at which organic matter could accumulate and be temporarily stored. The more variable the flow regime, especially in terms of flood flows, the greater the number of benches present.

Ecologically, flow variability underpins the rates of most ecosystem processes and the transport of organisms, nutrients, organic carbon, and other materials within rivers and on their floodplains (Baldwin and Mitchell, 2000). Many inland rivers are intimately linked to their floodplains (Walker et al., 1995); the variability of their flows creates a diversity of habitats over time. During high flows, water spreads across the floodplain, inundating lakes and billabongs (a billabong is a waterhole that dries up except during floods or the wet season). Drainage patterns are not always consistent, and floodplain lakes may then lie dry for years or decades — the length of time depends upon the flow history, the geomorphology of the floodplain, and human activity (eg. water abstraction, levee construction). Reflooding at various frequencies leads to a diverse biota (Humphries and Lake, 2000), exemplified by the differing taxa that emerge from desiccation-resistant stages in floodplain sediments, as observed in areas that differ in inundation frequency (Boulton and Lloyd, 1992; Jenkins and Boulton, 1999). Similarly, assemblages of aquatic invertebrates in three central Australian rivers with highly variable flow regimes — the Diamantina, the Cooper and the lower Darling — are structured by the flooding frequency of the various habitats, while in the less variable River Murray, the microhabitat features influence invertebrate assemblage structure (F. Sheldon, unpublished data). It is evident that flow variability in dryland rivers promotes a diversity of physical and chemical conditions in both space and time. This can lead to extreme levels of habitat patchiness and connectivity in space and time and, consequently, to increased biodiversity. Walker et al. (1997) describe the all-or-nothing tendency of the highly variable flow regimes seen in dryland rivers as contributing to a 'boom and bust' ecology. This emphasises the flood cycle and perhaps detracts from the importance of the low and medium flows in the between-boom years that maintain the integrity of refuges and thus populations, enabling them to use the high flow, or boom, years.

The alteration of Australian inland systems

The character of Australian inland rivers has been altered since European settlement (Thoms et al., 1999, 2000; Ogden, 2000) because of large-scale development on floodplains and the loss of connectivity resulting from flow regulation and the construction of levees. The grazing industry has had a long association with floodplains (Heathcote, 1988). However, since the 1980s, the floodplains have also become the target for an expanding cotton industry. For example, in the Lower Balonne, a major tributary of the Barwon–Darling River in south-western Queensland, the area of floodplain taken up by this industry has increased by an order of magnitude over the last ten years, to 58,400 ha. Similar development is being planned for other dryland floodplain regions (Kingsford et al., 1998).

Detailed examples of the impact of water development on Australian inland aquatic ecosystems are only just being documented in the scientific literature, eg. Maheshwari et al. (1995), Walker and Thoms (1993). In the State of New South Wales (NSW), more than 23.9 million ML of water is stored in large dams and the majority of inland rivers are regulated by headwater impoundments and water extractions for irrigation. Thoms and Sheldon (2000), for

example, highlight the influence of irrigation extraction on the hydrology of the Barwon–Darling River in western New South Wales. A summary of this work is given in Table 1. It is apparent that development has had an impact on the entire flow regime of this river system, not just on low and average flows. Water diversions in 1994 were equivalent to over 60% of the natural flow at Menindee on the lower Darling River. In response to pressure from the agricultural industry, the NSW Government allowed water extraction licenses to increase from 20 in 1960 to 267 in 1994, with little understanding of the impacts of this on the river ecosystem. The widespread media coverage of the 1,000 km of toxic algal bloom in 1991 was a 'wake-up call' to Australia, alerting us all to the impacts of large-scale water resources development on these highly variable river ecosystems.

Table 1. Hydrological changes in the Barwon–Darling River associated with water development

Flow period	Scale	Documented change
Flow regime	>100 years	• 48% reduction in long-term median annual flows • 68% reduction in annual flows with an AEP[a] <1.01
Flow history	1–100 years	• 58% reduction in some monthly flows • An increase in the predictability of monthly flows • 91% reduction in the magnitude of the annual flood event
Flood pulse	< 1 year	• Doubling of the rate of fall of some flood events • Extractions equivalent to 65% of daily flow during some flood events.

[a] AEP (annual exceedance probability)

The availability of habitat in rivers and on floodplains has also been substantially reduced in inland rivers because of changes to the flow regime. For example, the natural annual flood (18,000 ML/day) at Bourke in the middle reaches of the Barwon–Darling river system is adequate to inundate the majority of in-channel habitat structures such as snags and benches. However, water use has reduced the annual flood by 44%, severely affecting the extent of habitat regularly inundated. Moreover, the frequency of the floods that inundate floodplain billabongs and wetlands has been reduced by as much as 33% downstream of Bourke (Thoms et al., 1996).

Management of Australian inland rivers

Australia's inland rivers are a valuable but threatened resource. It is difficult to place a monetary value on ecosystem functions. Recently, Constanza (1997) has developed techniques to do so. Applying these to the inland rivers of the Murray–Darling Basin, for example, it is estimated that the rivers, wetlands and floodplains are valued at $187,302 million per annum for the various ecosystem services they provide. Previously, many management strategies for large rivers have been guided by commercial interests and are typically aimed at reducing floodplain area and regulating water levels. Now, the Council of Australian Governments (COAG) has recognised the fundamental importance of a whole-catchment approach in water resources planning. Water entitlements, both consumptive and non-consumptive, must now be allocated and managed in accordance with comprehensive planning systems that are based on a complete hydrological assessment of the catchment. Hence, State borders are no longer seen to be logical boundaries for water resources planning, despite the difficulties this causes.

A need for specialist policies

Given the uniqueness of Australian inland rivers, Boulton et al. (2000) suggest there is a need for specialist policies for the management of these systems. The formulation of policies based on our present knowledge of these ecosystems may seem premature, especially because we cannot easily extrapolate from experiences gained in systems overseas. However, the demand is urgent and we must learn from our management actions. For example, COAG recently released a communiqué outlining a national agenda for micro-economic reform. A national water resources policy was a key part of this agenda aimed at supporting higher sustainable economic and employment growth. Part of the policy required better definition of water rights for environmental purposes, based on the best scientific information available and having regard to the water required to maintain the health and viability of river systems and groundwater basins (Water Resources Policy, 1994). Environmental flow management strategies are now being developed by management agencies in each State in response to this policy. The approaches taken in each State differ according to the level of existing development, property rights in water, and potential for future development.

There are many gaps in the knowledge required to determine appropriate environmental water allocations (Cullen and Lake, 1995). Techniques and procedures developed elsewhere, eg. Gore and Nestler (1988), are not directly applicable to Australia's rivers because of enhanced ecosystem variability (Arthington et al., 1992;

Thoms and Swirepik, 1998). Boulton et al. (2000) suggest that, in the interim, specialist policies for inland systems must address the following:

- the importance of no flow (the dry phase), and of variable duration and timing, to inland rivers in dryland regions;
- the need for integrated flow management on a whole-of-catchment scale;
- maintenance of flow variability to promote a diversity of habitat types on a large time scale and spatial scale; and
- explicit recognition that the public perceive no flow (the dry phase) as a problem, and educational programs are needed to remedy this concern.

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Management of our inland rivers: dams, river management, wetlands and waterbirds

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Dr Kingsford has 15 years of research experience on inland river systems, their wetlands and waterbirds. His research has focused on demonstrating the ecological values of many rivers in arid Australia and impacts of water resource development on desert rivers. Work on the Macquarie Marshes and Lower Murrumbidgee floodplain have demonstrated the long-term impacts of water resource development on floodplain wetlands and their waterbirds. Work on the Paroo River and Cooper Creek has highlighted the importance of 'boom and bust' ecological processes operating on inland river systems. Dr Kingsford is also currently developing database software that provides information for the management of water within whole catchments. He is also involved in water reform in New South Wales and is on the Standing Committee for the rivers that flow between Queensland and New South Wales.

Most wetlands in Australia depend on river flows. There is an unknown, but considerable range of plants, animals and other biota dependent on river flows that flood these wetlands. There are many examples remaining of river systems that still largely flood wetlands, their flows uninterrupted by dams, river diversions or floodplain development.

Our inland rivers have high variability and large flows. Two rivers serve as useful examples of the wide range of species and diversity of waterbirds that reflect complex habitats and water regimes. Years may pass with no flooding and then a huge flood can inundate vast areas of the catchment. The characteristic 'boom and bust' cycles of our inland rivers is distinctive and the ecology follows the hydrology. So during floods, tremendous bursts of life occur as invertebrates build up populations, fish breed and frogs colonise and breed. The birds follow the boom cycles of their prey. Soon after the Diamantina River started to fill Lake Eyre, banded stilts established a colony, as their crustacean prey became abundant. Australian pelicans followed soon afterwards. Elsewhere on Cooper Creek, Australian pelicans, straw-necked ibis and cormorants bred in large colonies. As our knowledge of the hydrology and ecology of inland rivers grows, so does the pressure to turn their waters to 'productive' use.

Up until relatively recently, most inland river management in Australia was driven by an imperative to develop water resources, mainly for irrigation. About 75% of all water used in Australia is for irrigation. Water resource development was delivered through the policies of governments and their water agencies. Water legislation has only recently been updated in many States of Australia. For example, New South Wales passed comprehensive water legislation last year, replacing the 1912 Water Act. Much of water resource development has occurred rapidly within the last 50 years. Rapidity of development was most recently demonstrated by the development of the Condamine–Balonne River in a little more than ten years, considerably reducing flows to terminal wetlands and floodplains.

Water resource development has produced considerable wealth in some parts of Australia, with many inland towns and agricultural communities reliant on income derived directly or indirectly from irrigation, but the ecological impacts have been many. These include increasing salinity, high incidences of blue-green algal blooms, changes in the timing of flows, slumping of river banks, increased pesticide loads, loss of floodplain wetlands and biodiversity, permanent flooding of other wetlands, and increased populations of European carp. Most freshwater native fish populations have declined significantly in numbers. Six species are now threatened in New South Wales. The ecological effects of such water resource development are likely to be widespread as Australia has at least 446 large dams (>10 m crest height) storing 8.8×10^7 ML (10^6 litres) of water, much

of which is diverted upstream of floodplain wetlands. About 50% or more of floodplain wetlands on developed rivers — ones with dams — may no longer flood.

There has been a major ecological price to pay for this development on wetlands. Major floodplain wetlands such as the Macquarie Marshes, Gwydir wetlands, Barmah–Millewa forest and Lowbidgee wetlands shrank as the water was denied to them. Their margins were colonised by terrestrial plants. Fish and waterbirds declined in diversity and numbers with these changes. Graziers owned most of the floodplains and they relied on the regular flooding of the rivers to produce the nutritious grass for their cattle. They had also often paid a premium for the land. Much of the water resource development has occurred over the last 50–100 years. Over a period of little more than ten years, flows to Narran Lakes, which lie at the end of this system, have been reduced by 75%. Such declines in flows have been followed by major long-term declines of biodiversity on the Macquarie, Gwydir, Murray and Murrumbidgee rivers.

What are the main principles for management? I believe that inland rivers can be divided into two main groups: developed and undeveloped (sometimes called regulated and unregulated). For undeveloped rivers, there are the usual concerns for river management: pollution, impacts of grazing, feral animals, weeds and possibly climate change. Some factors can be managed, given sufficient money, and others cannot. For all these rivers, there will be future pressure for water resource development. Discussion about future development needs to include a much more sophisticated debate about the costs and benefits of such a choice. Knowledge of the impacts of water resource development on other river systems needs to be applied. If development occurs, access to water needs to recognise the flow pattern of the river and remove a veneer of the water available, as opposed to large parts of the flow regime. This requires different policies for the management of access because access to water currently does not reflect the ecology of a river system. There needs to be recognition that there will be ecological and economic costs with such development.

For developed rivers, the challenges are much more difficult. Major dams impose such control on a river's flow regime that it becomes more difficult to 'mimic' natural flow patterns. For example, the Burrinjuck and Blowering dams control about 70% of the flows of the Murrumbidgee River. In addition, whole communities are now dependent on the adequate delivery of this water. Communities and their governments have provided incentives to develop irrigation areas because, in the past, water was considered a 'waste' if it flowed into a wetland or out to sea. Social responsibility in the development of new policies and management are essential and needs to recognise the investments of people. An adaptive management framework for the delivery of the environmental component of this remaining water will be essential. This will depend on adequate hydrological models and better understanding of ecological requirements and flexibility for water management. Equally, the implementation and management of policy instruments for restricting greater access to water, such as the Murray–Darling Basin Cap, are essential for the health of inland river systems and reliability of current users. State borders impose an artificial constraint on water resource management and so it is essential that water resource management occur at the catchment level. Water management needs to embrace the ecological complexity that is inherent in inland river systems and their wetlands.

Finally, policy and management are virtually impossible without adequate knowledge in scientific communities, governments and their communities. It is essential to ensure that such knowledge is made available to everyone. Without knowledge, change is extremely difficult. For example, the choice to develop a river system is much more difficult if there is good knowledge of its ecological values and the predicted consequences on these of development. The management of inland rivers and their wetlands is a matter of choice for governments and their communities. The scientific role should be to deliver the information for informed decision-making.

ARIDFLO: environmental flow requirements for Australian arid zone rivers

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Julian Reid outlined the ARIDFLO project on environmental flow requirements for Australian arid zone rivers. A more comprehensive description of ARIDFLO was recently published by Land & Water Australia in RipRap (River and Riparian Lands Management Newsletter), Volume 18, 2001. The article is reproduced below.

What is ARIDFLO and why is it important?

The *Environmental flow requirements for Australian arid zone rivers* project, or ARIDFLO, is a major two-year multi-disciplinary research project on selected rivers of the Lake Eyre Basin (Figure 1). It aims to develop an interactive predictive model of hydrology–biology relationships for Australian arid zone rivers.

Increasing interest by governments, communities and scientists in the rivers of inland Australia has meant that this project is of critical importance. It is especially so in the Lake Eyre Basin, which is the largest internally draining basin in Australia (Morton et al., 1995), and one where the rivers are largely untouched by development. The Lake Eyre Basin Regional Initiative is a community-driven process working with governments and stakeholders towards economic and ecological sustainability in the Basin. The Catchment Committees and Coordinating Group established under that Initiative released their Strategic Plans on 21 October 2000. All of these plans include surface water management as a key natural resource management issue. On the same date, the Commonwealth, Queensland and South Australian Governments signed the Lake Eyre Basin Agreement. This Agreement sets out processes and structures for all governments to work together to address the management of water and related natural resources. In relation to ARIDFLO, the Agreement contains principles that relate to environmental flows and recognition of the environmental values of the Basin. This situation provides opportunities for researchers to assist in informing communities and governments as they work toward sustainable management.

There is ample evidence that arid zone rivers are hydrologically, geomorphically and biologically different from rivers in more humid zones. They are hydrologically much more variable (Puckridge et al., 1998), their geomorphology is less stable, and many of their plants and animals are more opportunistic. Australian arid zone rivers show these characteristics to an extreme degree. It is thus essential that we base our management of such rivers on locally specific information, and not attempt to extrapolate from findings in rivers in wetter environments or from other continents.

Knowledge of the hydrology and ecology of the rivers of the arid zone is limited. This is due to the size and remoteness of the arid zone, the difficulty of attracting funding to an area considered largely undeveloped, and an historically held belief that rivers in the arid zone are nearly always dry. Hydrological cycles and corresponding biological responses take place over large temporal and spatial scales in arid zone rivers and their

study therefore requires expensive, long-term projects covering wide areas. The ARIDFLO model is intended to provide input to determining environmental flow requirements of Australian arid zone rivers, as well as to help prediction of the impacts that upstream water resource developments would have. The model will also have application to the restoration of the semi-arid rivers of the Murray–Darling Basin.

What are the management issues ARIDFLO addresses?

There is very strong community and government interest in the management of inland rivers, especially in the Lake Eyre Basin. For example, proposals such as the Currareva cotton project for Cooper Creek in Queensland (Walker et al., 1997) have confronted managers with the strength of community concern about water resource exploitation in these rivers, and highlighted the paucity of information relevant to the determination of environmental flows in such systems. The critical management issues that ARIDFLO addresses are the inadequacy of hydrological data, the more severe inadequacy of ecological data and the very limited understanding of environmental flow requirements for Australian arid zone rivers.

Many Australian arid zone rivers, even some very large systems, are hydrologically ungauged or very sparsely gauged. The Diamantina, for example, which is over 1,000 km long, has only one gauging station rated over the full range of flows. Further, many such rivers have complex geomorphology, high transmission losses and erratic spatial patterns of rainfall, so flood path prediction is extremely difficult. These are major issues for industries dependent on beneficial flooding, and also for managers trying to assess the impacts of water resource use. The hydrologic methodology of ARIDFLO will describe flow regimes in arid floodplain rivers for which no long-term flow data exist. This methodology will achieve this using satellite imagery, rainfall, climatic, hydrographic and geomorphological data and local landowners' records. The ARIDFLO model will combine the outcomes of this approach with the results of biological sampling to provide improved understanding of the environmental flow requirements of arid zone rivers. It will also help managers predict the likely biological outcomes of water resource developments and provide a monitoring program to support adaptive management.

Figure 1. ARIDFLO research project area.

What is the science behind ARIDFLO — how will it assist management?

ARIDFLO is based on three premises:

1. That field data on hydrology and biology, collected at appropriate temporal and spatial scales and subjected to sophisticated modelling techniques, can be used successfully to develop models of hydrology–biology relations in large rivers. Such an approach cannot establish cause–effect relations with the certainty of experimental science, but experiments on large rivers are seldom feasible. As long as management is genuinely adaptive, such models are valuable inputs.
2. That knowledge of hydrology–biology relations in relatively unmodified rivers can inform the management and restoration of modified systems.
3. That in large, highly variable rivers, sampling design and analysis must be structured at many scales. The ARIDFLO project will therefore be stratified at four spatial scales — rivers (3), river reaches (5), waterbodies (35), sites within waterbodies (70), and three temporal scales — multidecadal (flow regime,), multiannual (flow history) and subannual (flow pulse) (sensu Walker et al., 1995).

Although ARIDFLO will only be able to directly monitor responses over one year — an extremely short timespan for arid zone rivers — this year's data will be supplemented with data from a previous five-year study in this region (DRY/WET, Puckridge et al., 1999). ARIDFLO will also extend its window in time using remote sensing, rainfall data, landowners' records, and growth signals in fish otoliths.

The ARIDFLO project will use the hydrology–biology relations developed in the earlier DRY/WET model as hypotheses to be tested. ARIDFLO will test the predictions of DRY/WET against the new biological data collected in the one-year sampling program. The program will cover arid zone rivers in the Lake Eyre Basin in South Australia and Queensland, and will sample fish, macroinvertebrates, zooplankton, riparian plants and waterbirds. Flow, rainfall and patterns of wetland inundation will be monitored, and waterbody geomorphology described.

From the outcomes of the testing of DRY/WET, and in collaboration with pastoralists, industry representatives, interest groups, water resource managers and other wetlands experts, the first generally applicable model of relationships between flow regime, ecological processes and biological community structure for Australian arid zone rivers will be developed. Finally, an environmental monitoring program for the Lake Eyre Basin rivers will be designed.

Preliminary results

Sampling

Fortuitously, the year 2000 has brought the biggest floods in the Lake Eyre Basin since 1990. This has provided ARIDFLO with the opportunity to sample from an extreme flood peak through the drawdown phase and potentially right to the drying phase in many waterbodies — thereby capturing biological responses to a wide spectrum of short-term events.

Sampling in April 2000 close to the flood peak was, unfortunately, hampered by flooded tracks. Nevertheless, 24 waterbodies in 5 river reaches were sampled. In August, most tracks were dry and 65 sites in 33 waterbodies and 5 river reaches were successfully sampled for all biological assemblages. In both April and August, aerial surveys of waterbirds covered not only these sites but ranged more widely over the wetlands of the Basin. The waterbodies sampled were chosen to cover a broad range of flood frequencies and drying times, and relating biological structures and processes to these long-term hydrologic parameters will be an important component of the ARIDFLO model.

Hydrology

Data from the Diamantina Lakes and Birdsville gauging stations on the Diamantina River were analysed to identify the scale of transmission losses during flow events within this 330 km reach of river. Our analysis indicated that for flow pulses with total flow volumes at Diamantina Lakes of less than 1.2 GL, between 75–94% of the total flow volume did not arrive at the downstream gauging station at Birdsville. These extremely large decreases in discharge with downstream distance are typical of the rivers of the Lake Eyre Basin (cf. Knighton and Nanson, 1994) and their causes and effects are currently being investigated.

Eighteen automatic depth loggers and a salinity logger have been installed at key locations in the three river systems. The loggers on the Neales–Peake rivers are providing the only hydrographic data recorded for this system. On the lower Diamantina and lower Cooper, the logger data will be used to constrain transmission losses and the timing of flow events downstream of the gauging stations at Birdsville and Innamincka. Cross-sections and physico-chemical depth profiles at depth logger sites will be used in the hydrological analyses of waterbody water regimes and will assist in the geomorphological classification of waterbodies.

The depth loggers indicate that water levels in the studied waterholes on the Neales and Peake rivers have remained very stable since the flow event in April 2000, indicating that a long-sustained residual flow is still balancing water losses due to evapotranspiration. Around the Oodnadatta

Track, the recession flow is responsible for rapid increases in salinity in some of the waterholes. This long, saline flow recession possibly indicates a contribution from saline groundwaters to the Neales–Peake River (see below, *Implications of water quality variation associated with flooding*).

Biology

Biological responses to flooding. Zooplankton diversity in the Lake Eyre Basin rivers during flooding is unexpectedly high, and several new species have already been identified. The structures and composition of zooplankton and macroinvertebrate assemblages have also varied strikingly between waterbodies and between sampling times. It remains to be seen to what extent these variations are related to hydrology.

Larvae and young juveniles of bony herring, desert rainbowfish and Lake Eyre hardyhead were abundant in both April and August. Such a protracted and aseasonal spawning is likely to be an opportunistic response to the February–April flooding, and suggests that the Lake Eyre Basin fish assemblage is unusually responsive to hydrological events.

A large tally of waterbird species and some very large numbers of individual species have been recorded on the 2000 flood event. We have established that at least 45 species of waterbird bred during the floods; significantly, many species have bred through the autumn–winter months, but we expect greater spring breeding activity along the Lower Cooper. Many of the waterbird colonies have not been previously documented scientifically. Initial estimates suggest that in August there were 250,000 waterbirds on Lake Gregory alone, and that the total waterbird population in the study region numbered in millions over April to August.

Finding the locations of many of the large mixed-species breeding colonies has relied on information provided by pastoralists and other residents. This demonstrates the knowledge and experience in the local community. Two large-scale geomorphological features — tributary junctions and river bends — appear to be crucial in providing sufficient water-residence time for the large colonial nesters to complete a successful breeding cycle.

Implications of water quality variation associated with flooding. A widespread disease affecting most fish species and involving skin ulceration and fungal infection was apparent in April 2000, and there were reports on the lower Cooper and upper Diamantina of large fish kills. In August the incidence of this disease was greater, and in the upper Diamantina in Queensland it was epidemic. The epidemic was accompanied by very low dissolved oxygen levels and evidence of stress even in healthy fish. The cause of this is being investigated.

Fish assemblage variability is apparent between waterbodies, particularly in the Neales River and its tributaries. This river, because of its smaller size and high gradients (compared to the Cooper and Diamantina), has a more rapid flood progress, so its waterbodies are connected for a relatively brief time. In addition, some of these waterbodies are subject to highly saline inflows during flood recession. Waterholes that become disconnected early in the flood recession can remain quite fresh while waterholes upstream and downstream become saline. The likely source of these saline inflows is the Great Artesian Basin, however further work is required to confirm this. As a result of these features, the Neales is an extreme example of a spatially patchy aquatic system in which refugia for freshwater-dependent species must be crucial. This patchiness is reflected in the dramatic variations in fish assemblages between waterbodies.

ARIDFLO and inland river water management

The management of Australia's inland rivers is subject to increasing community, government and scientific interest. The development and management of some river systems in Australia has left a legacy of salinity, poor water quality and massive loss of biodiversity. This has resulted in reduced economic and social opportunities as well as a huge loss of conservation values.

Australia's inland arid zone rivers are now amongst the last in the world of their type that are relatively untouched by development. Communities, governments and all stakeholders are in agreement that sustainable development in these arid river basins is a priority. The challenge for the scientific community is to work with communities and governments to develop our understanding of these rivers.

ARIDFLO is an important step in that process. The ARIDFLO model will be available as a predictive tool in the assessment, management and monitoring of water-use projects in the arid zone, and in the restoration of arid zone rivers already affected by water resource use. It could be used to predict the likely outcomes of different water-allocation options. The model will be publicly released on CD-ROM (with an accompanying User's Guide) and in two versions — one for government/corporate agencies and one for landowners.

To optimise the contribution ARIDFLO can make, the sampling program of the project needs to be extended beyond its one-year timeframe. At the very least, the sampling should encompass two calendar years, to provide replication over seasons, and to provide opportunity to follow the present flood conditions through drawdown to drought.

Beyond the lifespan of ARIDFLO there are two clear issues. First, it is essential that there is improved, ongoing collection of basic water quality and hydrologic data on all major rivers of the Lake Eyre Basin. Results of ARIDFLO will be able to identify river reaches where such data collection would be particularly beneficial. Secondly, if the community is to get value for money from investing in research, it is important that the results of research are used in decision-making. This is more likely to happen when all key stakeholders have been consulted on the research, as they have been in the case of ARIDFLO.

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Panel discussion

Statement

Scott Parker, Environment Australia

The Lake Eyre Basin Inter-governmental Bill has just passed through the Senate with bipartisan support and is to go to the House of Representatives.

Clarification

Tom Baker, Environment Australia

What are the policy implications for groundwater management, especially in terms of management requirements for low flows and your recently outlined 'bathtub ring' concept where the majority of algal activity occurs within a narrow band around the edges of rivers and floodplains?

Response

Stuart Bunn

These systems have been recognised as highly dependant on groundwater inflow which helps sustain waterholes during the dry period. We don't know whether the delivery of nutrients for algal growth comes from surface flows or groundwater or both, and if it is the latter, to what extent it contributes nutrients for algae growth. Policy should reflect this interaction and not separate groundwater and surface water extraction issues.

Martin Thoms

It would be useful to know firstly which refuges are groundwater dependent and where they are located to be able to address the questions of:

- what are we talking about?
- how many are there?
- what is their longevity? and
- how dependant are they on groundwater?

Clarification

Graham Griffin, CSIRO Alice Springs

Martin, you made the point that the sediment transported down the rivers is small in comparison to rivers in other countries and therefore it was insignificant or not important. Could you think about the implications of processes which may distribute the sediment out onto the floodplains and then where further distribution is carried out by wind within catchments? These kinds of processes may mean the amount of sediment being transported around catchments may be much larger than you think.

Response

Martin Thoms

I said that the rate of erosion is high but the export is low, therefore most sediment is held in resonance. The floodplains are a temporary store for the sediment. There is re-working of that movement by aeolian (wind) processes which represents a very important aspect of sediment movements.

Clarification

Carol Godfrey, Lower Warrego Water Users Association

As a landholder, I wish to know who is driving and funding your projects and how are you going to get the results of those projects back to stakeholders?

Response

Richard Kingsford

This represents a big dilemma as, in the past, the endpoint for research was a scientific paper, as that was considered good for scientific careers. Now there is a much greater emphasis on scientists communicating results. However, the concept of 'stakeholders' varies in its definition and at times may encompass the whole of Australia. Decisions regarding the end product must involve discussion with landholders in the study area, as they are there for a much longer time than the scientist who does the research and then may move on to another area of study. If this knowledge is transferred to people who will be in that place for a long time, then the knowledge can be of greater long-term benefit.

Julian Reid

In the ARIDFLO project, feedback to the Basin community is a major plank of the project. Communication involves newsletters to landholders,

however one-on-one dialogue is also important, and this informal dialogue provides researchers with a whole new understanding of how systems function. Discussion over time also helps to make people aware. All key residents are getting reports as well as city people who have had an interest in the project. Multimedia is also targeted at all levels of understanding of the project.

Martin Thoms

We work with the community about what they need, so it is a two-way communication about what needs to be done and why. These discussions reflect the approach to the science, management and policy.

Stuart Bunn

At the CRC for Freshwater Ecology there has been extensive work on identifying key knowledge needs and how these can be delivered.

Statement

Siwan Lovett, Land & Water Australia

We have found that identifying the management issue to be addressed, and then looking at how available science can be used to address issues, is a much more successful way of dealing with things. Especially in comparison to taking each piece of research and trying to work out which management issue(s) it relates to.

Clarification

Stuart Blanch, Australian Conservation Foundation

How can this information be used to change water policy and what can we do about replacing the antiquated Murray–Darling Basin Agreement?

Response

Richard Kingsford

There have been major changes in water policy and within communities which is now beginning to be realised. In the past, many of these agreements just reflected water sharing. However, in recent agreements such as the Lake Eyre Basin Agreement, there has been greater inclusion of ecological knowledge which affects how these agreements are written and managed. It is this new approach which may assist in driving changes in the Murray–Darling Basin Agreement.

Clarification

Angus Emmott, Pastoralist, Lake Eyre Basin Coordinating Group and Cooper Creek Management Committee

I think what we need is a paradigm shift. People have been referring to taking information back to the community. If things are to be changed on the ground we will have to redirect and structure policy to include the community right from the start. It is important that we know what is going on and we are involved, and this is necessary to make progress. It's not just about water, there are other issues including economic and ecological issues. As a community, we are still not being involved. In addition, if we are to have effective community management, provision of funding has to be addressed as well.

Response

Richard Kingsford

At the moment there is a tension between government and community, and government and government, which adds complexities. But I do think the model that involves starting with a wide range of stakeholders is the way to go. Information has to be targeted to assist everyone to make decisions. However, at times, all stakeholder groups may not be actively involved. At this point the importance of good government becomes evident.

Stuart Bunn

How do we communicate and get everyone involved that has an interest? We could try to work one-on-one but to do that on a huge spatial scale is an impossible task, so I ask you how do we do this?

Julian Reid

There is a funding issue that needs to be addressed in this area. However, there is also the problem of the more players involved, the greater the chance for gridlock in the decision-making process. The potential for research to be bastardised depends on who is pushing it and funding it. It is important to have people involved but independent research is really important and we should not ignore the value of that.

Martin Thoms

This is also an issue of expectations. The community has a different expectation to researchers and vice versa and it is important to have a vehicle or platform to realise those expectations when research is undertaken. When I started my work, the community was this huge group, and it's not just pastoralists, it is also children, so I tend to speak in schools as well. But pastoralists have a different expectation of researchers and researchers have a different perspective on the community and that must be kept in mind.

Community panel presentation

A. Emmott, C. Godfrey, T. Whitelaw and L. Marshall

Mr Angus Emmott

Landowner and Deputy Chair, Cooper Creek Catchment Committee and Lake Eyre Basin Coordinating Group

Angus Emmett is a pastoralist living in the Cooper System between Longreach and Windorah in Queensland. He is the Deputy Chair of the Cooper Creek Catchment Committee and Deputy Chair of the Lake Eyre Basin Coordinating Group.

Thank you for inviting me to attend and speak at this important workshop on inland rivers.

In regard to any research being undertaken, local knowledge is extremely important and can be found in many different forms (local, communal, Aboriginal etc). Up until 10 years ago, in the area I live, there was little scientific knowledge collected about the area. As a result, local knowledge was the information I used to assist in managing my property because that's all the information that existed. This is still the case with many landholders in many areas.

It is significant that this workshop is taking place in Alice Springs because, in most cases, people in rural areas feel that most of the decision-making and policy-making is divorced from our lives, despite the fact it affects us.

Another point I would like to make is the increasing dichotomy between owner-operators and companies. Owner-operators have difficulty with maintaining control of the paperwork and are feeling swamped. However, company-operated properties are much better equipped to deal with this. Greater assistance needs to be provided for owner-operators to maintain adequate levels of participation.

Finally, the significance of independent research and also the importance of passing our environment on to subsequent generations is recognised. However, it is also important that we recognise the whole spectrum of the community and address how the community can be included as full stakeholders and partners. Only with this level of cooperation can we go forward.

Ms Carol Godfrey

Landowner and President, Lower Warrego Water Users Association

Carol Godfrey is a landholder and President of the Lower Warrego Users Association and the Tinnerbunna Landcare Group. Carol has lived at both ends of the Warrego River, which has given her considerable experience in this river system.

Thank you for inviting me to address this very important workshop on inland rivers.

A shared vision, which unites the stakeholders, is the key to establishing successful planning and management systems for inland river systems.

The Lower Warrego River Liaison Basin Group Report is an example of such a shared vision. All stakeholders came together and thrashed out this report, which then became the basis for sustainable management of the Lower Warrego River.

The principles underlining the success of the report can be summarised as:

- mutual respect between all involved in the process;
- a commitment to establishing a fair and sustainable outcome for the long-term management of the river basin;
- recognition of the value of scientific evaluation of information;
- use of the latest proven technology; and
- government recognition of the importance of open communication and transparent processes.

The Warrego River is in south-western Queensland, spreading from the Carnarvon Ranges north of Augathella to the Darling River at Bourke. Rainfall ranges from 24 inches [607 mm] of rainfall in the north to just 12 inches [305 mm] in the south. Geographically, the river is divided into two sections, with all water entering the river in the top half and leaving at the bottom end. Great concern amongst landholders in the lower region is felt when it comes to the extraction of water. Pumping thresholds and after-peak pumping are the foremost factors of importance for these land managers, whose main desire is to maintain riparian rights and beneficial flooding.

In January 1992, the Lower Warrego Water Users Association (LWWUA) was formed. The group was formed with the help and cooperation of most major stakeholders in the catchment: such as the Department of Natural Resources (DNR), the local Shire Council, Fish Re-stockers Group, land managers, Aboriginal representatives, and irrigators. The resulting report outlined key issues and addressed how the river should be managed to obtain a sustainable and ecologically balanced system.

Detailed record keeping of rainfall and flood events, going back to the early 1900s, and local knowledge were critical factors contributing to the accuracy and credibility of the report. The recommendations in the report included a concerted effort to address and manage the whole river for the long-term benefit of all parties concerned.

Since then, some of the other studies relating to the Warrego River have been:

- The Warrego Paroo Nebine Catchments Overview by DNR Queensland, 2000;
- Natural Resources of the Lower Warrego River System Report by Ray Dowell, September 1998;
- Report on the Cunnamulla Weir and Lower Warrego River by G. Whitehouse, 1996;
- Wetlands of the Paroo River and Cuttaburra Creek by King, Green and Brady, 1995;
- Report on Flow Measurement Survey in the Warrego River and Tributaries at Cunnamulla by Lawson and Treloar p/l; and
- Wetlands of the Warrego River System by King and Green, 1993.

The floodplain of the Warrego River covers 1.78 million hectares, with 457,772 hectares receiving beneficial flooding in most years. This area has 83 grazing enterprises supporting 108 families who produce wool, sheep, cattle and feral goats. A dollar value for flooding in this region has been conservatively estimated at $8.3 million over one year of a large flood, $7.21 million for a medium flood, and $3.81 million for a small flood event (R. Dowell, pers. comm. 1998).

I quote: "Although there is a substantial benefit to landholders in flood years, it is the sustainability of the enterprise and of the floodplain species which rely on flooding for species rejuvenation and the maintenance of biodiversity. For all of these reasons, landholders believe that the natural flooding regime must be protected, particularly in regard to small and medium floods." The huge financial and ecological benefit of a dry flood (where flooding is a consequence of rainfall further upstream, without rain falling on the property) cannot be overlooked.

A further issue of concern to landholders is that if licences could ever be traded and moved upstream of the Cuttaburra Creek outlet, the result would be to substantially affect beneficially flooded areas. Bird breeding grounds in the lower section of the Cuttaburra Creek basin would also be affected by this. Both these reports confirm just how important the area is to the ongoing breeding of our birds.

The recent water management plan (WMP) process saw DNR Queensland wanting the Advisory Group to start again from scratch. This attitude showed disregard for all the previous work that had been done. Following consultation with stakeholders, it was decided that the liaison report should provide the basis and starting point for the WMP. This has caused great concern upstream because all the water (1,500 ML) has been allocated downstream of Cuttaburra Creek outlet. This situation came about in the early 1990s when the LWWUA fought and won to stop all the water being allocated to ONE irrigator. The result of the group's activity was that the government put in place a transparent process which resulted in expressions of interest from landholders along the river. Licences for the 1,500 ML allocated to Queensland were then granted to the submitters of these expressions of interest.

Another issue causing concern is the lack of a scientific model for the river. The Queensland Government promised the model would be available last year. To date, the WMP Advisory Group still has not sighted the model. Stakeholders are becoming very concerned that local knowledge and figures will not be used in formulating the model. After so much local interest and concern about the management of the river in the past, DNR seems to be ignoring community opinion and formulating their own agenda and rules from the top down.

Property rights and tradeable rights are important issues. Most stakeholders consider the method of allocation to be fair, however the core issues of thresholds and after-peak pumping times need to be clearly defined to avoid future conflict. An enforceable planning structure must stand over the allocation in order to ensure sustainable management continues for future generations.

With regard to the management of the river, fencing off the river is definitely not the way to go. The Tinnenburra house paddock runs 2 horses and 50 rams and is on both sides of the Cuttaburra Creek. The paddock is destocked once each year for 3 months when the rams are joined. During this period, the kangaroos, pigs and emus take over and it is in worse condition then than when the rams are in it. A stocking rate that changes with the seasonal condition is both environmentally sound and financially sustainable. Land managers are in the best position to make this judgement.

The key factor regarding local knowledge, in my experience, has been that it must be this knowledge that is the basis for the shared vision to emerge. The role of science is to verify and correct this knowledge where necessary, and to supplement the emerging vision with the most effective arrangement of technology that is available. For the outcome to be successful, the whole vision must grow from the bottom up and not be imposed from above, under the guise of some form of community consultation. My experience is that stakeholders will show the dedication necessary to succeed if given the respect, responsibility and resources to complete the job.

Mr Trevor Whitelaw

Santos Ltd, Adelaide, SA

Trevor is a manager at Santos Ltd. He has spent 24 years at Moomba near Innaminka in northern South Australia. Trevor is currently on the Cooper and Georgina–Diamantina Catchment Committees, and the Lake Eyre Basin Catchment Group.

I wish to emphasis the importance of local knowledge and also the difficulties that people may experience when attempting to access it and use it. Local knowledge comes in many forms — it is not just held by the pastoralists. The use of appropriate, accurate knowledge must be effective, seen as effective and used over the long term. This avoids discussion and questioning of knowledge collected in the past.

Our catchment is huge and has suffered little impact from human activity. There is a small and sparse population in many of the rural catchments and this means that inevitably the same people seem to have to be involved in everything and on every committee, which in turn has raised financial issues. To date, discussions have not happened easily. The river is variable and intermittent and there is always discussion about extraction during floods and the effect on people and ecosystems downstream.

The Murray–Darling Basin is where the pressure will continue to build. Science has been lacking in the past and the work that was done did not have as much community input as today, resulting in concern and scepticism from the community when research and other activities are being conducted in their area. The ARIDFLO project has incorporated a good communication process which is starting to include local knowledge and will lead to a better result and better use of knowledge over the long term.

To add to Angus's point, my involvement on committees is made easier because I work for a large company that has resources to access data and distribute that information. It is especially difficult for private owner-operators to become and stay involved, especially in the current economic environment.

Ms Lesley Marshall

Landowner and Chair, Desert Uplands Build up and Development Strategy

Lesley Marshall is a grazier in the desert uplands of central-western Queensland and has been involved with Landcare since 1989. Lesley is now Chair of the Desert Uplands Build up and Development Strategy.

Lesley Marshall kindly accepted an invitation to make a presentation at short notice due to the unavailability of a colleague due to flooding between Longreach and Alice Springs.

I am a member of the Desert Uplands Strategy Committee. We operate within the catchment area for the Thompson River which flows into the Cooper. Coming to this workshop has given me the opportunity to speak to scientists and government people and to take some information back to my catchment area.

A small example of the practice of governments not consulting the community can be seen in activities undertaken by some people at Environment Australia, who have recently released a strategy which affects our catchment without any community consultation. Groups such as the one I am a member of can be used to input important knowledge into these processes, and to take knowledge back to the community. This helps to increase the acceptance of such documents and ideas. The statement that Martin Thoms made earlier in regard to figuring out what we need and where are we going is very important and this is not happening at the moment. This is an important point in addition to recognising that community acceptance of decisions increases with community input to that decision.

The issue of woody weeds is considered to be a very important issue where I am from and needs to be addressed. As a panel member, I was also asked to offer constructive criticism, therefore I would like to say to all the scientific people, please stop with the condescending attitude, because it makes community people feel irrelevant.

Panel discussion

Clarification

Drew English, North Central Catchment Management Committee

There seems to be a fair element of frustration, which perhaps indicates a problem with communication. We are at a point in time when communities are experiencing and asking for more prominence in natural resource management. Where do panel members consider we go now? However, a lot of agencies are starting to feel the same — their budgets are shrinking and their work is often ignored through public political statements, making them also feel irrelevant. Could you comment on this?

Response

Carol Godfrey

Our group recognises that science has a role to play, but its role is to verify the knowledge that is already in our system. The scientists need to understand that they are not the be-all and end-all of everything — the community members on the groups are in it for the long term and the scientific community needs to be aware of this.

Angus Emmott

I don't think there is discontentment or frustration, I think we just have to re-evaluate the way we do things to make on-ground change. No one seems to know how to effectively manage at an on-ground level. We need to rethink the importance of natural resource management and how we can effectively put science, policy and community into on-ground management.

Lesley Marshall

Maybe some of the projects could factor in the use of community groups into their funding applications as this would help to expand the communication a bit better. Our coordinator is expected to cover approximately 17,000 km^2. We need more resources and this could reduce some of the frustration.

Trevor Whitelaw

We go to great pains to include science. The things going on now are working and people are becoming more comfortable with the science.

Clarification

Chris Humphrey, Environmental Research Institute of the Supervising Scientist

Carol, what Indigenous concerns were incorporated during the negotiations you mentioned in the Warrego and how were they coordinated?

Response

Carol Godfrey

There were many Aboriginal issues raised involving inundation of sacred sites, however the issue of raising the weir level was out of our control. The Aboriginal people were also adamant that low flows were maintained for the health of the ecosystems. In the report, we have very strongly encouraged step-pumping thresholds and after-peak pumping to assist in maintaining these low flows. I personally went to great lengths to keep the Aboriginal people involved in the process and talk to them — they realised after a while that I wouldn't go away!

Clarification

Julian Reid, CSIRO Sustainable Ecosystems

Carol's situation is a classic example of the issues that come up between upstream and downstream water users, especially when it comes to extraction, however the issue of local autonomy was stressed. How do we deal with a community which has conflicting needs and where can science assist in managing this process?

Response

Angus Emmott

We need to look at smaller bio-regions within catchments. In our area, we have formed a group with all stakeholders to discuss issues and work on consensus decision-making, which often prevents decisions being made. These kinds of groups should include all

stakeholders not just pastoralists. However, we need funding to have the community involved, and when community is involved there is ownership and informed decision-making.

Lesley Marshall

The advice I could offer is try to work within existing frameworks when you go into a community. Don't enter a community and start new groups etc. because the community gets very tired — use what is there!

Carol Godfrey

We have different issues between the upper and lower part of the catchment and differences in extraction rates. Managing the water when it comes is critical, so while I agree with participation by everyone, we have problems because they want to extract the water, but in doing so they have a huge impact on us. Therefore, if they can exist by dryland farming and not have to irrigate then that is what they should do because the impact is too large on those downstream.

Clarification

Lynn Brake, Arid Areas Catchment Water Management Board

There has been much discussion about what is replacing NHT [Natural Heritage Trust]. What would you like to see replace NHT?

Response

Lesley Marshall

My understanding is that at a National Action Plan level they are looking at 80% community funding and 20% research funding. I think a lot of the NHT was misdirected until the devolved grants came into place. This should be considered when NHT is replaced.

Trevor Whitelaw

In an overall funding context, we need more support over a longer period of time, not just 2 years or whatever the usual length of the funding is. There should also be more funding to assist communities to deal with managing natural resource management issues.

Clarification

Kim Alvarez, NSW Department of Land and Water Conservation

Carol, you have discussed the Lower Warrego and the tensions that exist between river users in the north and south. What process have you used to bring the downstream people into your management activities?

Response

Carol Godfrey

We have local landholders on our group who also sit on the Border Rivers Commission and other groups downstream. This provides a two-way channel for feedback, informing them of what we are doing and providing information back to us about what they are doing.

Clarification

Siwan Lovett, Land & Water Australia

In your experience, what is the biggest barrier to what you are doing?

Response

Angus Emmott

The sheer size, distance, lack of infrastructure, communication and funding to allow us to communicate with people across the Basin are all barriers. Distribution of population is sparse which represents a major challenge to logistics and funding.

Lesley Marshall

I have been on this community group as an unpaid Chair for seven years and I am starting to suffer burn-out.

Carol Godfrey

In my area, it is the multi-jurisdictional issue — different laws in different States. We need assistance to get everyone together and communicate properly. This is a huge barrier.

Clarification

Tom Vanderbyl, Department of Natural Resources

I have been reading RipRap and Lake Eyre Basin coordinating newsletters — there may be potential for a little bit of cross-fertilisation of those documents. What potential is there for this?

Response

Carol Godfrey

We tried to get a newsletter together but had no money and could not get anyone to do it. We are working on it, but it takes time. NSW NPWS [National Parks and Wildlife Service] are putting together a CD-ROM which will hold information on the Warrego and Cooper rivers. It would be nice to have one report or place where all information can be stored for easy access.

Lesley Marshall

We have a newsletter but I am not sure how effective it is because paper is overwhelming people. I am not sure what the best method would be for communication other than one-on-one.

Angus Emmott

There could be the chance for cross-fertilisation between local knowledge and science. I am not sure about crossing the two newsletters though.

Clarification

Richard Kingsford, NSW National Parks and Wildlife Service

We have done a CD-ROM for some other rivers and we are working on the Cooper and Warrego. We are trying to capture all the information that exists, as scientists often publish in journals. CDs can be useful in trying to break down communication barriers.

Response

Trevor Whitelaw

That is good except, where I am from, some people can't get reliable telephone lines, let alone other forms of communication.

Clarification

Jenny Bourne, Environment and Heritage, Port Augusta

As a community member getting involved in these kinds of activities, it is about communicating with people outside of your comfort zone. How hard has this been for the people on the panel and what have been their experiences and barriers?

Response

Angus Emmott

It has been a major challenge to come out of my comfort zone on a regular basis, especially with the work involved in Lake Eyre. That's why partnerships are important and talking and becoming friends and partners — if you can't achieve that, at least you understand everyone's point of view.

Carol Godfrey

The most difficult thing for me was trying to communicate with and get respect from the local Aboriginal people. I had to do it by taking my kids down to the river and sitting down and talking to them. Now we communicate on a regular basis and they will stop me in the street to discuss something.

Lesley Marshall

The most difficult thing for me has been my involvement with government and all the government intricacies and personalities. There is also the problem of disagreement with personal friends. You have to believe in what you are doing and want to achieve things in natural resource management to get this far. It can cause a large amount of personal stress at times and it can affect your relationships with friends in your local community.

Trevor Whitelaw

Some of the biggest barriers have been getting together. We have had many problems and disputes and arguments, but over a period of time barriers have broken down and people are accepting that it is okay to have different opinions, but we can still work together.

Clarification

Stuart Blanch, Australian Conservation Foundation

The National Land and Water Resources Audit has recently released a document which shows extraction levels for Australian rivers. How does the community see this? Is it in the same way?

Response

Carol Godfrey

In the area I am from, extraction can only take place downstream by nine people. The reason the nine people have the licences downstream is to stop them going upstream and into the hands of people who could have a massive impact on us. Only one of the licence-holders wants to use their licence; the other landholders don't really want to use them. But as part of the licence agreement, it says they have to use it or lose it, which obviously affects extraction levels. The legislation does not allow us to use it to our best advantage.

State/Territory management agencies panel presentations

Inland river management in Western Australia

L. Pen* and P. Davies†

Dr Luke Pen

Program Manager, Restoration and Management, Water and Rivers Commission, Perth, WA

Luke Jerome Pen has a BSc (Honours) in Environmental Science and PhD in biology from Murdoch University. He has been involved in research into the ecology of rivers and estuaries of south-western Western Australia (WA) since 1981. His postgraduate Honours studies were on the fringing vegetation of the Swan and Canning rivers. Between 1984 and 1990, he worked at Murdoch University, conducting research into the effects of mine water effluent and agricultural land use on the Collie River ecosystems and on other aspects of south-west stream ecology. During this time he completed a doctorate on the ecology of freshwater fishes of south-western Australia. He is author of many scientific papers and reports on the ecology of south-western freshwater fish and the fringing vegetation of the rivers and estuaries of the south-west. In 1991, he turned from research to the management of water resources, mainly stream systems. Work has involved the description, classification, mapping and assessment of riverine and estuarine fringing vegetation, mostly in conjunction with the activities of Landcare groups. Between 1995 and 1998, he was involved in the assessment of river systems throughout WA as part of the Wild Rivers Project. His current position has as its main responsibility, the restoration and management of waterways in WA.

Western Australia (WA) has no formal policy for the management of inland river systems. However, inland river management is a component of rangeland management. By encouraging the implementation of total grazing management systems, catchment managers seek to manipulate grazing pressure to reduce impact on river and wetland systems. In contrast, restoration management of these systems is based upon traditional European perceptions of rivers, as well-defined channels with adjoining riparian zones of minimal width and broader floodplains requiring protection in order to achieve flood mitigation. Approaches based on this model may work for many south-western coastal rivers but are certainly inappropriate for most internally-draining inland river systems.

At the present time, there is little scientific knowledge on which to base policy for the management of inland rivers of WA. The State would seek to use the knowledge gained in other States and to extrapolate from limited research on such rivers as the Fortescue and Robe in the Pilbara, and the Fitzroy and Ord in the Kimberley, although neither of these areas of investigation are well inland.

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What knowledge is required and on what principles should this knowledge be based to improve the management of inland rivers?

Western Australia requires a sound understanding of the ecological functioning of its inland river systems within the context of their highly variable environmental settings. To facilitate this, appropriate ecological models of how inland rivers function are required. Although the Flood Pulse Concept has been proposed for our inland floodplain rivers, there has been little research to validate this model. Work in the Channel Country would suggest the Riverine Productivity Model might predominate during 'dry' season conditions and indeed that this model may predominate over much of the State, including the drier coastal regions.

The model(s) would need to include the ecological consequences of floodplain inundation and how unpredictability of flow influences ecological processes and biodiversity, and whether these river ecosystems exhibit 'boom and bust' productivity.

The work of Dr Peter Davies done in the Pilbara (Fortescue and Robe) and the Kimberley (Ord) suggests that highly episodic events (like cyclones) are an important determinant of aquatic community structure. However, initial research suggests that recovery for some groups (eg. molluscs and crustaceans) is slow (as seen from sampling the same pools in the Robe River for 10 years). Initially there was a strong predictive model between simple measurements of pool size and macroinvertebrate and fish community structure. This indicates a deterministic relationship. This model, after a 1:100ARI cyclone (TC Bobby), had little predictive success. Even now, 5 years post-cyclone, the community structure of the pools has not 'recovered' to pre-cyclone conditions.

In rangeland areas, research work would have to be placed within the context of heavy grazing pressure and altered fire regimes, particularly in the Kimberley and Pilbara regions. In the South-west and Goldfields regions, the highly salinised palaeochannel systems are the relevant context. In the South-west Region, clearing of native vegetation has hugely complicated this issue through enhanced groundwater recharge and surface flows.

On what principles and values should the management of inland rivers be based?

The principles of river management for WA's inland rivers should include those outlined in the Council of Australian Governments (COAG) water reform agenda in some circumstances, but more generally as covered in the Integrated Natural Resources Management and Water Quality Management Strategy. We need to consider ecological water requirements of all river systems. This will be difficult in 'unpredictable' systems with large floodplains. We need to consider that, due to high rates of aquatic production, inland rivers may also support terrestrial food webs — that is, any disturbance to rivers may influence ecological processes and biodiversity at a landscape scale.

One issue for the management of inland rivers is the usual requirement for resource developers to have a guaranteed allocation. How a predictable water supply can be delivered in an unpredictable environment must be reconciled.

Rivers in rangeland areas need to be recognised as focal points for grazing pressure and management regimes need to be developed with this in mind.

Many inland rivers are disturbed in some way, but retain important environmental, social and economic values. The management aims of these rivers will differ from pristine or high conservation systems, but should nonetheless aim to conserve in-stream and floodplain processes that underlie their ecological integrity.

What aspirations are there for the future management of inland rivers?

The Water and Rivers Commission, as the lead agency for State-wide management of rivers in WA, seeks to develop the sustainable use of water resources. This would include encouraging the development of sustainable waterway and land-use systems that have minimal impact upon river ecosystems and to ensure adequate allocations of water to environmental flows. The Commission is also encouraging the recognition of 'wild rivers' for the protection of 'near pristine' river values. Such rivers occur in all regions of the State, but are predominant in the Kimberley region. Other degraded rivers retain pockets of high biodiversity or high-value ecological function (eg. Millstream on the Fortescue River). These too require conservation and management.

Major principles for the future of inland rivers

C. Robson

Chris Robson

General Manager, (Water Planning), Integrated Resource Management, Queensland Department of Natural Resources and Mines

Chris Robson is responsible for the strategic direction, policy, project management operational guidelines and standards for the development and delivery of the Department's water planning and water resource monitoring and information functions. This includes the development, implementation, and evaluation of basic scale Water Resource Plans (WRPs) for surface and groundwater resources, the establishment of appropriate water resource monitoring frameworks, the preparation of water resource development strategies consistent with approved WRPs, and facilitating research on water resource and related biodiversity functioning through cooperative alliances.

Scientific basis for current inland river management and policy

Queensland's statutory water planning processes, such as the water resource planning process (formerly known as the WAMP or WMP process) aim to use the best scientific information available when developing allocation and management strategies. These processes:

- collate and, where necessary, audit existing relevant data sets managed by State agencies as well as from elsewhere;
- undertake river condition and trend assessments involving field surveys, hydrologic modelling and targeted investigations by technical advisory panels or other consultancies;
- gather scientific and technical expertise from a wide range of disciplines with members of the community within public forums and/or panel workshops to exchange experiences and develop possible environmental management strategies;
- commission targeted monitoring and/or research projects relating to specific areas or issues within or across river basins, particularly through the Cooperative Research Centres; and
- establish monitoring systems that assist in the assessment of the effectiveness of management strategies in achieving stated planning outcomes.

Knowledge requirements for improvements in the management of inland rivers

The water resource planning processes within Queensland's inland river systems have identified a number of areas of priority research including:

- improvement in the accuracy and precision of inland river flow monitoring and assessment, including greater integration with the monitoring, assessment and management of water quality and overland flow;
- comprehensive monitoring and assessment of the ecological condition and trends of inland riverine systems, including identification of the key flow and non-flow drivers, processes and responses associated with riverine health;
- identification of habitat requirements of inland river habitats (particularly the flow-related requirements of key flora and fauna species), and mapping of important habitats for the maintenance of inland river system biodiversity;
- examination of the impacts of floodplain development on the health of inland river systems, and identification of possible strategies for their improved management;
- more detailed study of the natural variation in ecological attributes of inland river systems, and the implications of accounting for this natural variability when developing management strategies or condition assessments for inland rivers; and

- examination of the impacts, interactions and contributions that man-made structures can have on the ecology of inland river systems.

Principles and values for the management of inland rivers

Chapter 2 of the *Water Act 2000* effectively sets out the purpose underpinning the allocation and sustainable management of water resources in Queensland as:

> "to advance sustainable management and efficient use of water and other resources by establishing a system for the planning, allocation and use of water."

Where **sustainable management** is defined as management that:

(a) allows for the allocation and use of water for the physical, economic and social wellbeing of the people of Queensland and Australia within limits that can be sustained indefinitely;
(b) protects the biological diversity and health of natural ecosystems; and
(c) contributes to the following —
  (i) improving planning confidence of water users now and in the future regarding the availability and security of water entitlements;
  (ii) the economic development of Queensland in accordance with the principles of ecologically sustainable development;
  (iii) maintaining or improving the quality of naturally occurring water and other resources that benefit the natural resources of the State;
  (iv) protecting water, watercourses, lakes, springs, aquifers, natural ecosystems and other resources from degradation and, if practicable, reversing degradation that has occurred;
  (v) recognising the interests of Aboriginal people and Torres Strait Islander people and their connection with the landscape in water planning;
  (vi) providing for the fair, orderly and efficient allocation of water to meet community needs;
  (vii) increasing community understanding of the need to use and manage water in a sustainable and cost-efficient way;
  (viii) encouraging the community to take an active part in planning the allocation and management of water; and
  (ix) integrating, as far as practicable, the administration of this Act and other legislation dealing with natural resources.

And the **efficient use** of water:

(a) incorporates demand management measures that achieve permanent and reliable reductions in the demand for water;
(b) promotes water conservation and appropriate water quality objectives for intended use of water;
(c) promotes water recycling, including, for example, water reuse within a particular enterprise to gain the maximum benefit from available supply; and
(d) takes into consideration the volume and quality of water leaving a particular application or destination to ensure it is appropriate for the next application or destination, including, for example, release into the environment.

The *Water Act 2000* also sets out the **principles of ecologically sustainable development** as:

(a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;
(b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;
(c) the present generation should ensure the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;
(d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making;
(e) recognition of the need to develop a strong, growing and diversified economy that can enhance the capacity for environmental protection; and
(f) decisions and actions should provide for broad community involvement on issues affecting them.

Aspirations for the future management of inland rivers

Some of the key aspirations of a water resource manager from an agency such as the Queensland Department of Natural Resources and Mines are:

- achieving an acceptable balance between the appropriate allocation/usage of water resources and the protection of the health of a river system;
- greater awareness, understanding and commitment to the application of the principles of ecologically sustainable development by individuals, groups and agencies involved in the use, management or protection of natural resources;
- implementing improved water resource and river health monitoring systems that better inform all stakeholders on river condition trends and the effectiveness of their management strategies and actions; and
- increased participation by the community in processes and studies relating to the improved management of natural resources, including the fostering of stronger partnerships between scientists, members of the community and agencies in such activities.

New South Wales State policies driving inland river management

K. Alvarez

Kim Alvarez
Director, Water Management Systems, NSW Department of Land and Water Conservation

Kim has worked for the Department and its predecessors in the water area from 1975 to date, has a background in hydrology, and has worked in the water policy area including interstate agreements as well as operations. Kim spent 5 years as the Regional Director Murray managing both land and water in his rather large 'backyard' extending from Kosciusko to the South Australian border and up the Darling to Menindee. The catchment-based management approach comes naturally when overseeing that part of the Murray–Darling Basin. Kim has recently been instrumental in drafting the new NSW *Water Management Act*.

The New South Wales (NSW) Government is committed to the principle of a balance between the environment and water consumers.

All streams in NSW will be managed according to statutory plans.

The balance is achieved via a ten-year statutory plan which defines the gross share of the water that is harvestable by users, and is expressed as a long-term average diversion.

The plan is developed by the community and government in partnership. The plan must target particular and measurable environmental outcomes, but must do it in the understanding of the economic and social costs.

Committees must, when developing a plan, apply the principles of:

- sustainability;
- precautionary principles; and
- adaptive management.

Government will only intervene in the circumstances where unanimous agreement cannot be reached on outcomes by the committee. Both the Water and Environment Ministers must sign the plan.

What do farmers get?

- 10-year investment security, ie. no change to access rules for ten years;
- compensation for mid-term changes;
- a robust trading market, ie. get more money from less water; and
- a defined, tradeable property right in terms of volume and reliability.

What does the environment get?

- A better share of the resource;
- management decisions that favour environmental outcomes for the water available; and
- statutory adjustment mechanisms that protect against erosion of environmental outcomes because of development.

All water-sharing plans must, by statute, assign water according to priority outcomes:

1. Protection of environment
2. Basic domestic rights
3. Harvestable rights (ie. the rights to a small share of run-off from owned land)
4. Licensed diversions
5. Supplementary water (flood harvesting).

Summary

NSW water reforms represent a real change from the past. The process of river management recognises the requirements of human habitation and the natural environment. In NSW, the status quo is not good enough. These reforms are aimed at realising actual river improvement. The rules are robust and backed by statute in order to protect against future erosion.

Management issues for the inland rivers of the Northern Territory

S. Townsend

Dr Simon Townsend

Manager, Water Monitoring Section, NT Department of Lands, Planning and Environment

Dr Simon Townsend is Manager of the Water Monitoring Section, with the Natural Resources Division in the Department of Lands, Planning and Environment. The focus of his work is in the wetter parts of the Northern Territory. He has undertaken investigations into a wide range of water quality issues, including the effect of fire regime on stream water quality, floodplain grazing on billabong water quality and, closer to Central Australia, studies into the water quality of Mary Ann Dam near Tennant Creek and the Longreach Water Hole near Elliot. He is currently working on the use of river algae and their response to river flow, and the implementation of a water monitoring system for Darwin Harbour and its catchment.

The rivers of the Northern Territory arid zone are characterised by significant seasonal and inter-annual variability in flow, typical of inland Australia. Northern Territory (NT) Government policy underpinning the management of these rivers, and indeed their catchments, is one of ecologically sustainable development. The *Water Act* provides for the declaration of beneficial uses (equivalent to environmental values) of waters, including groundwater and riparian/floodplain ecosystems, thereby providing a river management objective.

The river systems and alluvial floodplains of arid NT constitute corridors of relatively rich and moist soils, and dense vegetation compared to the surrounding landscape. These corridors contain a diverse flora and fauna, and are amongst the most productive grazing land. Furthermore, the river systems are an increasing focus of tourist and recreational activity.

Water resource use is predominantly from groundwater sources that supply potable water for all townships and communities in the region, and irrigation water for some limited agriculture. The most significant groundwater extraction for agriculture occurs at Ti Tree. In accordance with NT Department of Lands, Planning and Environment water allocation and beneficial use policies, the groundwaters of the Ti Tree region will be a declared agricultural beneficial use. The surface waters are planned to be declared 'ecosystem protection' in recognition primarily of their groundwater recharge significance. This approach is likely to be policy for the arid zone.

Importantly, the inland rivers of NT are not regulated: there is no diversion or retention of surface water, excluding farm dams that store a minor portion (<0.01%) of total run-off volume. Water supply needs for potable and agricultural use in the region are provided from groundwater sources. The hydrology of arid NT for the most part has not been modified by anthropogenic activities, though small-scale impacts exist (eg. urbanisation).

The major management issues for the river systems and their floodplains in the arid zone of the NT are:

- Weed infestations — disturbed bank and floodplain soils following major floods are vulnerable to weed infestation. Weeds threaten the biological diversity and ecological integrity of the floodplain, either directly through the displacement of endemic species or indirectly by, for example, altering the fire regime. The weeds of prime concern are athel pine (*Tamarix aphylla*), Mexican poppy (*Argemone ochroleuca*), couch (*Cynodon dactylon*) and buffel grass (*Cenchrus ciliaris*). Measures to control these weeds are undertaken to varying degrees by landowners, Aboriginal communities, community groups (eg. Greening Australia, Waterwatch), the NT Department of Primary Industries and Fisheries, and the local government. A NT and national strategy is currently in draft form for the management of athel pine, whilst a Mexican poppy management strategy is under review.

- Soil erosion at local (eg. tracks and road crossings) and larger scales. This is compounded by periods of drought when vegetation cover is reduced.
- Fire and its interplay with grazing in the riparian zone. Grazing indirectly favours the growth of woody shrubs and hence displaces grass, reduces the frequency of fire, and enhances the density of shrubs.
- Total grazing pressure from cattle, rabbits, donkeys, camels, and horses, as well as native animals, on floodplain vegetation with resultant ecological and soil conservation consequences.
- Exotic aquatic fauna — potential exists for the introduction of exotic aquatic species to the arid zone. Recently, the exotic mosquito fish was introduced to wetlands near Alice Springs, but it is believed to have been eradicated.
- Management of permanent and temporary waterholes — these provide habitat and refuges for a range of flora and fauna, as well as being water sources for introduced and endemic animals. These waters are impacted by cattle use. Some waterholes are a focus of tourist activities, with as many as 250,000 people visiting the more popular sites annually. Access issues and visitation pressures to arid zone waterholes are expected to increase with continued growth of tourism.

Whilst the above issues are readily visible, their extent and ecological consequences are not fully known, with the likely exception of athel pine. The scientific basis of river and riparian management is based largely on terrestrial, rather than aquatic, focused studies. The state of knowledge about the river systems is far from complete, as exemplified by current inventories and descriptions being undertaken of wetland flora and fauna by the Parks and Wildlife Commission of NT, and the hydrology of Finke River by the Department of Lands, Planning and the Environment. Management of the inland rivers of NT would benefit from a greater understanding of river hydrology, geomorphology, aquatic ecology, riparian (floodplain) ecology, and their inter-relationships.

Managing South Australia's inland rivers

B. Cohen

Bernice Cohen
Senior Policy Advisor, SA Department for Water Resources[1]

Bernice has had extensive experience in natural resource management and planning. Her experience includes environmental assessment, National Park and regional planning, project management in natural resources management, and she is currently specialising in inter-jurisdictional issues. Bernice has had a primary role in negotiating the Inter-governmental Agreement for the Lake Eyre Basin on behalf of the South Australian Government.

Introduction

South Australia's inland rivers[2] may be divided into three broad categories:

- rivers of the Lake Eyre Basin;
- rivers and creeks of the Flinders and Gammon Ranges; and
- ephemeral creeks of the north-eastern pastoral, Gawler Ranges and Aboriginal lands.

The most widespread land uses associated with South Australia's inland rivers are:

- pastoralism (cattle north and sheep south of the dog fence);
- conservation reserves; and
- Aboriginal freehold and trust lands.

Other land uses which may affect inland rivers are oil, gas and mineral exploration and production, and tourism.

Legislation developed over the past 15–20 years generally has a collaborative approach to management. Therefore, a key feature in South Australia (SA) is engagement of government, industry and community in planning and management of water and other natural resources.

Key issues

The major inland rivers share a common feature: they are essentially unregulated and therefore present an excellent opportunity to retain their natural, variable flow regimes. The key issue is management of catchments, riparian zones and wetlands to retain variable flow regimes and for soil conservation, geomorphological integrity, biodiversity conservation and water quality. A key challenge is to ensure current and future land users manage for these values, as well as for relevant social and economic values.

The Cooper Creek and Diamantina River in SA are at the downstream end of these systems and therefore SA has a vital interest in land and water management upstream in Queensland. The Commonwealth, Queensland and South Australian Governments signed the Lake Eyre Basin Agreement in October 2000.

Legislative basis for managing South Australia's inland rivers

Several pieces of legislation incorporate principles for managing South Australia's inland rivers and their catchments and floodplains. The most important for the inland rivers are:

- *Water Resources Act (1997)* and the associated statutory State Water Plan;
- *Pastoral Land Management and Conservation Act (1989)*;
- *National Parks and Wildlife Act (1972)*;
- Lake Eyre Basin (Inter-governmental Agreement) Bill 2000 (which when passed will give effect to the Lake Eyre Basin Agreement signed between the Commonwealth, South Australian and Queensland Governments); and
- *Petroleum Act (2000)*.

1. The views expressed in this paper are those of the author and do not necessarily represent the views or policies of the South Australian Department for Water Resources.
2. This paper focuses on South Australia's inland rivers which have not experienced a high level of management and research effort. For this reason, the Murray–Darling system is not included

The draft *Integrated Natural Resource Management Bill*, which is currently at the consultation stage, is intended to integrate natural resource management in SA.

The Arid Areas Catchment Water Management Board has been established under the *Water Resources Act* and will prepare a catchment water management plan which will be consistent with the State Water Plan and the Lake Eyre Basin Agreement.

Principles and practice in South Australian legislation

Examples include:

The ***Water Resources Act (1997)*** requires all individuals and bodies responsible for administering the Act to have regard for:

- maintaining or improving the quality of naturally occurring water with resulting benefits to other natural resources, including land, soil, native vegetation and native animals;
- protecting watercourses, lakes, surface water and groundwater from degradation and to reverse degradation that has already occurred;
- protecting and enhancing ecosystems which depend on naturally occurring water;
- keeping the state and condition of water resources under review;
- identifying alternative water sources;
- encouraging the community to be actively involved in planning and management of water resources;
- promoting public awareness; and
- integrating as far as practicable the administration of the *Water Resources Act* with other legislation dealing with natural resources.

The **State Water Plan** is a State-wide statutory document which is strong on environmental principles. All other water plans need to be consistent with the State Water Plan.

The **Lake Eyre Basin Inter-governmental Agreement** has a set of 10 guiding principles which include:

- naturally variable flow regimes and the maintenance of water quality are fundamental to the health of the aquatic ecosystems of the Lake Eyre Basin;
- flooding makes a significant contribution to pastoral activities and to ecosystems;
- there are linkages between groundwater and surface water systems;
- precautionary approaches need to be taken to minimise impact on the environment;
- recognition of the national strategy for ecologically sustainable development and of other national and international obligations;
- local knowledge is important; and
- decisions need to be based on the best available scientific and technical information together with the collective local knowledge of the Lake Eyre Basin communities.

The ***Pastoral Land Management and Conservation Act (1989)***:

- provides for the conservation of the flora and fauna of pastoral lands, and assessment and monitoring, in order to evaluate how sustainable stock grazing practices are on each pastoral lease;
- the assessment process relies on the establishment of permanent photo-points in typical areas within the grazing range of each waterpoint on each lease. Remote sensing technology is used to augment on-ground assessment methods;
- these waterpoints are often in or associated with the major river systems in the northern cattle lands of SA;
- much of the productive country is associated with the extensive floodplains or braided channel systems of our northern rivers, and hence our monitoring of pastoral usage often concentrates on these land types; and
- where the on-ground assessors note overgrazing or use of the riparian or floodplain communities, the area in question is designated as a 'priority' area for action, but it is left to the lessee to determine how he or she will address the issue. These areas are more frequently monitored for evaluation of trends.

Aspirations for future management

- Active management of catchments, riparian zones and wetlands to protect biodiversity, sustainability and water quality under existing and future management land uses.
- An uncompromising policy environment to ensure that natural, variable flow regimes are maintained.
- Effective development of the Lake Eyre Basin Agreement to protect the values of the Basin, including the Coongie Lakes Ramsar Wetlands.
- Building on existing and emerging partnerships between local communities, city-based stakeholders, governments and industry.
- Research projects will always include a component for interpretation, explanation and consultation with communities.
- A much greater research effort, in particular:
  - continuation of the ARIDFLO project over three years in the first instance, and continuation of the project in the future under different environmental conditions, eg. exceptionally low flows, continuation at indicator assemblage sites over a longer period of time;
  - cost-effective, long-term monitoring, including an evaluation of the adequacy of gauging stations, and

other monitoring data, eg. as required by the Lake Eyre Basin Agreement;
- contribution of refugia to overall river health and ecology;
- population dynamics of fish in those areas subject to significant commercial and/or recreational fishing;
- effects of the various land uses in the river catchments on the geomorphology and ecology of the wetlands;
- causes of and remedial management for apparent extensive and rapid dieback of river red gums along creeks and rivers in the Flinders Ranges;
- hydrological relationship between surface water and groundwater and appropriate management regimes;
- pre-emptive mapping, identification of risk and research into salinity risks (before they become an intractable problem);
- effects of relatively small-scale water interceptions on river hydrology and ecology, eg. small-scale irrigation, farm dams, turkey nests etc.;
- responses of riparian vegetation to changing and/or improved management practices;
- social, economic and cultural value/importance of inland rivers, including a comparative valuation of flooding;
- cultural value of waterholes;
- strategies for incorporating Indigenous management practices into inland river management;
- strategies for incorporating scientific management practices into inland river management; and
- strategies for integrating local knowledge, Indigenous management practices and scientific knowledge into inland river management.

Thanks to Jenny Bourne, Lynn Brake, Brendan Lay, Michael Good, Jim Puckridge and Claus Schonfeldt for their information, advice and assistance.

Panel discussion

Clarification

Leith Boully, Land & Water Australia

There is a fairly low level of trust between community and government at the moment. How can you explain this?

Response

Kim Alvarez

This has been a historical development — hopefully it won't be true in future. We now have legislation that requires government to involve communities in the decision-making process.

Bernice Cohen

The level of distrust is patchy — I do not think it is totally this way. It also cuts both ways. I have seen significant change over the last five years. I have been to meetings where the community has been extremely abusive to government representatives, but this has not been recently. There have been changes and people are now sitting around the table and having discussions. It should also be remembered that government employees have to work under political masters, and also there are issues that communities elsewhere believe are important. This does not always sit comfortably in local areas.

Luke Pen

Objectives can also be skewed. I worked in one area where the outcome we wanted was better quality water, however we find that we are just helping people fix their land, which won't give us the outcome. We have to be honest.

Chris Robson

I agree with Bernice in that the level of trust is variable depending on where you go. But there is no doubt there is a level of distrust in our processes. Some people don't trust science and sometimes people in the community do not have the same objective in mind as government. We are trying, but when we have to deal with imposed timelines and the like, it makes it harder to work with the people affected. Legislation is very prescriptive and this has to be worked on. Agencies are also always asked to review their processes so there is always the chance to improve.

Statement

Jenny Atkins, Central Land Council

I have a local example of how community aspirations have been met. Aboriginal people in the Todd and Charles catchment have had a strong role in how the river is managed. This is illustrated by issues regarding fire, couch grass and protection of sacred sites.

Clarification

Sean Hoobin, World Wide Fund for Nature

Recently the Queensland branch of the World Wide Fund for Nature has been doing some good work in terms of a process to get scientific information incorporated into new legislation regarding allocations. One other theme looks at links between science, legislation and management. For example, in the new WAMP [water management plan] for the Condamine–Balonne, the information collected on ecological requirements of the river system has been ignored. Ironically, this also means that Queensland legislation has not been met. Why has this process fallen down, considering the large amount of information involved?

Response

Chris Robson

At the end of the day, the Government has to decide what form it wants to release the information in and we have provided options/scenarios. The advice provided by the technical panel has been taken on board by the Minister and it is part of a balanced debate — environment, social and economic. It is one input. There is still information and published reports provided for transparency, and the science is always evolving. In terms of consistency with the Act, the scenarios are not currently consistent with the Act because the drafts were released prior to the release of the Act. Therefore, when the final draft is released it must comply with the Act.

Clarification

Don Blesing, Lake Eyre Basin Coordinating Group

The institutional arrangements vary across the five States. We require smarter structures that incorporate broad NRM [natural resource management] issues and better or improved decision-making frameworks. What are the innovations in structures and decision-making which may be valuable in your area?

Response

Luke Pen

As I see it, we take an evolutionary approach to dealing with issues and the flavour of the month is a project management framework with a set start and finish time. I favour a process which allows a partnership approach with the community where trust is achieved, and it is capable of evolution as new information is provided from all stakeholders.

Bernice Cohen

I believe I covered that in a general sense, but the most innovative is the establishment of the Arid Areas Catchment Water Management Board and also the establishment of the Lake Eyre Agreement. The way we deal with the community will change over time and is getting better, however it is still an area where more effort and better directed policy are required. The innovative policy changes are only new and are yet to be tested and implemented. A similar workshop in five years will allow further discussion regarding their effectiveness.

Kim Alvarez

Innovation needs to be fostered. We don't know all the answers right now — if we did, it would be done. However, we do tend to get set in one direction and maybe frequent reviews can assist us in exploring new options and finding innovative solutions to problems.

Chris Robson

At the Department, we have restructured and it's difficult to avoid 'silos' and maintain adequate cross-section discussions and integration. At the moment, we now have separate planning and managers so as to be better organised. The most important thing is the implementation of National Action Plan, which is calling for community action and involvement.

Clarification

Richard Kingsford, NSW National Parks and Wildlife Service

All your agencies have mainly been charged to develop the water resource (or have done in the past), so how do the water agencies define the word 'balance'? Many of the decisions to develop water resources have been made within water agencies.

Response

Chris Robson

There are catchments where people want developments and catchments where they don't want development. All I can say is that our water resource process aims to be transparent and bring science to the table so people making decisions can understand the implications of their choices about development. It is not our role to promote development — we do provide allocation frameworks, but if there is a development opportunity the decisions made about how it is to be developed won't be managed by DNR [Department of Natural Resources], but probably by the Department of State Development.

Kim Alvarez

There are certainly some streams under-developed and some over-developed. Achieving balance between user groups should provide the best way forward in terms of development. The market is a good way of moving water around from bad to generally accepted good use. It is recognised that up to 90% of water used at the moment is not being used efficiently which means that there is more opportunity for development in existing water resources, which far outweighs going through long-winded processes to find the last unused megalitre.

Simon Townsend

I am optimistic that future development will have pressure to develop responsibly and meet its obligations because there will be a political environment which demands this.

Bernice Cohen

In South Australia, there is very little water available for development, despite a continual pressure to develop from politicians or communities. There will always be a price to pay for developing or not developing and, as bureaucrats, we have to be up-front about the price we have to pay either way.

Luke Pen

I usually find that after we have set the balance and no-one is happy, it is the right balance!

Clarification

Stuart Blanch, Australian Conservation Foundation

It is wrong to say that the government has no moral obligation when it comes to decision-making. Leaving it for greenies and landholders to battle it out is passing the buck. Recovery of threatened species is an example of where the government should be acting on its moral responsibility and making the necessary decisions.

Response

Kim Alvarez

There are obligations under our Act which we must meet, and these include community partnerships. I don't think it is our role as bureaucrats to take a moral stance. I think our role as bureaucrats is to provide a balanced amount of information so the community makes the decision. As government, we should not be into changing allegiance from supporting irrigation development to supporting the green groups. We manage to the outcomes that result from a balanced discussion from such groups.

Session 2, Day 1

On what principles and values should management of inland rivers be based?

What do we need to know to improve management?

Summation

L. Brake

Mr Lynn Brake
Arid Areas Catchment Water Management Board

It was fortunate to start off the conference with the history behind the naming of the Todd. The European naming of the river came late in the river's long history of occupation and use. Inland rivers have been the basis of human activity for a long time and the Todd is still a big part of life today.

Lynn went on to provide an elegant summary of the individual presentations from the first morning's session. In summing up, he outlined that the goals of this seminar are to find the links behind science, management and policy and the knowledge gaps to improve management.

Things we have heard this morning give a good place to start and have provided more questions than answers. What happens to science when you are looking at economic and social issues, not just environmental issues? An important question to ask is whether finding a 'balance' is going to stop our ever-increasing natural resource debt.

Thought provoker

Mr Andrew Campbell
Chief Executive Officer, Land & Water Australia, Canberra, ACT

Andrew Campbell has been Executive Director of Land & Water Australia since February 2000. Before that, he was a senior executive in Environment Australia, responsible for the development and management of the $360M Bushcare program under the Natural Heritage Trust. He came to Environment Australia in 1995, fresh from three years of postgraduate study at Wageningen in the Netherlands and sociological research based in Toulouse, looking at the social basis of French rural and agricultural policies. He is a fifth-generation woolgrower from western Victoria who started professional life as a forester, was instrumental in the development of Landcare in the late 1980s and was Australia's first National Landcare Facilitator from 1989 to 1992.

Mr Campbell was invited to provide a short 'thought provoker' focusing on key management principles and knowledge gaps for inland river systems.

Mr Campbell began with some quotes to impress on the audience that the fate of our inland rivers is not pre-destined; it is reliant on the choices we make about their future management. The quotes were:

> "the future is not some place that we are going to end up — but a situation we are creating"

and

> "paths to the future are made, not found".

Mr Campbell noted the importance of drivers that affect the choices we make and therefore assist in governing changes in the way we manage our natural resources. Some important drivers include global markets and, more precisely, issues involving capital, trade, and ideas originating in a global context. Also identified was the constant development of new technology to assist in both making decisions and solving them. The development of new, useful technology is increasing exponentially. Lifestyles and aspirations were also considered to be an important driver of change and one that is rising in prominence. As a final point, Mr Campbell recognised the importance of resource degradation and resource pressures as another significant driver of change which can be found at an international level.

In order to further encourage participants to consider the 'situation we are creating' Mr Campbell offered three simplified scenarios referred to as 'potential development trajectories'. These were:

- flat to the boards;
- clean and green; and
- landscape stewardship.

Flat to the boards

- Increased population pressures
  - 50 million population nationally
  - ten-fold increase in population in the rangelands
- Development of inland and northern waters
- Intensive livestock production in northern Australia
- Irrigated and opportunistic cropping
- Exponential growth in tourism pressures

Clean and green — increasing pressure, but more sensibly

- More intensive, but more professional
  - twice the level of production on half the area of land
- Environmental management systems (EMS)
  - enterprise level
  - industry level
  - landscape scale
- Driven by
  - access to market
  - licence to operate
  - exploiting market niches

Landscape stewardship

- Landscape focus
  - recognition of uniqueness, distinctiveness
  - keyed into national identity and positioning
  - landscapes are socially constructed
  - mix of public and private values
  - areas of consumption and production
- Policy and market settings
  - based on 'rational economics'

  - reward ecosystem services
  - penalise activities that degrade or deplete
- Most income is derived from **Australian** biota and landscapes (move away from European production systems and animals). Professional production systems are based on animals and plants with which no other country can compete.

Having covered the points under each trajectory, Mr Campbell stated that regardless of which direction we choose to move toward, we need to ask: what information do we need to make these choices? Are there any variations? What are the downsides to the choices we make and what are the alternatives?

Reporting on discussion in small workshop groups

1. **On what principles and values should the management of inland rivers be based?**
2. **What knowledge is required and on what principles should this knowledge be based to improve management of inland rivers?**

The workshop participants were divided into small groups to discuss one of these two questions. Each group then gave a short report on their conclusions.

The White, Black, Green and Red Groups discussed question 1, ie. On what principles and values should the management of inland rivers be based?

White Group

The White Group representative remarked that a number of group members thought they could have done better if they knew more about the expected outcomes of the workshop. The White Group also noted that it would have been useful to have discussed values before the discussion about principles.

- Should articulate and agree on values for establishing principles
- Management and policy should be based on best available knowledge (best available knowledge should encompass all types including local and Indigenous)
- Community involvement in decision-making is essential for effective outcomes
- Management should consider holistic and integrated approaches at a landscape scale
- Do not forget ecologically sustainable development principles
- Maintenance of ecological processes is a/the primary consideration (this caused some debate in terms of what should go first — environment, social, or economic etc. This is why values should be discussed first)
- Equity
- Reconsider current conditions
- Precautionary principles are a given.

Black Group

1. Adaptive ecosystem management — 'ecosystem' is all encompassing
   - maximising outcomes
   - learn from the past, adapt and develop for the future
   - ecosystems include humans
   - recognise interdependencies
2. Participation from stakeholders for decision-making (participatory management). This has been a big issue during this morning's sessions, however stakeholders who are participating in decision-making should also be responsible for the outcomes of those decisions
3. Social, environmental and economic
   - a balance
   - may change through space and time
4. Scale management to the system being managed
5. Framework for communicating shared information: this process is in decline and needs to be restored or replaced.

Green Group

The Green Group treated principles and values as the same, except to acknowledge that principles flowed from values. The Green Group thought there should be quadruple environmental management — environmental, economic, social and cultural. There was also recognition that the aspects making up environmental, economic, social and cultural systems may have different spatial and social boundaries and time-lines.

- Sustainable environmental management should arise from clear and honest processes developed on dialogue and trust and based on integrating economic, environmental, social and cultural elements.
- Wise management recognises the need for a whole-systems approach, but needs to account for different boundaries that may be applied to aspects of the system.

- Management decisions should be made with the best available knowledge (local/scientific) and the impacts of those decisions should be monitored.
- Commercial production 'invests in what is here' (Australian flora and fauna) and does not rely on new introductions of invasive flora and fauna.
- Recognised best management practices should be used to protect or improve natural resource condition for the equal benefit of future generations.
- The intrinsic value of biodiversity should be recognised and conserved.
- The importance of the natural variability of the flow regimes of inland rivers should be recognised and protected.

Red Group

The Red Group noted that you have to remember that most of the future stakeholders have not been born yet.

- Community involvement
  - opportunity for all
  - not just at a table
  - do those most affected have a greater say?
  - feedback and education
  - agree on outcomes and goals
  - transparent process
  - parameters — there are boundaries within which effective community consultation can take place
- Ecology
  - protect naturalness
    - higher conservation values
    - ecological process
  - improve degraded systems
    - to what level?
    - cost and practicalities
  - environment comes first, which could mean development is constrained
- Best science
  - independence (arms-length from business and government)
  - decisions based on best science
  - adaptive
  - the higher the risk, the higher the level of monitoring and funding (it should be in proportion).

The Yellow, Orange, Blue and Pink Groups discussed question 2, ie. What knowledge is required and on what principles should this knowledge be based to improve management of inland rivers?

Yellow Group

The Yellow Group representative commented that, before starting, the group had decided to split 'knowledge' and 'principles', and to answer each separately.

Principles

- Relevant spatial, temporal scales (long-term)
- Knowledge is defensible (independent, high quality, peer-reviewed)
- Targeted, timely for decision-makers
- Knowledge is understandable, can be shared and is shared
- Collaborative identification of knowledge requirements involving all stakeholders and culturally sensitive
- Adequately resourced
- Interdisciplinary
- Facilitate adaptive management

Knowledge

- Ecology/hydrology/geomorphology relationships, eg. commence-to-flow heights
- Better understand hydrology and hydrology models of appropriate time-steps
- Climatic variability, particularly long-term changes and historical perspectives
- Benefit–cost of development versus no development, including ecosystem services
- Transportable — generic
- Species–habitat relationships
- Knowledge — community education, communication
- Decision support systems — prioritisation given for scarce water resources
- How to trade-off non-pecuniary environmental assets in market systems

The Yellow Group representative commented that, in addition to the above knowledge needs, knowledge has to be transportable between catchments and different areas as much as possible. Work has to be undertaken to address the improvement of knowledge transfer. Decision support systems are required to help managers decide how to allocate a scarce resource.

Orange Group

The Orange Group also addressed the issues of principles and knowledge separately.

Principles

People have the right to healthy ecosystems, which in turn support healthy social systems.

- Knowledge is relevant to opinion-makers and decision-makers and land managers.
- There are strong interactive relationships between knowledge and management.
- We have responsive, relevant, robust science at a variety of scales and in a variety of disciplines

Knowledge

- Knowledge exchange (federal, State, regional, local)
- Extension
- Participatory
- Multi-avenued.

Blue Group

The Blue Group representative commented that they had started by going through a high-level approach looking at ecologically sustainable development (ESD) and got stuck on the precautionary approach.

Principles

1. ESD principles
   - Inter-generational equity
   - precautionary approach
   - community involvement
   - conservation of biodiversity, habitats, species and genotypes
2. Scale
   - policy/management at catchment scale, irrespective of State borders
   - importance of long time frames
3. Communication
   - report to stakeholders in appropriate forms
   - common understanding and plain language
4. Science
   - rigorous
   - value for money
   - justification and accountability
   - take account of, consider and corroborate all knowledge
   - use best available technology
5. Funding
   - allow community groups to participate
   - allow scientific groups to consult and communicate
6. Information
   - many sources accessed and used
   - freely available and understandable
7. Decision-making
   - whole-of-ecosystem approach
     - integration of social, cultural, economic and ecological values
     - costs/benefits — cost and benefits need to be applied but are not the only factors — the intangibles need to be considered
   - shared vision, mutual trust, consensus, patience and transparency
   - representativeness and community participation, including agencies (agencies are considered part of the community, representatives must also articulate who they are talking for, so they are not just representing themselves)
   - adequate level of staffing and continuity (staff turnover in agencies must be considered and its implications for corporate knowledge)

Knowledge

- Inventory and status of
  - river-dependent ecosystems
  - habitats
  - species
  - genotypes
  - ecosystem processes
- Ecosystem values and services, including social and cultural (what are we gaining and losing, possibly before we even know it's there?)
- Roles and responsibilities
- Connectivity (vertical and horizontal)
- Living knowledge.

Pink Group

The Pink Group explained that many of their members were scientists, so they spent a lot of time discussing what the question was about! They reworked the question based on this discussion as follows:

What are the principles for identifying/generating and using knowledge for management of inland rivers?

1. Overarching principles
   - use best available knowledge
   - embrace all components (social, economic and ecological)
   - target information needs
   - ecologically sustainable development principles
2. Participatory process
   - partnerships
   - capacity building
   - agreed planning processes

There should be provision for a forum at which people of all perspectives can raise issues and problems.

3. Rigour of process and methods
   - protocols
   - quality assurance (developing protocols, quality assurance and standardisation which can assist in communication down the track)
4. Biodiversity
   - conservation
   - rehabilitation
5. Utilise existing knowledge
6. Craig's Principle
   - the group could not get agreement on this but if you are looking at an issue in a catchment make sure you have the knowledge and your management style reflects the variability both temporally and spatially. Scientists often don't have the luxury of time to conduct long-term experiments.

Synthesis

Mr Andrew Campbell

Mr Campbell was invited to attempt a synthesis of the presentations given by each of the groups.

Mr Campbell began by noting that many groups started off in a philosophical position and then started re-hashing ecologically sustainable development (ESD) principles (that is, the ones they could remember!). However, most groups believed that ESD provided an appropriate, high-level framework in which to operate, including:

- intergenerational equity;
- conservation of biodiversity (species, sites, processes);
- intrinsic and cultural values;
- precautionary approach; and
- community involvement.

Community involvement is considered to be essential for durable outcomes. The issue of primacy of the environment also came up in some groups — does the environment come first and provide constraints in which we should operate, or should we consider humans to be part of the environment and acknowledge that the environment does not always come first?

Discussions regarding the aspects of science were extensive, the groups expected **science** to:

- explain how systems work, and the implications and consequences of decisions and actions,
  – especially thresholds, irreversibilities,
  – at different spatial and temporal scales;
- be accessible to users (language, form, spread, technology);
- seek to understand users' needs (eg. timeliness for policy and management);
- utilise, access and critique existing knowledge;
- be defensible — independent, peer-reviewed;
- embrace different types of knowledge and values; and
- be adequately resourced and constantly updated.

The groups also specified what they saw as **knowledge gaps** for the management of inland rivers including:

- ecology/hydrology relationships;
- climate variability;
- ecosystem services compared to cost–benefit analysis;
- trade-offs of non-market/intangible values;
- species–habitat relationships;
- connectivity; and
- inventory and status of river dependent ecosystems, habitats, species etc.

Mr Campbell noted that the groups did not seem to consider knowledge gaps in a particularly focused way, and he questioned whether benefit–cost analysis was really science. The only way that it could be useful in these situations would be when more ecological information could be incorporated. Otherwise these methods become fundamentally useless when dealing with intangibles and where discounting is inappropriate.

Mr Campbell commented that we have to avoid instances where knowledge for policy comes out after the development of policy. The knowledge required for policy should be predicted so it is in time with policy development. The prevailing issues of returning to existing knowledge and valuing different knowledge and its source was also noted by Mr Campbell.

Following the discussion regarding knowledge gaps, Mr Campbell turned to management issues. He synthesised the discussions regarding management and found that **management** should:

- be informed by the best available science;
- be tuned to the scale of relevant ecological processes — this may be difficult in some cases, eg. with migratory species which may be on your farm. The decisions you would tend to make reflect the scale of your farm, not the scale of a migratory species. The issue of 'exceptional circumstances' is the reflection of management along the line of a European policy setting. Climatic variability, which is part of our natural system, should not be referred to as drought. The word drought should be avoided,
  – across jurisdictions, if necessary,

  - account for different boundaries for different system elements;
- be adaptive, informed by good long-term monitoring;
- focus on the whole system;
  - be holistic, integrated, and long-term;
  - incorporate the 'quadruple bottom line' — cultural added to the triple bottom line [of environmental, economic and social];
- be accountable — accountability has to be wider,
  - to wider stakeholders, and
  - to future generations.

Mr Campbell noted that a good comment had come from one of the groups that stated where a risk is high, then the level of monitoring and management should be also be proportionally high.

Policy was the next issue to be covered and Mr Campbell identified eight points which underpin good policy. Policy should:

- be informed by the best available science;
- be adaptive, informed by good monitoring;
- 'protect the best first' — naturalness and high conservation values;
- 'do the important before the urgent';
- involve the community — this may not be at a table as this may not necessarily be the right way to go,
  - representativeness and agreed transparent processes;
- learn from the past, not continuously repeat mistakes;
- high risk = more monitoring and funding; and
- use clear and honest processes, making agendas explicit (there is no such thing as agenda-free facilitation!).

The impact of policy changes should be tracked. At the moment, this process is very poor.

Finally, the issue of **balance** was brought up. The word balance has been used extensively during discussions at this workshop so far. Mr Campbell commented that:

- 'balance' will change in space and time;
- are shared visions necessary? Is a shared vision an essential or an absolute prerequisite on these issues? How much shared dissidence can there be in a shared vision? It is unlikely there will ever be complete agreement;
- dialogue, trust, consensus, patience, and transparency are vital when trying to achieve balance;
- 'not just a table';
- should those most affected have a greater say?
- getting best net community value. You have to weigh up the net value — it's a combination of economics, environment etc.; and
- recognising and managing trade-offs,
  - primacy or otherwise of ecological processes,
  - ecosystems include humans.

Mr Campbell finished by thanking everyone for the day's participation and effort.

Before closing for the day, Mr Edgar noted that one group had commented that knowing the outcomes Land & Water Australia were seeking from the workshop would have made the group sessions easier. Mr Edgar explained that the outcome was to get a diverse group of people together and see what convergence that group could achieve in terms of the management of inland rivers in Australia. Mr Campbell also noted that he was also looking to raise the agenda of inland rivers within Land & Water Australia, and also to avoid repetition of mistakes made in the past in terms of the management of our inland rivers. He also believed it was an opportunity for gaining further funding in this area.

International speaker

Professor Kevin H. Rogers
Department of Animal, Plant and Environmental Services, University of the Witwatersrand, Johannesburg, South Africa

Kevin Rogers is the Director of the Centre for Water in the Environment (CWE), Professor of Ecology in the Department of Animal, Plant and Environmental Science, and Interdisciplinary Coordinator for the Wits School of the Environment (WiSE) at the University of the Witwatersrand, Johannesburg. The CWE has a small (6 staff, 2 post-docs and 20-odd postgrads), interdisciplinary research group of fluvial geomorphologists, ecologists, hydraulics engineers, and water policy and natural resource management experts. WiSE is a University-wide venture to link scientific, social and engineering initiatives in environmental problem-solving, research and teaching. Professor Rogers was Research Manager of the Kruger National Park Rivers Research Programme during its eight years of existence. His personal interests are integrating disciplines in the quest for improved understanding and management of ecosystems — making sure that science is used, not just useful!

Tonight I am going to tell you of two experiences. The first is an account of working with people like Charles Breen, Harry Biggs and Mark Dent on the Kruger National Park Rivers Research Programme to develop a system to manage water allocation to the rivers flowing through the two million hectare Kruger National Park. I learnt many lessons working with these people. The second is trying to develop systems to manage environmental water allocation under our new legislation which recognises that people have the right to a healthy environment. In order to achieve this, we must, amongst other things, allocate water for the maintenance of healthy aquatic ecosystems.

I believe it is safe to assume we have learnt a lot in the field of translating research into policy or management. Similarly, we can assume that we will only know that we have learnt when we can measure a change in the way we do things.

Peter Senge, the renowned business-change academic and consultant from MIT [Massachusetts Institute of Technology, Boston] points out that most change initiatives (>70%) fail and they do so because profound change requires us to change the most basic ways we think. Many of the lessons I have learnt have been about changing the ways I think, and therefore act, in natural resource management.

The first lessons I learnt were about who needed to be involved in science/management interaction and what their world views (mental models) were.

Lesson 1: interfacing and 'mental models'

Ecologists operate in a world that focuses on **understanding** nature and how it functions. Managers usually operate in a highly structured institution where they must set certain systems/procedures in operation to achieve end points set by policy. I was convinced we needed to set someone up to act as an interface between these two very different world views — someone to transform scientific information into 'something' management could use; be it a predictive model, an assessment procedure, a synthesis etc. This was simple — anywhere else in the world it is called technology development and transfer. The technologists' mental model had to be very customer-orientated and therefore pragmatic.

But now we had three different mental models/world views trying to communicate with each other and I found many myths and misconceptions, which we rapidly had to dispel and seek alternatives for.

Lessons 2 and 3: myths, misconceptions and alternatives

Identifying myths and misconceptions and some alternatives was not too difficult, but getting people to admit to themselves that they suffered from them and to change their ways of thinking is an ongoing issue. Too many ecologists focus on their research on organisms rather than the interactions between organisms and their environment as the term ecology requires. By implication they are studying organisms as if they lived and died on a static stage!

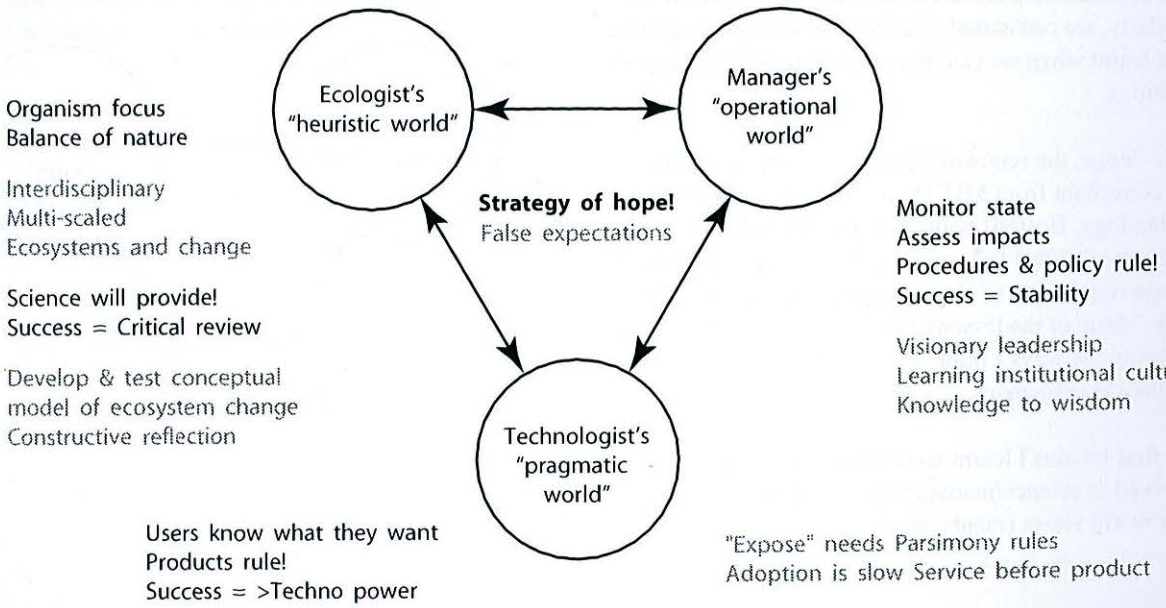
Similarly, too many ecologists study organisms and ecosystems in the present rather than also asking: what they were like and how are they changing — toward what? This is tantamount to adopting the assumption that nature is in balance or must be kept so. Nothing could be further from the truth and we need to adopt explicit interdisciplinary approaches to our science which provide multi-scaled perspectives of ecosystem change. In other words, we need to recognise the flux of nature, and study both the organisms and their physico-chemical environment, and this must be at multiple scales because different aspects of organisms' life histories occur at different scales.

Furthermore, managers must understand the scale at which interactions are taking place and to scale their actions accordingly. Ecologists should therefore be sure to develop a clear conceptual model of the ecosystem they are studying and of how it changes in time and space in response to different driving forces.

I have noticed an unfortunate tendency amongst scientists to believe that scientific information alone will solve problems. This is not the case and all research findings have to be transformed in some way before they are useful to managers. Similarly, when interacting with managers, scientists need to understand that their usual process of critical peer review is inappropriate and a more constructive approach, where more time is spent reflecting on the problem and solutions, is much more appropriate.

It seems to me that managers of our systems tend to be slaves to policy and procedure and adopt a very reactive process of monitoring of ecosystem state and assessment of impact to it. We are seriously in need of visionary leadership that can break the mould set by restrictive policy and adopt innovative ways of meeting their mandate. Managers and their organisations need to explicitly adopt an adaptive management approach, recognising that this requires organisational change. If adaptive management is 'learning-by-doing' then classic organisational structures are inappropriate and a 'learning' organisational structure, as defined in business management literature, is imperative. Such organisation must take us beyond the data and information era into the knowledge era and have the clear purpose of turning management into wisdom for better decision-making.

Technologists, especially modellers, work under the misapprehension that the people they are developing products for know what they want and that the more powerful the technology (model), the 'better' it will be. On the contrary, they should spend a great deal more time working with their clients to ensure that there is a clear

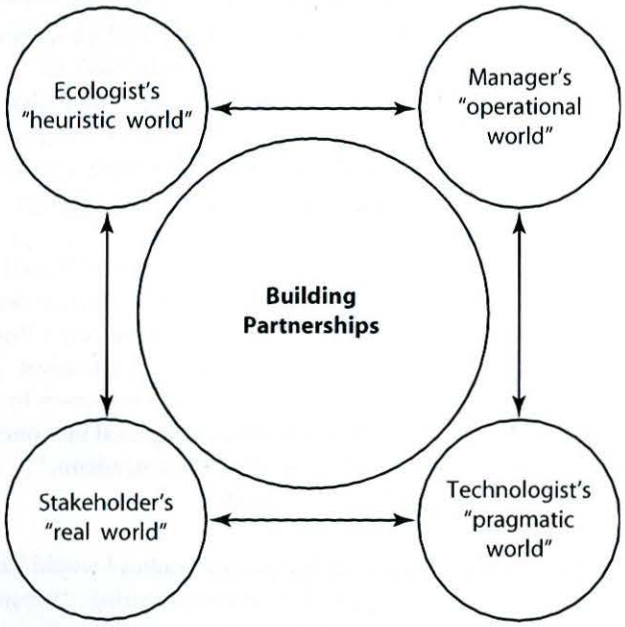


understanding on what is wanted and that the product proposed can in fact deliver what the clients need in a parsimonious manner.

Consequently there is a need for people operating in the technology department and transfer fields to be more service (than product) orientated and recognise that adoption of products is a slow process of working with clients, not for them.

It soon became apparent that there were more players than the three thus far identified. These can be collectively described as the 'stakeholders' who range from the public to government departments charged with implementing a particular directive.

Lessons 4 and 5: more players in the actual game



The range of myths and misconceptions that lie amongst this group is too large to recount here, but it is equally important to bring them to the surface in any particular venture.

With all of these people involved, it became imperative in the Kruger National Park to spend much effort on building partnerships.

The imperative to build partnerships became entrenched when I started working on trying to implement our new Water Law in South Africa. A brief description of this law, backed by the new Environment Law, explains why.

Recognition that our new constitution gives us each the "right" to a "healthy environment" and requires "cooperative governance" at all levels of civil society goes, hand-in-hand with the recognition of the ecosystem and not just the water, is the resource to be managed. This, in essence, requires that we develop a cooperative stewardship of the ecosystem to ensure equitable, efficient and sustainable allocation of both the costs and benefits of the goods and services provided by the ecosystem.

I interpret the phrase "good and services" widely. For example, one of the Indigenous tribes believes that the serpent which looks after the ancestral spirits lives in white water. We must therefore build into "environmental flow" requirements the need to generate white water in certain places and certain times. This brief summary of the imperatives of our water law should leave us in no doubt about the need to develop sound partnerships in water/natural resource management in South Africa at least.

In response to our Water Law we have developed a process called Strategic Adaptive Management (SAM) which has six component processes designed to integrate science and management and form a partnership which embraces community involvement. Implementation of SAM has taught us some very important lessons about building partnerships.

We have found that working together for a common, rather than an individual, purpose is no trivial exercise, so I distinguish a partnership as a shared opportunity to learn and grow. It is therefore more of a collaboration where we tend to work together but for our own ends. A partnership should aim to build a future more than it should focus on the present or even past problems. The future provides a neutral playing field on which to avoid conflict. The present and past, on the other hand, are clouded by entrenched territorialities and preconceptions.

South African Water And Environment Acts

Two rights

- Basic human water needs
- A healthy environment

Corollaries

- Constitution requires "co-operative governance" at all levels
- Ecosystem, not water, is now the unit of focus
- Ecosystem's ability to provide resources is to be protected
- Resources are the goods and services ecosystem can provide
- Co-operative stewardship provides and allocates costs and benefits of the goods and services

Lessons For Partnerships

- It is about creating opportunities for **shared** learning and growing
- It is more about **future building**, than the present or past
- It is about **co-evolution** of: values, vision, needs, goals, rewards.
- It takes **time**, it takes **practice** and it involves change!

During an electronic discussion on these issues, colleague Charles Breen, wrote: "The present is so fraught with implementation and problem solving that it is likely impossible to use it to build vision. The needs become so immediate that there is no room for discourse and lateral thinking. On the other hand, partnerships built on a vision of an uncertain but exciting future are able to scale back in time to identify and examine the more pressing problems constructively." In other words, he is suggesting that it is often more effective to solve problems by creating a future than restricting oneself to finding solutions to apparently immediate problems.

A second fundamental aspect of partnership building is the ongoing process of co-evolving shared mental models. It is essential that over time the partnership thrives more and more on shared values, vision, needs (not wants), goals and a reward system.

The last lesson that many have learned before is that it takes time and patience.

I firmly believe we cannot carry on doing all things the way we have, so we must learn how to change. This does not mean abandon all the old ways, but it does at least mean consciously add some new ones. Again, Peter Senge and colleagues come to the rescue. They have studied organisational and personal learning and change through countless case studies in their work on the 'fifth discipline'. I have turned their five disciplines into the five challenges of change:

Five challenges for change

1. Shared Vision — shared images of the future create mutual purpose. Without mutual purpose how do we focus team efforts?
2. Mental models — understanding each other's world views reduces unfounded, counterproductive conclusions and assumptions. Focusing on surfacing and understanding other people's mental models instead of trying to change them or impose yours, is a powerful tool to master personally.
3. Personal mastery — cultivating a creative tension between vision and reality leads to better choices. This applies equally to institutions and individuals. I often hear words: "We are tired of vision and need action." The real problem is that we to easily generate vision but seldom use it to focus action to merge it with reality! People also tell me you can't get a shared vision. I suspect that their problem is they want shared detail of goals or objectives and/or expect vision to be too precise and unchanging. Vision needs to be broad, undemanding and to evolve as mental models evolve.
4. Team learning — practise collective thinking, learning and doing. Would you expect your rugby or cricket teams to perform well without practice? We would never expect our sports teams to perform without repeated practice so why do scientists and managers so often give up when an initiative does not work as well as expected the first time? Probably because they do not appreciate that learning to do it well requires real change in the way we think and do!
5. Systems thinking — understanding interdependency, feedback and complexity. Do we really have an option but to develop a new understanding of what science/management/community partnerships should be all about? I think not and am certain that it can't be obtained by reductionist, self-serving thinking.

In this presentation I have deliberately borrowed from the work of other people and disciplines and so practise the interdisciplinary approach I preach. Unfortunately I find that all too often people are wary if the way this takes them out of their comfort zones. Frequent responses to having the work of other disciplines integrated into ones own are: "It's just jargon" or "That is too academic", "That's too fluffy/fuzzy to be useful".

After many years in interdisciplinary studies I would like to leave you with a quote from my own writing: "When learning from others we need to make particular effort to understand the paradigms or mental models which lie beneath their approach to a problem." In each case a discipline has its own terminology which provides important definition of its guiding principles. We recognise that one person's 'jargon' may be another's definitive criteria and, in this paper, have tried to remain faithful to the range of disciplines from which we draw inspiration.

I would urge scientists, managers and community representatives to take heed of Senge's five learning disciplines because their application to the problems we experience will provide the grist for the real change we need in achieving true integration of science in policy and management.

* * * * *

Clarification

Julian Reid, CSIRO Sustainable Ecosystems

The words 'team learning' tend to be the words of practitioners of practical management. However, it is up to ecologists to get back to the managers and explain the importance of good experimental design. How do we do this?

Response

Kevin Rogers

By getting up and doing it. But the issue is how do we know when we have got enough information? We always have enough to make a decision, but quite often we fall into the trap of hiding behind the need for more information. You have to set up a conceptual mode with a hypothesis and go out and do it. If we are serious, we can do it. Scientists are always challenged and told that "if you don't tell us what the information we need, we will make a decision anyway". My message is "get off your butts and do it".

Clarification

Jamie Pittock, World Wide Fund for Nature

The *South African Water Act* has been in place for 2–3 years and sounds quite radical. How is it going?

Response

Kevin Rogers

It is exciting, but it boils down to issues regarding huge riparian rights in the last Water Law. However, there is recognition that people may have been gaining a benefit from the use of water, but were passing the costs onto someone else, eg. forests. The fundamentals in science are great.

Clarification

Lynn Brake, Arid Areas Catchment Water Management Board

The shared vision — is it a waste of blood sweat and tears? Is it necessary for a partnership?

Response

Kevin Rogers

You could probably form a partnership without a vision, but would it last? Probably not, unless there was great evolution. People get jumpy about a shared vision. We have to merge vision with reality to go where we want to go. If Nelson Mandela did it, the rest is peanuts.

DAY 2: WEDNESDAY 28 MARCH 2001

Future — what are the aspirations for the management of inland rivers?

Opportunities/impediments/constraints — what are the opportunities and impediments to improve our ability to manage these systems including knowledge, institutions, markets, legislation, policy?

Strategic directions — a statement of the strategic directions including priority values, principles and actions to improve inland river management

Outcome — a statement of the strategic directions including priority values, principles and actions

Introduction

Mike Williams outlined the proceedings for Day 2 for participants. The intention of the morning session was to look at institutions and communities in order to determine how well they are prepared and positioned to address the future needs of inland rivers.

The presentation by Professor Rogers provided a great base on which to work. His key messages indicated that we can work together, but we must take our institutions with us. However the question remains, are they able, capable and in a position to meet their values and goals?

Mr Edgar restated the objectives of the workshop in order to maintain focus for the day. The objectives and outcomes of the workshop were clarified in light of the comments and discussion that had taken place on Day 1, as follows:

Objectives

1. To explore how research and other knowledge shapes river policy and management — how do you use science and knowledge to shape decisions?
2. To seek solutions and common ground.
3. To develop principles on which to base improvements in future river management.

Outcomes

1. Increase the focus of attention on inland rivers. Inland rivers operate differently and their importance should not be underestimated. This workshop is considered a platform on which to achieve this.
2. Seek a convergence of ideas from numerous stakeholders.
3. To assist in developing guiding principles, issues and actions on which to base policy development, research and future river management.
4. The production of a report of workshop proceedings to communicate the outcomes.

Statement

Jamie Pittock, World Wide Fund for Nature

From the point of view of the World Wide Fund for Nature, we are concerned that within inland Australia there seems to be a process in train where 'freshwater buccaneers' are going from valley to valley and they are being governed by the same outdated management approach. There has to be something done about getting water managers together and updating this management approach.

Statement

Ralph Leutton, Cotton Australia

As a representative of Australian cotton, I came here with the intention of looking for ideas or 'seeds' for the development of policies for Australian cotton growers. I think yesterday has indicated that we are headed in the right direction and so far I have received several ideas that could be used in policy development by Cotton Australia.

Statement

Tom Baker, Environment Australia

I think it is important to revisit what we mean by inland rivers. In some areas the inland rivers are not characterised by floodplains. We also have rivers in much rougher terrain that are characterised by episodic flows and also a multitude of other classifiers. When we say we are discussing inland rivers, we are indeed covering a gamut of different river types. Whether we will get principles for the variety of inland rivers I don't know, but it is something we should keep in mind.

Statement

Don Blesing, Lake Eyre Basin Coordinating Group

Our group was one of the ones raising the issue of clarity. Personally, I would be putting more focus on the customer. I think the outcomes are weak and need re-emphasis. It should be recognised that there are customers and clients who are different from stakeholders. For example, the private sector and non-government organisations that are looking for a raft of information, such as what could come out of this workshop.

Statement

Sean Hoobin, World Wide Fund for Nature

I believe it is good to recognise differences and also to accept them. However, I am concerned about the word 'balance' and its association with the triple bottom line. Achieving a balance is not necessarily the same as meeting the requirements of a triple bottom line. In my opinion, there are some things you should not go below, so is the answer to the question just finding a balance? Or should we figure out where our bottom line is?

Mr Williams concurred that the issue of balance has raised questions in people's minds.

Statement

Lynn Brake, Arid Areas Catchment Water Management Board

This process is all about evolution and change. I would like to have some points here about change that can be used to affect things such as the funding source replacing NHT. We should be thinking more about ways to bring about change.

Session 3, Day 2

How are our institutions and communities positioned to address the future needs of inland river management?

The importance of effective frameworks and institutions to manage cross-border river systems

K. Goss

Kevin Goss
General Manager, Natural Resources, Murray–Darling Basin Commission

Kevin is General Manager, Natural Resources with the Murray–Darling Basin Commission (MDBC), having spent his earlier working life in Western Australia. He holds an MA (Communication) from Michigan State University and a BSc (Agriculture) Honours from the University of Western Australia. Kevin's job in the Commission is to manage the Natural Resources component of MDBC, across the spectrum of integrated catchment management, water resource allocation and riverine environment protection. Also, he is the Commission's Deputy Chief Executive, and has a broader policy advice role.

This presentation will be concentrating mainly on the public policy environment. I acknowledge that having worked in the Murray–Darling Basin my experience has mainly centred on highly-regulated inland rivers. Models other than that used in the Murray–Darling Basin and issues to do with cross-border management will also be discussed during the presentation.

The National Land and Water Resources Audit recently released a map of the surface run-off in percentage for different basins across Australia. The Murray–Darling Basin rated fairly low with only 6% surface run-off. This contrasts with the high dependency of agriculture on the water resources of the Basin. This association between the resources available and the dependency upon them explains the over-allocation issues in the Basin.

This history of dependency is illustrated by Figure 1, which represents the trend in total Basin diversions and total Basin government storage from 1920 until the year 2000. As can be seen, there is a rapid increase between 1950 and 1960 in both storage and diversion. It was this rapid increase which became the trigger for the introduction of the cap on diversions. This graph also indicates the extent to which the Murray has become a highly regulated river.

As with any organisation working with a multitude of jurisdictions, there are many difficulties that can arise. In the Commission, the sovereignty of States is protected by Clause 100 of the Australian Constitution:

"The Commonwealth shall not, by any law or regulation of trade or commerce, abridge the right of a State or of the residents therein to the reasonable use of the waters of rivers for conservation or irrigation."

This clause restricts the ability of Commonwealth intervention in regard to the use of the waters of rivers for conservation or irrigation, however it also contains the qualifier of "reasonable use". These two words in particular have been receiving a lot of airtime recently. However, should this issue of "reasonable use" be tested in the judicial system, there are many other things which could further complicate the matter, including Clause 99 of the Constitution which states:

> "The Commonwealth shall not, by any law or regulation of trade, commerce, or revenue, give preference to one State or any part thereof over another State or any part thereof."

Current arrangements which provide examples of different models designed to deal with cross-boundary river management include the Murray–Darling Basin Agreement (and also along similar terms the Lake Eyre Basin Agreement), in addition to the Council of

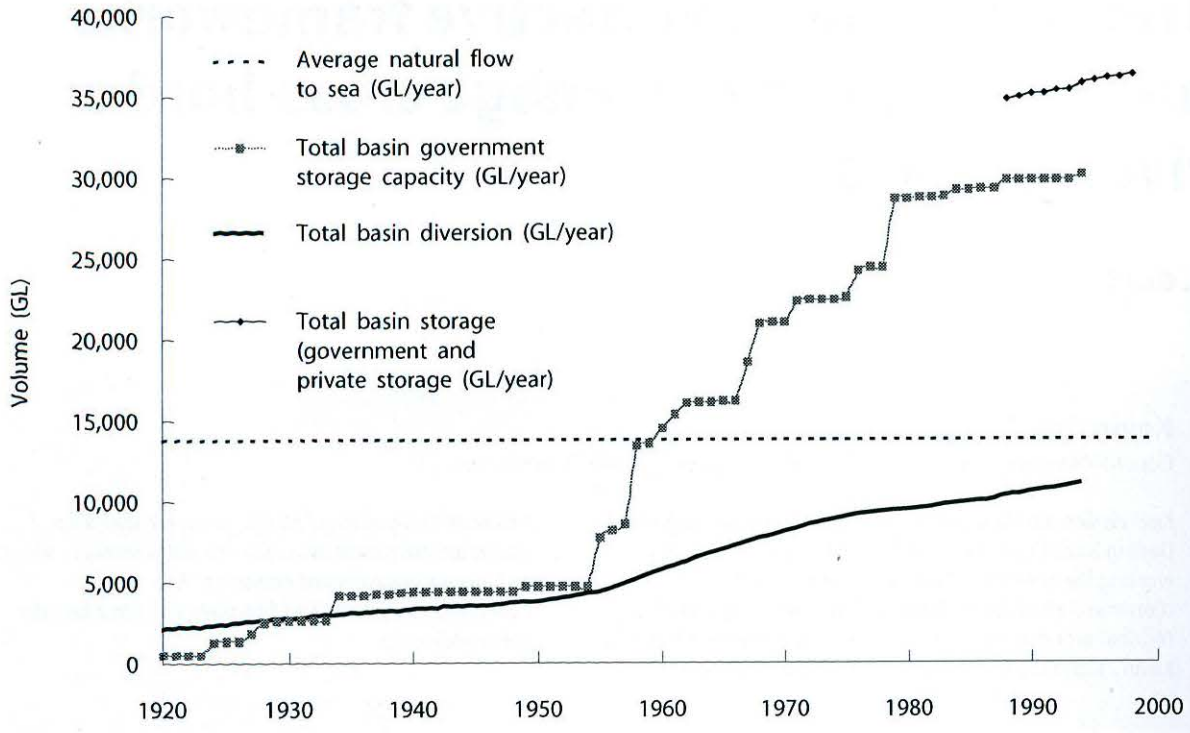


Figure 1. Storage capacity and diversions in the Murray–Darling Basin over time.

Australian Governments (COAG) reforms and Commonwealth environmental protection and biodiversity conservation legislation.

The MDBC agreement has limitations and is constantly under debate. Key features of the agreement are:

- policy advice and implementation — the Ministerial Council which deals with natural wealth across boundaries is responsible for setting the policy which the Commission implements;
- water sharing and river operations — water sharing has been a very real driver over the last 80 years and is undertaken by river operators within the Commission;
- water quality monitoring — this has been a heavy obligation and is not yet perfected; and
- assessment of developments — this is a clause by which the Commission can call in developments, however it is not a decision-making authority itself.

The Murray–Darling Basin Agreement has been built on and adapted since 1917 and therefore reads that way. This is especially noticeable in terms of its lack of modern jargon. However, in terms of a legally conceptual understanding of the MDBC Agreement, it is important to note the subtle power contained within the text.

The Agreement promotes the relinquishment of a certain level of power by States, no better example of this would be the cap on diversions. Under the Agreement, all decisions have to be collectively unanimous. In order to assist in obtaining unanimous decisions, the Agreement contains a paragraph on comity. This paragraph states:

> "Each government will voluntarily withdraw from the unilateral exercise of regulatory power, in the interest of mutual implementation of the Agreement."

There have been a number of significant achievements which have come about under the Agreement. The first significant achievement was considered to be the Natural Resources Management Vision. This Vision is contained within the Natural Resources Management Strategy. The Strategy itself emphasises the word partnership, and in doing so provided a basis on which to start building relationships with the community. Other significant achievements include:

- continuous river accounting;
- the salinity and drainage strategy;
- the cap on diversions; and
- targeted investment.

These achievements encapsulate some of the greater successes of the Agreement.

In contemporary terms, integrated catchment management (ICM) is considered to be the new charge of the Commission. The newly released Draft Integrated Catchment Management Policy will lay down new standards and expectations (Figure 2).

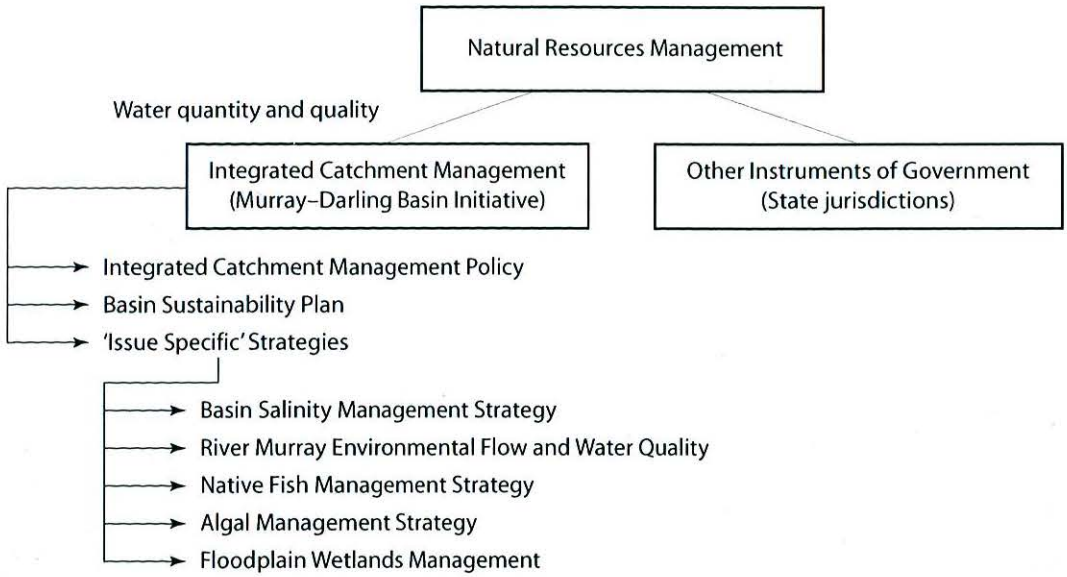


Figure 2. The new role of the Murray–Darling Basin Commission in terms of integrated catchment management.

The Basin Sustainability Plan will still be utilised for the generation of knowledge for long-term strategic thinking and planning, and in addition to this there will be the development of 'issue-specific strategies' that will operate around the premise of targets. The first of these issue-specific strategies is the recently released draft Basin Salinity Management Strategy (BSMS). Upcoming issue-specific strategies also include a River Murray Flow and Water Quality Plan, which deals in part with environmental flows — an issue considered to again raise the debate around sovereignty of States. All of these contemporary issues will continue to challenge the Commission and provide a full book of issues to cover.

The following is a score card which provides a rating of the success (out of five) of the agreement over four main areas:

- Public policy ✪✪✪✪
- Targeted investment ✪✪✪
- Monitoring and reporting ✪✪✪
- Compliance ✪✪

The record on public policy under the Agreement has been pretty good considering the fairly bold decisions made by the Commission over the past 10–15 years, the Agreement was awarded four stars in this area. Targeted investment earned three stars and is considered to be continuously improving. The Agreement has allowed new standards to be set in this area. The process of monitoring and reporting takes place through an audit process which has independence from management and helps to make Ministers accountable for themselves — the process of developing the Sustainable Rivers Audit from the Review of the Cap was assisted by the arrangements set up for monitoring and reporting.

Compliance only rated two stars on the score card as there have been questions raised about the amount of 'teeth' that the Agreement has to deal with this issue. The area of compliance is considered to be the biggest weakness of the Agreement and also the biggest challenge.

While the Commission is now directed towards integrated catchment management (in addition to maintaining a continued level of institutional arrangements focused on regulated rivers), there remains a lack of confidence in the Basin community that all of these things can be delivered. The question of whether 'unreasonable use' can be evoked also hangs in the air. While Clause 100 offers a certain freedom, it should not be used to encourage 'window-shopping' for the best regulatory framework, only to wind up in the courts while river management continues to decline.

The COAG process has made a large contribution and has experienced many successes, including the increased value of water which has acted as an excellent driver. However, the ability of COAG to move into natural resource management and consider detailed issues such as conjunctive use of water resources may be limited. Regardless, the question of which management approach or combination of management approaches for our inland rivers needs to be discussed in depth.

In conclusion, the importance of having knowledge-driven public policy (which has not always been the case) is extremely important. This issue has been recognised within the MDBC, but on a national scale we cannot be as secure in knowing that this is the approach being taken. Finally, it is extremely important that pressure is placed on policy-makers and management to drive the knowledge agenda — after all it is their responsibility.

How community expectations are shaping future river management

L. Boully

Leith Boully
Landowner and Director, Land & Water Australia

Leith Boully is a primary producer of sheep and cattle in Queensland, is Chairperson of the Murray–Darling Basin Community Advisory Committee, a member of the Australian Landcare Council and was previously a Commissioner of the Australian Heritage Commission.

Before beginning her presentation, Ms Boully acknowledged the traditional Aboriginal people of the area.

Ms Boully noted that coming to Alice Springs for this conference had a special significance for her personally because of her previous work in this area with cattle stations run be Indigenous people. Exposure to different people during this time taught her that people could achieve anything with vision, passion and energy, and that science is good but people make the difference.

In order to shape the presentation for this workshop, the most important question to be answered is: "What is the community?" Is it all of Australia? Communities of common interests? The irrigation community, the informed or uninformed, the natural resource management (NRM) club (the converted) or the other community that we continually criticise but who are not involved? Or is it just those that have access to agencies and government? The answer in this case is the Australian community. But there is currently no shared vision for rivers, which makes judging past performances and influencing the future difficult. The next question is: "Are community expectations really shaping future river management?" The answer is yes! Community expectations have always shaped river management.

Until quite recently, the expectations of river managers have been to deliver safe drinking water and water necessary for the development of wealth through agriculture. This has been within a framework of so-called 'property rights' that confer on individuals the authority to do what they please with 'their' land and water — the frontier mentality. This is no longer acceptable. In the last decade or so a number of things have changed, as outlined below.

- Water is scarce but demand is increasing.
- Land and water management impacts are no longer absorbed by the ecosystem and we are seeing individual interventions polluting the common asset, the river. A good example is salinity.
- The values and principles upon which river management has been based are under question as knowledge about the long-term environmental and economic consequences increases in the public domain.
- Conflict between and within water-use sectors is increasing. This conflict is often used by agencies and government to take no action rather than create solutions.
- The community is demanding greater accountability of managers and opportunities to negotiate as equals in decision-making. Mr Goss is right in terms of his suggestion that compliance is the biggest weakness and greatest challenge for the Commission, however, unlike Mr Goss, I consider two stars generous!
- The community is demanding an integrated approach to land and water management, as that is how they work on a day-to-day basis. We have failed to achieve this if South Australia had to legislate in order to integrate. Why is it that agencies and their functions have to be split?

The triple bottom line has become common currency in natural resource management in recent years, but we

don't have the understanding or tools to achieve it yet. This is because the stool actually has four legs, not three. That fourth leg represents the three Ps: politics, power and the public service. As we are talking about a public asset being managed to generate private good, people use the political process and power to prevent change. The public service and their political masters have to date failed to protect the public good. This is not necessarily a criticism because the way in which our legislative base and political process works mean that they have been constrained, to some extent, by the dominant value set. It remarkable that the very same people who handed out rights on the basis of no science are now reluctant to change those rights without perfect or near-perfect science. That said, the crisis in our developed rivers and a desire to develop the rest has created derision and conflict. The values on which river management is based are under question by a more diverse and knowledgeable community trying to achieve the triple bottom line.

Rather than try and analyse how community expectations are shaping the future river management from a disinterested perspective, two examples were used to look briefly at what the impediments to success were.

Examples

- The Snowy — the political debate responded to community expectations and process and forced the decision to have environmental flows (which was not necessarily based on strong science) and to legitimately pay for water for the environment.
- The Lake Eyre Basin process — this process began about five years ago. Rising from the flames of a conflict that wounded many personally, but put the issues of development of our icon, the Cooper, and the role of community on the public agenda for debate. This community has, against enormous odds, used values, passions and knowledge to tackle the three Ps in order to create their future. The Lake Eyre Basin (LEB) Agreement is a substantial move forward but if it is to be successful it will require that this community continue to grow their knowledge base and evolve processes where real partnerships can develop — partnerships where power is shared.

Unfortunately we don't have too many LEB Agreements and the one next door does not have the luxury that the LEB has had here. The Murray–Darling Basin (MDB) is a highly modified and regulated landscape — trying to meet the community expectations in the MDB may well be impossible. I say this because expectations are often quite divorced from reality and may not be knowledge based. Community expectations in the MDB have been clearly articulated in two documents that were to be approved (hopefully) by the Ministerial Council on Friday 30 March. These documents are the Integrated Catchment Management (ICM) Policy Statement and the Basin Salinity Management Strategy (BSMS). Professor Rogers' address gave me hope that we have got some things right. The ICM Policy Statement is built around a vision that is a statement of commitment, that we the community and government of the MDB commit to do all that needs to be done to ensure ecologically sustainable development. Importantly, this commitment is supported by a set of shared values and principles. These are yet to be interpreted into the behaviours that all partners will adopt to achieve the goal. It also commits both the community and the government partners to clearly define their roles and responsibilities. It is built on the basis of a learning or adaptive management approach to ICM where targets will be used to help focus effort and allow us to monitor progress.

It is human- and process-focused rather than the traditional biophysical approach. It has been driven by the community and is likely to cause considerable angst as the significance of the commitment is realised and the inability of our current governance and institutional arrangements to deliver against it become obvious. The Community Advisory Committee (CAC) is currently developing in cooperation with the community a set of performance indicators for the ICM so that progress can be discussed with the Ministerial Council annually.

The BSMS is the first attempt to turn the philosophy into practice. It is fair to say that we have a long way to go in the way we are working collectively before we have lived the values and principles in terms of salinity. But it is an important first step to be closely followed by work on the River Murray environmental flows.

It must be recognised that rights can not be given and taken away. The community must take responsibility and be accountable, as in the past the community has been good at throwing stones.

Community expectations are shaping river management. The impediments which may exist include:

1. Knowledge — communities don't want to act until they have some comfort.
2. Process for debate planning and negotiation is not robust. Institutional arrangements are under question. Little accountability, monitoring and evaluation are dismal, and the three Ps still affect everything we do.
3. The difficulty of integrating land and water management planning is still a huge issue.

Above all, it is important that we listen to each other, value the differing views and understand each other's perspective. The community has more power than any of the institutions and through passion, power and energy, institutions must be driven to meet needs of the community.

Building confidence in and mechanisms for sharing knowledge and data

P. Cullen

Professor Peter Cullen
Chief Executive Officer, CRC for Freshwater Ecology

Professor Peter Cullen is Chief Executive of the Cooperative Research Centre (CRC) for Freshwater Ecology. He has over 30 years of experience in land and water management. He has carried out research in nutrient dynamics and lake eutrophication. He has also been influential in communicating science to managers and using science to develop appropriate policy options for land and water management. He is a Fellow of the Australian Academy of Technological Science and Engineering and a member of the International Water Academy.

Introduction

The two major themes of the workshop relate to knowledge and to the institutional arrangements we erect to manage our inland rivers and their catchments. Both of these elements are important because all participants feel deeply about the future of these rivers and their typically Australian landscapes.

Deciding on our futures

The actions we take today determine the future landscapes we will live in. The challenge is to understand the linkages between our actions and the futures we cause, and to be smart enough to choose desirable futures. Many of those present at the workshop seek to protect the highly pulsed 'boom and bust' ecosystems characterised by dryland rivers. Others seek to maintain an economic livelihood in what is often very harsh country. A challenge is to accommodate both of these visions, in a landscape where mistakes cause irreversible damage.

There was much talk at the workshop about balance between these differing objectives — as though there was some optimal mix if only we could find it. It is not likely there is a shared vision for any of our major river basins. There is a range of interests, all seeking to be accommodated to some extent. Knowledge can help understand the consequences of various actions and might be able to demonstrate what we will lose or gain by particular courses of action. But at the end of the day, communities will have to decide the mix of activity they want, and will decide what they are prepared to sacrifice. The challenge of catchment management comes when the beneficiaries are in the upstream part of the catchment and those wearing the costs are downstream. That is why catchment organisation tries to incorporate whole catchments to ensure this range of views and understanding is available to the community. Economic interests are seeking information on where it is appropriate to locate their activities; environmental interests seek to identify high value protection zones.

Knowledge — a prerequisite for intelligent action

The need for a good knowledge base was acknowledged by all. There is little doubt that knowledge is a better driver of action than ignorance. The importance of local and Indigenous knowledge was also recognised by the workshop. It was recognised that we needed knowledge to guide sustainable agricultural production as well as the knowledge to maintain the essential life-support processes of the landscape.

There was a sense of frustration about knowledge. The research community believes it does have a lot of knowledge about these systems, but that it is ignored by landholders that are interested mainly in the economic returns from the land. On the other hand, landholders feel a sense of frustration that there is knowledge about their landscapes to which they are not able to get access.

There were some key issues relating to knowledge:

- How do we agree on the research agenda?
- How do we fund and manage the research?

- How do we package the knowledge into useful units for different users?
- How do we deliver knowledge to potential users?

It is important to ensure that when we invest we actually do create new knowledge worth having. There are many consultants who charge considerable fees to find the last few reports on a topic and just re-present them. If the purchaser of the knowledge is ill informed, they may pay and get nothing other than this 'churned' material that has no new data or analysis.

There was a lot of discussion about adaptive management. This is not an excuse to act blindly out of ignorance. It is a strategy where we assemble the best available information, and use it to come to an informed view as to the appropriate way to go forward. We then proceed to implement, but put in place a properly designed monitoring and evaluating system so we can learn what actually happens, and if need be we can modify our actions. It is an approach to learning by doing that can be carried out by local communities.

The workshop spent some time discussing what might be the knowledge priorities to guide management of dryland rivers. Obviously such priorities are a function of the issues in the particular basin, but these commonly relate to the impacts of development decisions.

Inventory investments

Some participants felt that an inventory of existing resources was the first step, especially to document the biodiversity in a region, and to identify undisturbed areas that might be important to protect.

Monitoring investments

Another approach was to establish a monitoring approach that enables a State of the Rivers Report to be produced periodically. This involves periodic measurement of key indicators. It was accepted that state-of-the-art monitoring programs were built around hypotheses being tested rather than just collection of data.

Process understandings

There was a view that we are aiming to protect key ecological processes at a variety of scales, rather than particular groups of biota, which are a consequence of those processes at some particular time. It was seen as important to understand the relation between stream flow and river biota, and of flooding and floodplain and river health. Others thought there were possibilities to take an experimental approach rather than a descriptive approach to this work.

Management tools

Some thought it was important to collate and synthesise existing knowledge as the first step. Others felt the development of decision support systems might be possible. Several people thought a risk analysis was an early step to help focus the knowledge priorities onto likely threatening processes. Others felt it was important to integrate social science research with the biophysical from the start.

Knowledge delivery

The importance of packaging and delivering knowledge was appreciated, but it was unclear who should have this responsibility or how it should be funded. Some felt the researchers should be responsible for delivery throughout the project, and others thought there should be follow up after the project to see that action takes place.

The conventional technology transfer plans that are developed assume that the research project is the appropriate unit of knowledge to deliver, and that it can be done during the research project rather than in subsequent years. Both of these assumptions are not proven.

Institutional arrangements

The institutional arrangements we develop to manage our natural resources are man-made, and the structures determine the sorts of outcomes we get. To many, the institutional arrangements are the main cause of much of the degradation we have experienced.

In looking at the array of institutional arrangements that have been developed in different jurisdictions, it might be helpful and step back to think about what we expect of governments and their agencies, and what we can expect regional and local groups to achieve.

It seems to me that catchment groups are important for articulating the issues and the threats to a region, and they do a lot to focus attention on issues and to bring relevant knowledge to the process. They provide a bargaining arena for the diversity of local views and aspirations. They provide peer pressure on individuals to encourage them to act in a way that suits the broader community.

Governments are responsible for allocating resources such as water, and ensuring that landholders meet their obligations to neighbours and the wider community. They have made investments in knowledge, and in transferring the knowledge through extension programs. They are responsible for ensuring a wider community perspective is considered, including State, national and international obligations.

The devolution of responsibility, commonly without the attached resources, has been a function of public administration of the last 20 years. In natural resource management we have seen the development of Landcare, where local communities learn about problems together

and choose to act in a coordinated way. Larger groupings, at catchment scale, have developed more recently. These catchment bodies have in some cases been given legislated responsibility, and in some jurisdictions have their own rating power, giving a source of funds for catchment activities. These mechanisms have been seen as an appropriate way for governments to channel funds to natural resource management under programs like the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality. A challenge for these regional catchment groups is to provide an effective bargaining arena for upstream–downstream issues, and to ensure regional, national and international interests are considered along with local interests.

One suggestion of the workshop was that rather than expect problems to fit in with the various arrangements, we might do better to design arrangements to address particular issues. Some felt that institutional arrangements should be quite dynamic and flexible, and able to evolve to meet new issues; others sought a greater stability and certainty in organisations. It was generally agreed that structures should be transparent and different groups should be accountable.

Community engagement

Community groups were in favour of devolved block funding rather than being supported through grants. They were strongly of the view they needed the support of the facilitator network. There was concern in most jurisdictions to have clarity in the relationship between the community catchment group and the agency that provides support. It is important to be clear as to who is advising who, and who carries decision-making responsibility.

It was inappropriate to believe that community groups would be able to come to a unified view on some issues. In some situations, there is a real tension between community interests, and it takes an extended period of dialogue to enable trust to develop and to find a position that might be widely supported.

The issue of payment to community groups for their out-of-pocket travel expenses and for the time they contribute is also one that needs to be addressed. It was felt there was an over-reliance on volunteers, and that this was not an effective long-term solution to many of the problems being experienced. It is clear that public interest elements will need to be funded from the public purse.

Issues of capacity building were frequently raised, and covered a wide range of things. It was also felt there was a need to build agency capacity, and to build scientific capacity on dryland rivers.

There was a concern that in some jurisdictions there were series of overlapping committees, with poorly defined roles, resources and responsibilities. Indeed, in some jurisdictions it seems each agency wants to have its own system of community groups.

Threats to our dryland river systems

The two major threats to our dryland river systems were seen as inappropriate development that takes water from downstream beneficial uses, and invasive species.

In both cases, knowledge is a precursor to effective and early action. Water resource planning needs to be conservative, and to consider existing beneficiaries of flooding. As controls tighten up in the Murray–Darling Basin, it was felt that 'freshwater buccaneers' were looking to bring irrigation development to the upstream reaches of dryland rivers that might have considerable downstream impacts. This issue provides a driver for research so that we have a better understanding of such issues.

In conclusion

Dryland rivers are important to those who came to the workshop for a variety of reasons. Agricultural development is dependent on the flooding, and biodiversity is an important feature of these systems. It is important that all who make decisions about these systems do so in the light of the best available knowledge, and consider the long-term as well as short-term outcomes.

It is important that we treat these river systems as whole systems and think about the river channel, the floodplain and the terminal wetlands as one system. It is dangerous to believe we can restore them once they are damaged. Such restoration is proving particularly costly and difficult in wetter regions; in dryland rivers it may well be impossible.

Panel discussion

Clarification

Stuart Bunn, Centre for Catchment and In-Stream Research, Griffith University

Your presentations have highlighted temporal problems but no one has discussed how you overcome spatial problems to deliver science and research.

Response

Peter Cullen

There are big difficulties in terms of delivery of information over such a wide area, and considering the time and money it costs just to make Lake Eyre Basin meetings, I am not sure how to support and develop infrastructure to make this easier. However, I am a big believer in regional research stations where there are constituents and a thirst for knowledge. I would like to see a Lake Eyre Basin Research Institute but there does not seem to be money available to commit to such a project.

Clarification

Tony Rayner, Department of Primary Industries

Leith, there has been a lot of discussion regarding engagement processes and also the social processes needed for this to occur, however I have noted our ability to make broad, sweeping statements. We must avoid isolating people by using these statements. For example, whilst legislation in South Australia may have not got agencies to talk to each other, it has got landowners to work better. Peter Cullen discussed the impact of regional communities — what impact do you think they have?

Response

Leith Boully

In terms of making general statements, this is often a result of the complexities of the topic, which can only be addressed in general ways in many cases. In terms of local communities, it is important they don't drive decisions but have an opportunity to offer and receive knowledge and discuss issues. The ability to negotiate and contextualise knowledge brings together people from diverse views. For many communities, researchers are considered to be remote from them. Researchers also never seem to ask permission to put the community under the microscope or even to do work which attempts to understand the processes in that community. In terms of protection of public good, landholders must be held accountable for their actions in the future — this has not been the case in the past.

Kevin Goss

In making the claim of generalisation, you have drawn a comparison in terms of the way we deal with issues in our approach. We need to be more pragmatic about using different approaches in different circumstances. All approaches must be grounded, however at times of big decisions you sometimes have to run a different process in order to move forward. However, we do need to get some balance in how we take some things forward, we need stable representative frameworks which are reliable and accountable.

Mr Williams indicated this could be identified as a research theme in terms of institutions.

Clarification

Les Russell, Agriculture Fisheries Forestry Australia

Peter, you touched on something I have been thinking about and that is there is an emerging community on one hand and then there is science. I am looking for a complement between this and 'bare foot' science where the community is involved in the scientific process.

Response

Peter Cullen

The whole concept of adaptive management is taken on the assumption that we measure something necessary for making a decision and then we wait and watch the change. We need to strengthen our capacity to improve this.

Clarification

Don Blesing, Lake Eyre Basin Coordinating Group

You all spoke about improved institutional arrangements. What are some of the options?

Response

Peter Cullen

The model I prefer is that all key players are around the table and those people are all operating in a rich, open knowledge environment. This process would require strong facilitation, but it would allow all players to challenge and understand knowledge. If you have good players, good knowledge and good processes, it will allow you to move forward.

Leith Boully

It should be recognised that we should not always be looking toward managers. Other tools such as markets can have a big effect — this is best illustrated in the emerging water market. The other tool is legislation which is appropriate. At the moment we have a lot of prescriptive legislation but no legislation which allows us to do the planning required to take us forward. A planning process which allows you to go through a course of action and produce a plan, which then becomes part of the research, is needed. Once people have confidence in a plan they demand legislation to provide comfort that that plan and the rights outlined within it are protected.

Kevin Goss

An alignment between the opportunities, responsibilities and accountabilities is required and we often have a tendency to dis-aggregate this. Whatever structure you are inclined to apply, those that are appointed to positions of responsibility accept the accountability that comes with that opportunity. If they are in a position of responsibility, they need a predictive capacity when making decisions, which they may not have now. This capacity allows them to answer the question, if we take these actions now, what will happen and how confident are we in that outcome?

Clarification

Chris Robson, Department of Natural Resources

Peter, the current institutional arrangements present barriers to knowledge transfer. What solutions or ideas regarding this would be useful in the Lake Eyre Basin and other areas?

Response

Peter Cullen

One could get into structural discussions, however it should be a cultural issue. We have a management structure which almost prides itself on making decisions in the light of ignorance — this management structure is not driving or helping set the research agenda. A high turnover and loss of corporate knowledge within our public service is also compounding this, making things difficult because we need to be strong about predictive issues.

Kevin Goss

State agencies should being looking internally. I am under no illusion that we have the expertise in our organisation to cover all of the issues we deal with. We know we will have to purchase knowledge and as a result we have to be intelligent purchasers. We are coming through a period of change where previously information and expertise were held internally, but because of budget constraints and other factors we are weaker and we need to rely on a much more developed external group.

Clarification

Richard Kingsford, NSW Parks and Wildlife Service

I am interested in the different institutional decision-making processes of different areas. It is much more difficult to make decisions now because of the massive number of interest groups — how do we break down these impediments to decision-making?

Response

Peter Cullen

In the Lake Eyre Basin, the knowledge that the Coordinating Group had to control their own destiny became a unifying force, despite the formation of the group causing difficulties for both the community and the State governments involved. The difference is that the community has been driving the process and has been able to integrate the information across the whole picture, unlike the agencies who are quite narrow on their patch of ground. The negative side encompasses the classic upstream and downstream issues. While this is not going away, the Coordinating Group offers a bargaining area to discuss such issues. However, in saying that, if the strain becomes too much, I am not sure if it will be strong enough to sustain the pressure.

Kevin Goss

There are consistencies between the Lake Eyre Basin Agreement and the Murray–Darling Basin Commission:

- Sovereignty — this is an issue you will never get away from and a forum like the Ministerial Council

is the only way to deal with it. I am sure that will happen with the Lake Eyre Basin eventually.

- A consistent weakness is the clarity of roles and responsibilities of stakeholders and also what is at stake. There is a real need in my mind in these arrangements to clarify the roles and responsibilities for States and the Commonwealth and really identify what is at risk. At the MDBC [Murray–Darling Basin Commission], the Environmental Protection and Biodiversity Conservation legislation provides clarity for us in terms of what the Commonwealth believes need to be protected.

Leith Boully

There are also a couple of differences: in the MDBC, the community has not been able to drive the process, while in the Lake Eyre Basin, there was a very concerted effort by the community to drive the process. In terms of the MDBC, the Ministerial Council operates on a unanimous decision-making process which can be subject to impact by the lowest common denominator. The Commission is also made up of the heads of government agencies that are traditionally engineers and involved in water resource development and have been in government for some time. There are questions over whether they are capable of providing free and open advice to the Ministerial Council. This membership should be looked at to provide a level of independence in MDBC processes.

Clarification

Jamie Pittock, World Wide Fund for Nature

Everyone in here is either committed to the cause, or is an environmental junkie or already engaged in these decisions. A while ago we wanted to engage people in rural Australia about environmental issues — we held workshops about people's opinions regarding environmental issues. The response was amazing — people recognised that there were problems but these were often in someone else's valley, and they felt no responsibility to do anything about this. This shows that there are some substantial challenges in dealing with our fellow Australians, in terms of offering support and making change — what is your advice in engaging these people?

Response

Leith Boully

Only 30% of farmers are actually participating in Landcare, which leaves 70% who are not and currently we have no way of engaging these people. What we don't look at is the social profile of our communities — many farmers don't want to work in groups and be part of the social process, which is exemplified in Landcare. In many cases, they want to be given information and some assurance it is okay, but they also want to know the resulting change is of benefit to them. There is currently no way of contacting these people and servicing their needs.

Peter Cullen

We have found the same denial in the work we have done. One of the things the CAC [Community Advisory Committee] is about to have is a workshop at Dalby to discuss the indicators of health of that river system in light of the WAMP [water management plan] and other emerging issues. We want to walk through the available information with them and try to assist in change.

Kevin Goss

We have to break out of some of the constraints we put on ourselves. We have to deal with the representative dimension of the community, a whole structure of interest that exist outside our comfortable worlds. I also think we have gotten ourselves into the position that we are separate from the rest of the government. I see that in future we will deal with NRM [natural resource management] the way they now deal with health and roads and so on. Not the add-on approach we have now. This will be a much more stable approach that communities are used to dealing with.

Commonwealth and non-government organisations panel

L. Russell, M. Tucker, J. Pittock, R. Leutton, S. Blanch and J. Atkins

Les Russell
Agriculture Fisheries and Forestry Australia, Canberra, ACT

Les Russell is a biological and agricultural scientist with 25 years of experience in land, water resource and catchment management investigation, and natural resource planning and management experience. He has been a farmer, and has subsequently been employed by both Commonwealth and State agencies in natural resource matters. In his present position as a Policy Adviser in the Natural Resource Management Business Unit of the Commonwealth Department of Agriculture, Fisheries and Forestry, he has specific responsibilities for national groundwater policy issues and the implementation of the Great Artesian Basin Sustainability Initiative. He represents the Commonwealth policy interests in groundwater in the National Groundwater Committee.

Often in natural resource management the responsibilities are not specific to the different groups that have a role in management. My discussion today will be focused around four building blocks which must be recognised for effective natural resource management. This may also assist in answering the question that was raised earlier regarding an appropriate model for inland river management.

- The first building block relates to **institutional arrangements**. This incorporates government structures, responsibilities and levels of authority centred around some agreed management objectives. The resources available to government departments to assist in meeting their responsibilities are currently a big issue, and need to be investigated.
- **Rights and signals** make up the second building block, which includes the development of market-based signals, and the building in of externalities. The downside must be factored into the issue. Pursuing innovative market-based signals, such as carbon credits.
- The third building block is **partnerships** such as Landcare, which not only build partnerships but also capacity of the people involved. Other examples include the recently released National Action Plan and further development of current arrangements with the Cooperative Research Centres.
- The fourth building block is **science** to underpin management. Investigations into the relationships between components of our ecosystems, the effects of land use on water quality and so on. We want to avoid dollar chasing and window-shopping.

The challenge is the scale and the system is different to those on which previous models have been based. Opportunities in inland rivers abound — as little scientific research has been carried out previously, it is almost a blank slate! There is the additional bonus of not having existing structures to unpick and rebuild; we can begin without too much baggage.

The constraints facing us in this area are those common to most areas — the availability of money and resources to fund appropriate management. Also a major constraint is the low level of population density. The principles that came out of the workshops yesterday were fairly generic. I see the major 'speed-humps' as including the building and fostering of appropriate partnerships which will work over the long term? Another speed-hump is the issue of order — environment first or humans? We need a process to consider the merits of each argument and be able to talk through issues — not merely decide that in all situations the environment will come first.

Mark Tucker
Assistant Secretary, Water Branch, Environment Australia

Mark Tucker leads the Water Branch of Environment Australia. He has been involved in a diverse range of environmental and natural resource issues including *Environment Protection and Biodiversity Conservation Act*, regional forest agreements, fisheries and environmental performance of industry and mining.

Policy background

Environment Australia has the following policy objectives in relation to inland rivers:

- implementing the *National Strategy for Ecologically Sustainable Development* and the *Environment*

Protection and Biodiversity Conservation Act and assessing/protecting matters of National Environmental Significance (including Ramsar wetlands, World Heritage, internationally protected migratory species, nationally threatened species and systems);

- progressing the Council of Australian Governments (COAG) water reform framework for ecological and economic sustainability; and
- developing policy and cooperative management frameworks and models for aquatic systems, at catchment/basin or regional level, particularly where systems cross boundaries, with full involvement of community and industry.

We see opportunities and advantages in protecting the relatively intact, inland aquatic systems and avoiding the management mistakes that have been made elsewhere. The Lake Eyre Basin Regional Initiative, the Basin strategies prepared by the Basin Community, and now the Lake Eyre Basin Inter-governmental Agreement, provide the basis for implementing an integrated, participative approach in the Basin.

The challenges

Human dimension

There is one view that we can adapt the environment to meet our needs. On the other hand, there is now a realisation that perhaps we need to adapt more to the environment and ensure the maintenance of ecosystems and their functions and services. For this purpose, we need genuine involvement of all sectors and we need to communicate the environmental values that are at stake. We also need to recognise the strong feelings of farmers and other people living in regional and remote communities about their links to the land and access to water. Indigenous viewpoints and values are particularly relevant.

Ecological dimension

Recognising the disjunction between science and management, we also need to develop and communicate a common understanding of the functioning of ecological systems. Science needs to be more management relevant and managers need to communicate their needs more effectively. Research is essential. An example of current research effort of relevance to inland rivers is the National River Health Program-funded ARIDFLO project. This project is modelling the functioning of inland river hydrological systems and developing the capacity to predict ecological responses to change.

Governance in transition

Institutional failure in its broadest sense is impeding the achievement of ecologically sustainable management of inland river systems. The important ecosystem services provided by arid river systems and associated biota need to be factored into management decision-making. Institutional arrangements need to be more flexible and practical for this to occur. Institutions need to fit the management responses to the problem, not as is often the case, fitting the problem to suit the particular institutional arrangement.

What we are seeing now is a transitional phase. It includes the different approaches taken under the Murray–Darling Basin Initiative and the 1992 COAG Water Reform agreement. The Lake Eyre Basin Initiative is a particular example of a catchment-based management approach. The next phase will be the extension of a devolved model under the National Action Plan, building on previous administrative lessons and not repeating past mistakes.

Implementation

We need long-term visions. Processes need to be participative, transparent and integrated. We need agencies to become holistic in their views, flexible in their responses and 'one stop shops' in terms of dealing with the community. Decision-makers must have access to best information, so we need to improve the linkages between managers and researchers.

Rather than 'monitoring' for its own sake, we require assessment of management actions as part of the adaptive management model. For this purpose, we need baseline assessment of ecological health, and appropriate indices/ indicators that will inform and foster this adaptive management process.

Jamie Pittock
Program Leader, Nature Conservation and Murray–Darling Basin, World Wide Fund for Nature (WWF) Australia

Jamie Pittock has a background in zoology and geography. He is the Program Leader at WWF for Australian nature conservation policy and the Murray–Darling River Basin program.

Jamie was involved in the advocacy that secured the passage of new national environmental laws, the *Environment Protection and Biodiversity Conservation Act*, in June 1999. He has chaired the WWF International Freshwater Advisory Group (1996–99) and was a member of: the Board of the Cooperative Research Centre for the Sustainable Development of Tropical Savannas (1997–99); New South Wales Government regional vegetation committees (1995–98); and Queensland Government ministerial advisory committees on vegetation management (1995–96, 1999). He is a member of the Federal Government's Council for Sustainable Vegetation Management (1997–) and the Indigenous Protected Areas Advisory Committee (1998–).

Jamie acknowledged the traditional owners of the area before beginning his speech.

How are our institutions and communities positioned to address the future needs of inland river management? A conservation perspective

Values of the rivers

World Wide Fund for Nature (WWF) is one of the world's largest non-government conservation organisations. Our global assessment of biodiversity conservation priorities has identified rivers in Australia's semi-arid, arid and wet–dry tropics as among the least disturbed and highest priorities for conservation globally. For these reasons, WWF has invested in conservation programs for rivers such as the Paroo, the last free-flowing river in the Murray–Darling Basin, and those feeding into the Gulf of Carpentaria.

WWF believes that, nationally, the unregulated rivers of central and northern Australia represent our last opportunities to learn from our river management mistakes in the south. We need to conserve their natural variability and ecosystem function to maintain our biota such as waterbirds and native fish, and to establish benchmarks for our restoration efforts on damaged rivers.

We also consider that sustainable inhabitation of these river basins is vital to maintain the unique cultures of local and Indigenous peoples, and to manage these natural landscapes.

Rivers under threat

WWF is alarmed at the threat posed by the 'freshwater buccaneers', a band of entrepreneurs invading the continent from the ruined rivers of the south, seeking cheap water and lax environmental regulations in the west and north upon which to base intensive agricultural developments.

We have seen the Queensland Government's disgraceful capitulation to irrigators on the Condamine and Balonne Rivers, where annual diversions have doubled from 385,000 ML in 1993/94 to 647,000 ML in mid-1999.

Thanks in large part to local pastoralists and conservationists, it looks like the Cooper and Paroo may be spared from irrigation. However the forces of darkness are targeting more rivers:

- the Queensland Government's draft water plan proposes new diversions on the Warrego and Bulloo rivers;
- the rivers feeding into the Gulf of Carpentaria are being targeted for ponded pastures, aquaculture and irrigation;
- the Northern Territory Government is accelerating development of the Katherine–Daly River Basin; and
- rivers in the Kimberley of Western Australia are being targeted for irrigation.

WWF believes these rivers need to be conserved under the framework of the Ramsar Convention on Wetlands (see the Web site: <www.ramsar.org>). The Convention is now about much more than waterbirds and wetland sites. This Convention requires member countries like Australia to manage their entire freshwater and wetland biome to maintain its 'ecological character' through 'wise use', managing whole river basins, and by supporting local and Indigenous peoples. The Convention provides an international framework and repository of knowledge for best practice management, and is the basis for legal protection in Australian law of river ecosystems under the federal *Environment Protection and Biodiversity Conservation Act (1999)*.

WWF has applied the Convention in Australia through wetland conservation agreements with pastoralists and governments to maintain productive and environmental values (in the Gwydir and Macquarie Marshes), and is now working with Indigenous communities.

Managing the threats — knowledge gaps

Much of Australia's current research effort is focused on highly modified temperate rivers. WWF believes that new research needs to focus on those outback river systems that are next slated for 'development', such as

the Warrego, Bulloo, Flinders, Daly, and Fitzroy rivers. We consider the following knowledge gaps need to be addressed to promote sustainable management:

- *Ecological character and wise use.* We need to know what is the ecological character of these unregulated rivers, what are the assets of national environmental significance that need protection, what are the thresholds that may cause significant or unacceptable impacts, and how can these rivers and their valleys be sustainably used. In particular, we need to know how much water extraction may be too much and how to avoid the damage caused by river regulation. In WWF's view, the most sustainable long-term environmental and commercial uses of these rivers will not usually include intensive agriculture.
- *Invasive species.* WWF believes that there is systematic failure to control invasive species from the time exotic species get past quarantine to the point at which a State government declares it noxious or feral, when the species is too widespread to control. Unregulated river valleys are among the areas least impacted by exotic species. Intensive agriculture and other activities threaten to introduce pest species, such as exotic fish through aquaculture, and ponded pasture grasses. Research is required to develop better risk assessment procedures, government programs and laws to keep these valleys free of such pests, and monitoring and incursion management systems to eliminate newly emerging pest species.
- *Landscape-scale conservation.* Research is required into the voluntary, market-based and regulatory mechanisms that will best provide the tools for sustainable management of these outback catchments. For example, independent, third-party certification systems are required to ensure sustainable production is well recognised in the market. Legislation to conserve wild rivers, such as a further iteration of the Victorian law, is required nationally to protect riverine assets of national environmental significance.
- *Cost sharing and institutional arrangements.* The communities in these remote areas are unlikely to be able to fund all the required public-good river conservation works. There are many unemployed people in outback communities, especially in Indigenous communities. We need to research new cost-sharing arrangements for all Australians to contribute equitably to management of these unregulated river environments, employing local residents in the public interest. Further, we need to research the qualities of and means of establishing competent catchment and resource management organisations for each of these rivers. This is urgently required, given that most states are moving to establish such bodies. The duplication, inefficiencies, and lack of professionalism and authority evident in the system of catchment, water and vegetation committees and strategies in New South Wales should not be repeated in other States.

WWF hopes that this workshop will help establish such a research agenda for Land & Water Australia, and the National Rivers Consortium.

Ralph Leutton

Policy and Legislation Manager, Cotton Australia

Ralph Leutton is the Program Manager for Policy and Legislation at Cotton Australia. His key focus at Cotton Australia is the development of realistic and achievable industry policy.

Cotton Australia represents both Australian cotton growers (approximately 95%) and cotton ginners. Our funding source comes from a voluntary levy on approximately 85% of cotton crops grown. Cotton Australia is not a statutory body, and as a result cannot tell growers where and when they can grow cotton, however we see ourselves has having an important role in advising and informing growers about appropriate places and times that cotton can be grown.

Our policy development focuses on strategic issues and in future we are hoping to have third-party independent auditors to assist in achieving best management practice. The process of policy development is by a consultative process involving cotton grower focus groups (by valley). We also undertake consultation with external stakeholders such as cotton research groups and conservation groups.

Cotton Australia has recently developed a position on landscape planning. Our policy has an extensive statement on landscape planning and sustainability, but the difficulty is the translation of this statement into practical terms — what does it mean for land managers? Currently I am focusing on how we develop policy statements which indicate appropriate cotton-growing areas. This means investigating the development of criteria for 'go' and 'no go' areas for future cotton development in both existing and new areas. This criteria would draw from the quadruple bottom line of economic, environmental, social, and cultural criteria.

Cotton Australia is serious about developing this policy line to the extent that we are withdrawing support for development in areas that have already been identified as inappropriate. At this forum there has been much discussion regarding the government agencies and their

research needs and I think it is important to realise that 'agency policy' is not necessarily 'industry policy'. The issue is to have the two policy development processes working in close conjunction. We will continue to work with growers and ginners, however we can't guarantee they will all line up and agree to what is being developed.

Finally we ask the question, how can we shape our future? We are putting in place statements and policies which are not limited by State boundaries, something that is often recognised as an impediment to progress. I am hoping a report will come out of this workshop to help us in the development of policy for the Australian cotton growers and ginners.

Dr Stuart Blanch

Healthy Rivers Campaign Coordinator, Australian Conservation Foundation

Stuart Blanch trained as a river and wetland ecologist in the Murray–Darling Basin. He works with the Australian Conservation Foundation to improve river management in the Basin.

The comments below pertain largely to large regulated rivers such as those of the Murray–Darling Basin.

Knowledge needs

Flooding requirements of floodplains, wetlands and billabongs

Implementation of environmental flow regimes to rehabilitate over-regulated rivers is contingent upon an understanding of the ecological requirements of these ecosystems, particularly the frequency, duration, and rate of recession of over-bank flows. For example, floods which occurred every year in the Murrumbidgee River now occur on average every four years. What scientifically-informed flow rehabilitation targets should the Murrumbidgee River Management Plan adopt, such as a flood every one in two years, or one in three years etc. Insufficient data exist to guide this decision support system on vegetation flooding needs, effects of flushing saline floodplain deposits into rivers through flooding, and the relationship between flood duration and fluxes of invertebrates, nutrients and carbon into the channel.

Weir removal and modification

An adequate understanding of ecological, social, economic and engineering aspects is lacking.

Removal of the barrages at the Murray's estuary

What are the geomorphological implications? What are the flow needs of the estuary? How will marine and estuarine fish benefit? What are the water delivery needs for towns around the lower lakes such as Goolwa, and for irrigation?

Levees and channels on floodplains

What are the ecological and flow impacts of these structures on carbon flows, invertebrates, vegetation, and fish? How can they be modified and removed? Of particular concern are the Gwydir, Balonne, and Lowbidgee floodplains.

Cold water pollution

What are the impacts of cold water releases from the dozen or more dams which release cold water in the Murray–Darling Basin on nutrient fluxes, microbial decomposition, invertebrate growth, seed germination and fish recruitment? There is potentially $70–200 million worth of cold water mitigation in Murray–Darling Basin — what are the priority dams and what is best practice cold water pollution mitigation?

Providing alternative supply options for irrigation

A long-term goal is to phase out the use of rivers as supply canals for irrigation through piping of water from storage directly to irrigation areas. This may facilitate the removal/changed operation of re-regulating weirs, and be contingent upon construction of large, off-river storages within irrigation areas which are sealed and capped. Salinity pollution effects on riverine ecosystems: what are the ecological impacts of rising salt levels on aquatic plants, invertebrates, amphibians etc.? Is 500–600 EC a useful threshold for sub-lethal impacts in guiding flow (dilution) and catchment management?

Principles and values

Increase environmental flows and restore more natural flow regimes

Excessive extraction has reduced the frequency of floods and instream flow variability. For example, the frequency of large floods (100 GL per day, averaged over 28 days) has fallen by 64%, and that of medium-sized floods by 57%, in the River Murray at the South Australian border. The most important river rehabilitation task facing government and communities is to restore more natural flow regimes in over-extracted rivers by reducing irrigation extractions. Such rivers include the Murray, Goulburn, Murrumbidgee, Macquarie, Namoi, Gwydir, and Balonne rivers.

No increase in extractions in unregulated or little-regulated rivers

The Paroo, Warrego, Moonie, and Castlereagh within the Murray–Darling Basin, and all rivers within the Lake Eyre Basin, should be protected from broad-scale irrigation.

Recovery of threatened fish species and ecological communities

There are eight listed threatened fish species in the Murray and its major tributaries in New South Wales and Victoria, whilst the lowland fish communities are also listed, or soon to be listed, as threatened. As fish use a broad range of habitats within a river system (main channel, snags, deep holes, riparian zones, creeks, wetlands, floodplains, billabongs) they are useful ecological indicators of general river health. Hence the status of fish species and communities is a useful surrogate, and the recovery of threatened fish in degraded rivers should be a key goal of river managers.

Commonwealth involvement in river management

Parochial attitudes by States frequently thwart moves toward more ecologically based river management policies. In particular, progress towards substantially reducing irrigation extractions in many rivers is progressing too slowly. The Commonwealth should consider anew means by which it can facilitate the reduction in extraction levels, including the provision to abridge States' rights to manage river flows should management prove unreasonable, as provided for in section 100 of the Commonwealth Constitution.

Aspirations

Rivers on the national agenda

The rehabilitation and protection of rivers is yet to be considered as an issue of national importance. Natural resource management, including river management, should be a core Commonwealth funding responsibility rather than funded through asset privatisation.

Inland floodplains valued and valuable

Income derived from eco-tourism and other industries consistent with nature conservation supports local communities living near significant wetlands in various countries, such as the Pantanal and Amazon (Brazil) and the Okavango (Botswana). Floodplains such as those of the Paroo, Macquarie, Balonne, Warrego, Narran, Cooper, Diamantina, Georgina and Finke are of similar quality and should be better marketed for eco-tourism.

Use of river health indicators that are meaningful to general society

Indicators of river health used by river managers and researchers frequently convey little meaning to society at large, such as levels of nitrogen or dissolved oxygen or flooding frequencies. Recovering threatened fish and re-introducing fish to rivers from which they have disappeared is a more readily understandable river management goal. For example, the changes in management of the Murray River required to re-establish Murray crayfish in South Australia are likely to include increased flows, amelioration of poor water quality and habitat protection, amongst others.

A new Murray–Darling Basin Agreement

The Murray–Darling Basin Agreement (1992) fails to provide an adequate basis for catchment and river management. A new Agreement is needed which raises environmental protection and rehabilitation to a level of concern similar to that provided for irrigation and salinity mitigation in the 1992 Agreement.

Ms Jenny Atkins

Representative Speaker, Central Land Council

Jenny noted that in the absence of an Indigenous representative she was nominated to speak on behalf of the Central Land Council at this workshop.

Aboriginal people have a strong connection with inland rivers, which is best illustrated in the dreaming stories of Indigenous peoples. Today there still exists an extremely strong connection between groups and specific rivers. Like landowners, Aboriginal knowledge should be respected and sought up-front, before starting a development or planning process. The information provided to Aboriginal people should be in a form accessible to them in order for them to assist in planning and making informed decisions.

There are a number of things that should be taken into account when working with Aboriginal people. When we talk about communities we think in terms of a unified group, but in the Aboriginal population, there is much divergence amongst the different groups. When working with Aboriginal communities, you must talk to the right people — although accessing them and travelling out to meet them can be costly. Many Indigenous peoples also expect payment when they are consulted and this must be factored into budgets. Facilitation may also be necessary, especially when working with different gender groups. In some areas, the English language is not spoken, however regular visits and effective communication will assist in building a trusting and informative relationship.

Issues considered to be important vary amongst Aboriginal people and so do perceptions of country and water between Indigenous and non-Indigenous peoples, so the issues identified by some groups will not be those of concern for others. The length of time it may take to build up a relationship with Indigenous peoples must be factored into any process.

There have been some important successes in regard to the formation of partnerships with Indigenous peoples. A couple of years ago, Greening Australia was given resources to put together a plan for the Alice Springs area. The traditional owners, who at that time had submitted a Native Title claim over the area, were included in negotiations and had the power to veto any decisions that were made. The Native Title claim was successful and work with Greening Australia is ongoing and is considered a successful process.

Another achievement was the formation of a small Desert Working Group, which was established alongside the Lake Eyre Basin Coordinating Group. This provides an opportunity for issues to be discussed in the local Indigenous language with funding and additional support.

An important issue to note from this process is that if local Indigenous peoples are given the information they require, then they can make decisions about their involvement in management such as more training, interpretation, or development of plans of management. The right to make that decision is vitally important. Management decisions must involve input from Indigenous peoples during the initial stages of work — it is not appropriate to present something that is set in concrete for their input.

Panel discussion

Clarification

Leith Boully, Land & Water Australia

As a cotton grower, Ralph, we have a CRC [Cooperative Research Centre] for Cotton and an Australian Cotton Growers Research Association which is provided with funds for a public good. How can I be reassured that as a cotton grower my money is going toward public good?

Response

Ralph Leutton

At Cotton Australia we are initiating projects with conservation colleges and the like. There is a great deal of pressure on the cotton industry to be involved in landscape planning, however as we are not a statutory body, we only have the capacity to *influence* choices of growers and ginners.

Clarification

Lynn Brake, Arid Areas Catchment Water Management Board

There has been a lot of money go into grant schemes — is there any money to assist transfer of information over the next five years to address the issue of lag time as discussed earlier?

Response

Les Russell

There has been substantial money directed toward communication exercises and the employment of extension officers. But we have been constrained by higher powers to a certain extent. I don't know what the future will be in terms of the son of NHT [Natural Heritage Trust], or its contribution to communication.

Mark Tucker

In terms of institutional structures, we have to make clear links between research and decision-makers. You do get in positions where there are no linkages and research is not being used as it should. We are definitely talking about these issues and making sure the linkages are in place.

When NHT was established it was seen as a one-off process. It was flawed from the start because it was reactive, not targeted to achieve substantial change. If we are looking for changed institutional arrangements we must address international obligations, regional catchment accreditation, and invest money through regional bodies in a targeted manner to achieve outcomes. All of this has to be measurable, not scattergun like NHT.

Clarification

Tom Baker, Environment Australia

I am still grappling with Peter Cullen's 'ooh ah' comment, where science is sophisticated and impressive but there is no link to the users. Each system has its own needs and should be studied in its own right. So far we have had suggestions for new models, the return of extension roles, river managers (LEB [Lake Eyre Basin] coordinators). Leith Boully talked about developing and sharing power, Mark talked about the need to integrate information and decisions, Jamie wants catchment authorities with power, and Peter proposed a scientific institute in the Lake Eyre Basin. All these strands are part of the solution, but I would like to hear from the panel their interpretation of the term 'capacity building'.

Response

Jamie Pittock

There have been two processes of thought: that good environmental management relies on voluntary involvement and also market-based mechanisms to change behaviour. To date, the government has relied too much on voluntary involvement without making use of all the tools in the toolbox. Whatever process is used to build the capacity of regional communities and catchment management organisations, it should at the very least enable them to deliver a well-targeted program with limited resources, which will always be the case.

Jenny Atkins

I believe it is about empowering local people through the provision of knowledge and information and also listening to how they want to manage their land. The

process of engaging them to encourage empowerment should be appropriate to their situation, therefore it must be flexible and dynamic and there should be recognition that this process requires a long-term commitment.

Mark Tucker

One thing which I find condescending is that the words 'capacity building' are always used in the context of the local community, but we should recognise that it is a two-way process, and should be a serious proposition in government agencies.

Ralph Leutton

We should be careful that we focus on what we need to know and work with this within the current structures. We should not be establishing committee on committee, which eventually causes the same people to be over-committed.

Clarification

Drew English, North Central Catchment Management Authority

There has been much discussion about communication over the last couple of days, but not nearly enough about listening. Communication and talking is important but one of the central issues is the WIIFM (what's in it for me?) principle. The panel members each put up a wish list and many speakers have been operating from this WIIFM perspective. Have any of you asked collectively '*what is in it for me?*' for your clients?

Response

Mark Tucker

As I said before, in the past we tried to design the problems to fit the institutional structures within which we operate, but the institutions should change to suit the problem. But we are in an experimental phase and it is painful for both the people in agencies who want to do the right thing and the people who are on the receiving end of these changes. I don't think there is an answer yet and hopefully over time we will develop the right approach.

Les Russell

We should stop kidding ourselves that there is a single right structure. We should get on with things and not try to refine things down to what we consider to be a perfect structure.

Jamie Pittock

Those of us who have been advocates of biodiversity have treated it separately, but through establishment of working groups we have the methods to achieve cooperation and outcomes for biodiversity.

Jenny Atkins

People are reluctant to keep putting out information without getting tangible results. We are cautious about being asked the same questions again and again to no avail.

Clarification

Michelle Rodrigo, Greening Australia Northern Territory

Community people are burnt out and always seen to be in a situation where they are responding to policy. The word is that if there is another NHT there is hope that the responsibility of administering NHT will be at a regional level. Do communities have the capacity to handle this responsibility?

Response

Les Russell

I suspect that the targeted areas of the National Action Plan tend to be in regions of reasonable economic activity and the ability and capacity to handle this opportunity will emerge. But in other areas it may just have to be taken on as something to be considered and dealt with.

Ralph Leutton

We have to be proactive in these situations. In most cases we are chasing money all over the place and keeping people employed reading and writing proposals. We want to be proactive and set the agenda and then go to the agencies and see who we can work with to address our agenda.

Jamie Pittock

This is a good point and I think the many States and Territories have squandered funds in this area. There is lots of duplication, the same people doing all the work with few resources. There could be a rationalisation of existing structures which would use the same money more efficiently and judicially.

Stuart Blanch

This is a big issue as many people get burnt out quickly because they are constantly going to meetings. Conservation groups are hard up to put in the effort that is required of them and you get sick of doing more than you're paid to do or valued to do.

Reporting on discussion in small workshop groups

How would you invest $1M (pa) over 5 years on knowledge and knowledge generation to improve inland rivers management?

Black Group

The Black Group noted that they had looked at the problem holistically and the process should be participatory:

1. Scoping of the issues
2. Assemblage and assessment of existing information
3. Decision support system for resource prioritisation and policy development (knowledge product)
4. Framework for engagement processes (product)
5. Communication and information products (product).

Of our million dollars, we would put just as much effort into determining the direction of research and the way it is disseminated — no research work though.

Blue Group

Premises

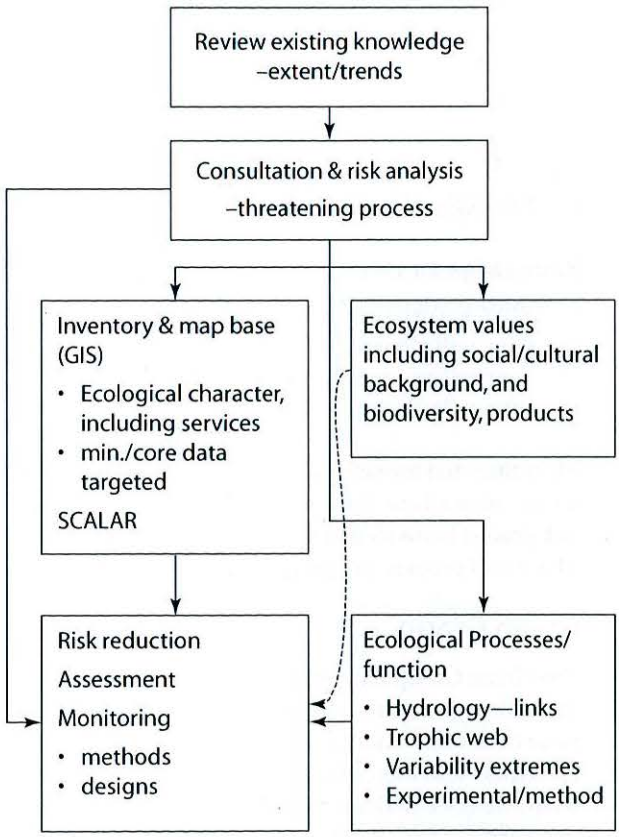
1. Do the important, not the urgent
2. Community-based partnership in place
3. Focus on relatively undisturbed catchment
4. Underpinned by project management structure
5. Vision for natural resource management in place
6. Knowledge delivery process determined at the outset, which is ongoing and incorporates a review process.

The relative effort is not outlined between the three boxes in the following diagram (inventory, ecosystem values, and processes).

Ecosystem values — how do they value the area and what are the goods and services they receive (including the non-dollar value)?

Ecological process — hydrology from top to bottom. The risk analysis would set the hypotheses.

Risk reduction assessment (which is linked to inventory).



Delivery

1. Direct contact — 'one-to-one travelling show'
2. Internet
3. Publications — scientific papers, newsletters, information sheets
4. Formal report with recommendations which specifically say who should follow them up!
5. Media — print, radio and TV
6. Key groups — catchment committees, management agencies, local champions and schools.

Pink Group

Upfront

1. This is part of a bigger planning process
2. Initial consultative process involving stakeholders combined with,
3. Risk assessment that uses current information. Identify knowledge gaps critical to potential threats

Feeds into the catchment management plan

Data gathering and streams of research

- Biodiversity/biophysical/inventory
- Ecosystem processes
- Indigenous knowledge
- Social research into communities' understanding of natural resource management (capacity building)

Delivery

- Monitoring and assessment

Knowledge strategy

- What knowledge do we need?
- How will we get this?
- How will we use the knowledge?
- Who will use it?

Most time and money would be spent sorting out what to do and then a little bit doing it. The point regarding Indigenous knowledge encompasses all local knowledge. The social process provides direction for delivery.

Green Group

The Green Group indicated that they had spent some time determining what the agenda was. When discussing the issue of new knowledge, the Green Group focused on one catchment and then had a detailed discussion about what would be done in that catchment and the transferability of the work.

The green group questioned:

- Is the question correct?
- Should the question contain constraints?

That aside:

1. Define inland rivers and their characteristics — existing, 'on-ground', gaps, needs
2. Which rivers and what sections (relates to threats and risks)? Develop draft policies
3. Develop new knowledge — projects, focused
4. Outcomes — 'go/no go' — policies.

How would we deliver that investment?

1. Throughout the program
2. Use and build on existing networks
3. Conclude by packaging regional/catchment 'data sets' to inform policy and land and water-use decisions that will aid in preventing mistakes
4. Conclude by packaging specific knowledge sets to target particular management needs of land and water managers, eg. pastoralists, irrigators and State agencies.

Yellow Group

The Yellow Group noted that they had had trouble initially actually deciding what the question meant.

Focus on undisturbed Lake Eyre Basin catchments

- Monitoring
  - what should be monitored?
  - how do you do it and some 'doing it'
- Basic biological and physical inventory (characterising the catchment systems/species/landscape)
- Hydrological modelling
  - with a spatial emphasis (areas, time of inundation in addition to volume)
  - long-term
- Community consultation — part of the process
  - research how to do this
  - how to deliver knowledge (also a research project)
- Ecology and flow relationships
  - impacts to events/change
- Land-use impacts (including weeds and ferals)
- Bringing together existing information

How Do We Deliver Outcomes?

1. Consultation and communication strategy — a project on how to deliver knowledge, not just delivering knowledge
   - plain English summaries
   - employ a knowledge broker
   - information clearing house
   - community education and training
   - range of media, taking into consideration distances
   - public meetings
   - scientific reports
2. Full involvement of community in all phases
3. Project management
   - interdisciplinary project teams
   - leaders must be good communicators and engender trust
   - firm contracts for delivery
4. Implementation
   - patrons' support
   - legislation/agreements
   - accountable agency groups.

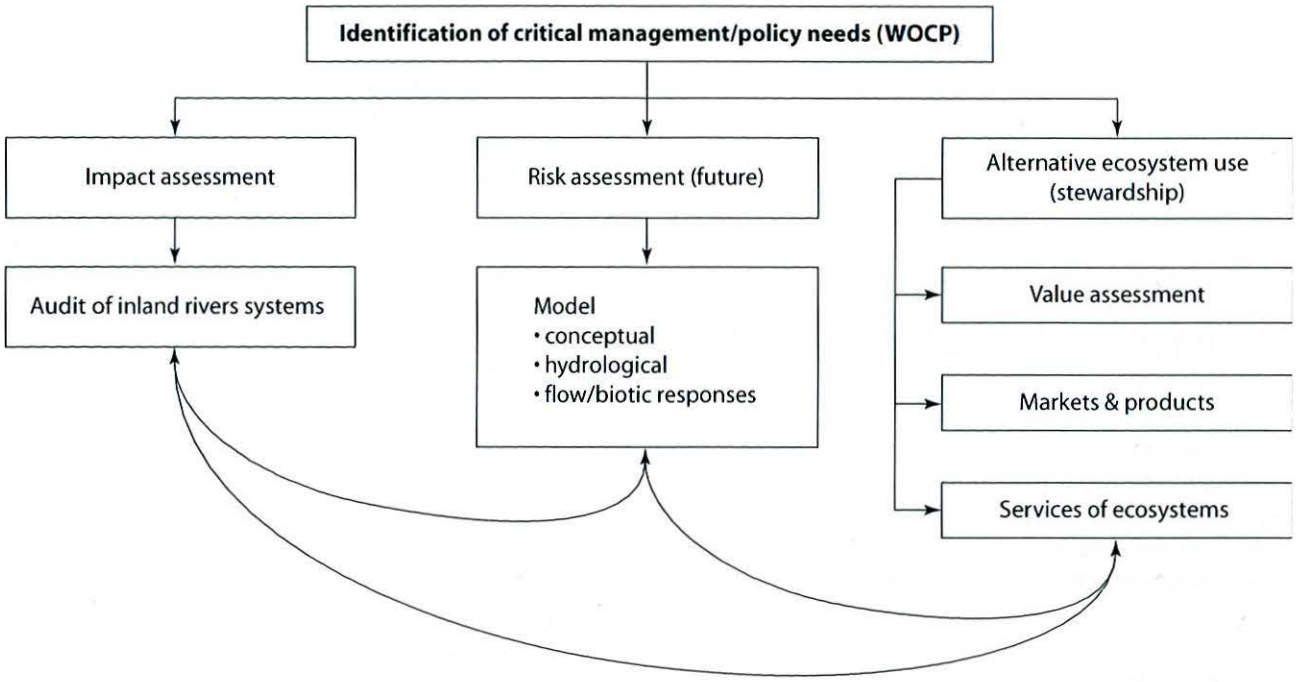
Orange Group

The Orange Group identified this as a whole-of-community process, with three main areas where money could be channelled.

WIIFM — what's in it for me?

This has to include what is in it for the minister, the investor and the community, science and environment.

There should be knowledge exchange at all levels — federal, State, regional and local — assisted by extension, a participatory approach and it should contain multi-avenues. We currently have a very narrow idea about how we exchange knowledge.



White Group

- Invest $100K in planning program
- Invest $400K in issue development
- Invest $500K in communication
- Invest $4M in knowledge generation

Process

- Consultation
- Identify partners
- Design conceptual model
- Identify interests/issues
- Differentiate issues
- Active partnerships
- Identify priorities
- Gap analysis
- Identify hotspots

A plan for knowledge investment

- Sharing opportunities with stakeholders
- Investment proposals — identify local knowledge providers' communications
- Call tenders and commission work (involve partners' own research)
- Invest in process/delivery
- Proactively use outputs

Communicate

Communication and delivery begins when the project does, not after.

- Targeted
- Via partners

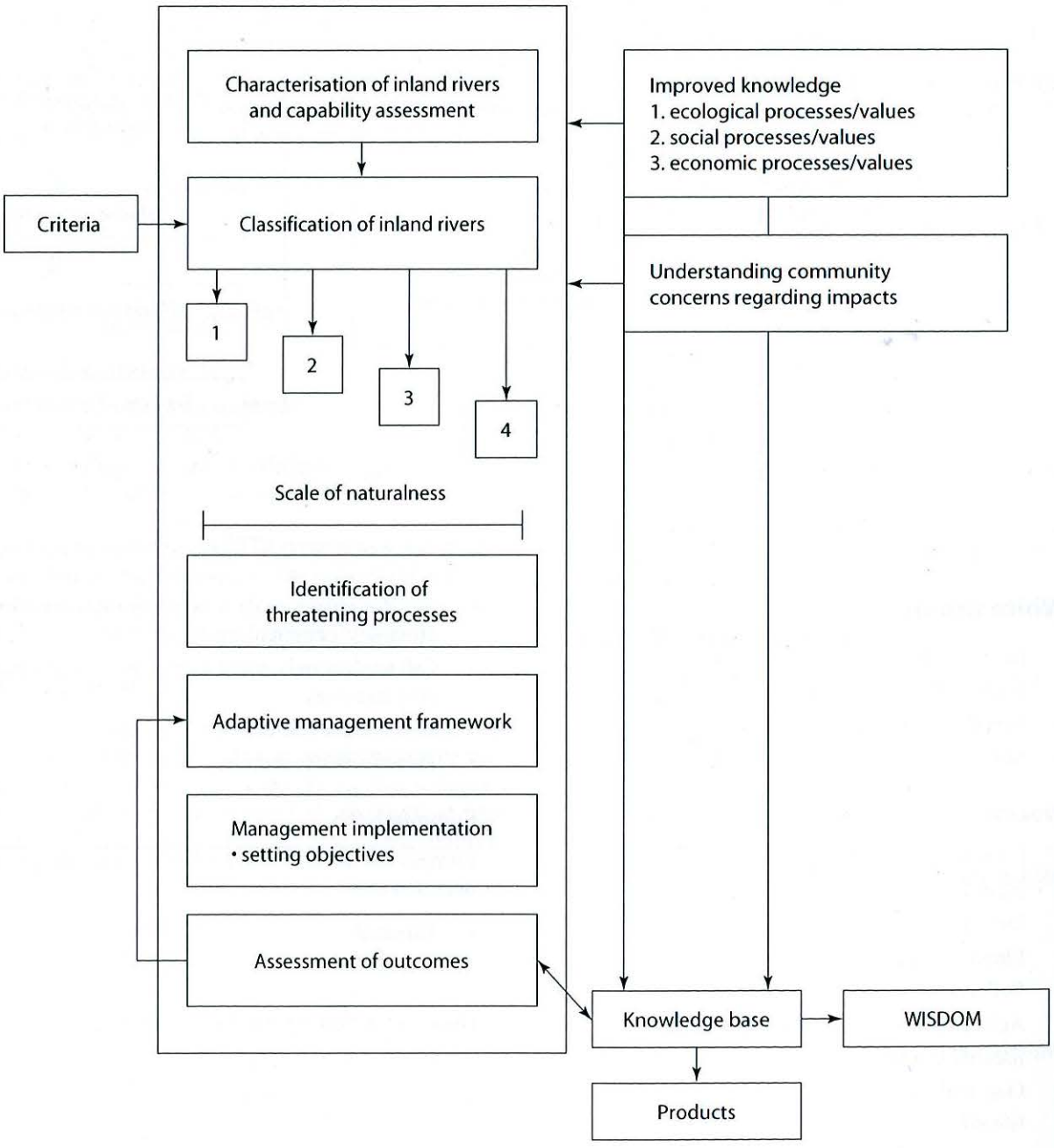
How do we deliver this knowledge?

- People participation
- Communication strategy
- Adaptive assessment of process implementation
- Set up process and structure to turn knowledge into action (new players)
- Urge partners to take action.

Red Group

Knowledge delivery

- Depends on client requirements (community, manager, proponent, other stakeholders)
- Need to use technology where appropriate and best options
- Need to be part of adaptive management approach (ie. is management relevant?)



Reflections

Professor Kevin Rogers

Professor Rogers started by thanking all of the people who contributed to making his trip to Australia a success.

There are four issues which I would like to elaborate on as a result of attending this workshop, the first of which is adaptive management. I look forward to the day when we stop looking at adaptive management as something a section of our community is responsible for, but something we do as a community in its entirety. Adaptive management is a combination of management at all levels and science, so as a result we should all be considered knowledge generators and action takers in that process. I look forward to the day when this is the case.

The other thing that struck me are the perceptions of government, community and science. Someone once told me that government can only go so far down, but the resources they use dissipate as they get closer to the ground. Therefore, to be effective we need a pot of money to turn this around and adapt the approach to a bottom-up and top-down approach. In order to do this, we must really get our communities organised. I have heard from scientists that the community dictating what we do is threatening, but I say this would be a good position to be in and people should be positive towards this kind of model because they are not really demanding unusual things from us.

I would like to take this a bit further and sketch out the real measurement of success at the end and also try to ensure that there is a difference in the community at the end. If we completed a massive task and got all the way to the end, how would things be different? A tactic has been to fund scientists only to get research applied, not just to do the research. As a result, the research has had to become accountable in order to make sure it has some effect at the end of the process. Some people have suggested to pick a case study, plan it completely from beginning to end and have a good idea about what the ends are and what needs to be done in the middle, make sure things are done correctly for the entirety of the work, and perhaps add some satellite projects around the sides. This kind of process allows you to experience the gamut of the problems and discover their solutions all the way through.

Lastly, if you went through this process, ask yourself questions like: "If I were to work from a different perspective, would I be doing the things I do differently as a result?" I saw a lot of potential for this to be put into practice.

Thank you once again for allowing me to participate — it is a very exciting time to be involved. Good luck in the future.

Summation

Professor Peter Cullen

Futures

I thought one of the biggest challenges we got from this process is the one of futures and how we imagine the type that we want? How can communities vision a future? I thought Mr Campbell's trajectories were very interesting as they provided us with some examples of scenarios. It was emphasised that the actions we are now taking will determine what kind of future we will have — we can make choices to change or we can be satisfied to drift.

Themes

The themes of the workshop centred on:

- knowledge;
- institutional arrangements, including partnerships, legislation and markets;
- capacity; and
- accountability.

Knowledge

A lot has been said about knowledge. I believe deeply that knowledge is better than ignorance when making decisions! I think that local and Indigenous knowledge is important and we have to determine how we integrate this. Farmers often require different knowledge and we have to investigate this. Is it orientated toward production or environmental requirements and how should we prioritise these requirements? I am trying to do this for Lake Eyre and it is difficult.

There seems to be a great deal of frustration. Researchers feel that their input is no longer valued and that dollars direct all decisions, while the community feels the information is not accessible or in a useable format for them. We also need to determine a process of agreeing on a research agenda and then adopting a way to fund and manage the research, and again the answers to how we package the knowledge and deliver it remain elusive.

I would like to add some general points on knowledge, such as the need to create knowledge, not churn knowledge. This is a process I have been noticing with consultants, and as a result nothing is being learnt. The discussion regarding adaptive management and the 'learning by doing' approach is encouraging, but the hypotheses have to be clear and also data provided to test them.

Knowledge priorities

The knowledge priorities which emerged when groups were asked how they would spend $1M a year for five years were interesting. There were relative allocations for monitoring, inventories and ecosystem process studies, all guided by issues and values. In response to a few things, the results from the development and use of decision support systems have been mixed — it is vitally important to make sure the information and predictive tools are there to make them trustworthy. The issue of focusing on what is important rather than urgent needs to be further developed. There was a clear message to focus on undisturbed areas, which ironically flies in the face of the National Action Plan where the worst catchments are being rewarded. Many groups wanted to see a collation of existing knowledge, and still more wanted better understanding of ecosystem process at differing scales. Experimental approach, risk analysis of threatening processes and a biodiversity inventory were all covered. Another important point was the integration of biophysical and social research, instead of treating them separately as has been done in the past. One group asked for a 'go' and 'no go' map for development which could be driven more by process. Ecology-flow relationships were a popular suggestion. The issue of policy needs driving knowledge generation was raised in addition to impact assessment and auditing, risk assessment (conceptual models), alternative economic uses and stewardship. I think that $1M is a ridiculously small amount of money in any case to undertake knowledge generation.

Knowledge delivery was covered — there should be follow up and action on knowledge delivery to avoid future concerns that science is not being applied. I am unsure about the suggestion of knowledge delivery through the entire project. The packaging of data sets is

always useful, for example, the recently released 'Basin in a Box'. Again the issue of turning knowledge into action, from being useful to being used was raised, along with a warning that we should be careful about scientists promising and then not being able to deliver.

Structures drive outcomes

Institutional arrangements are critical because they will determine the outcomes. The important question we should ask is who are we trying to influence to bring about what? A shared vision was discussed and questioned: is there a shared vision between economic and environmental imperatives? The issue of balance was also debated, and whether just achieving a balance is good enough. I felt that no concept of balance was given and as a result uneasy tensions remain. The current process of forcing problems to fit the arrangements was identified and it was suggested that arrangements should be dynamic and flexible enough to adjust to the problems. While there is no right structure to deal with everything, structural arrangements should at least allow knowledge to flow through and be accountable and transparent.

The point regarding a river manager is important. Is there anyone championing the river instead of the resource? Should this be part of the structure? We also looked at the role of legislation, markets and the Constitution in regard to the roles and responsibilities of the State and the Commonwealth. I must note that I was prepared to rewrite the Constitution after Kevin Goss' presentation!

Institutional expectations

The rights and responsibilities of community were raised, but it is important to have a clear idea about who we want to be making which kind of decisions? This question should be addressed before playing around with communities and agencies. Associated with this are our expectations of agencies. What can we reasonably expect of them? How can we incorporate the upstream and downstream issues into our decision-making and what about the inclusion of national and other interests?

Community processes

The need for ongoing, reliable funding as preferred to grant schemes was noted in order to provide greater support for community groups. I believe there should be much greater development of facilitator capacity in community groups: facilitators are crucial when working in communities and this needs to be developed. The level of agency interaction was raised. There is also an assumption that across the community there is a unified view on issues. This is not currently the situation in most cases. While it is possible to get a unified view, there will be tension that must be broken down with dialogue, trust and time.

Capacity building

Capacity building was an issue raised on many occasions. At the moment, it is very clear that there is a definite over-reliance on volunteers. Capacity building is more than empowering locals. I am interested in scientific capacity more so than others but there is also the capacity of agencies which may have to be addressed. Many people noted the importance of using the structures that are available and avoiding the development of a multitude of overlapping committees.

Threats

The 'freshwater buccaneers', as they were referred to, are seen as a threat to the health of our inland rivers. People moving from inland river to inland river working under inappropriate management techniques. Invasive species were mentioned as a big threat that was not being addressed adequately.

Bargaining requirements

There are three important points that need to be met if bargaining is to take place:

- all players need to be present;
- the appropriate knowledge must be made available to all; and
- the process must be facilitated to achieve the most agreeable outcomes for all.

How might our efforts be sabotaged?

There seems to be a lot of good intention out there but the important part is to make sure intention is acted upon. Failure to influence the decisions of landholders, agencies and community groups will mean good intentions remain as just that. Consideration of temporal changes is essential. Making decisions without consideration of their long-term implications is an excellent way to sabotage our efforts. The division of our systems into 'silos' without maintaining and identifying the connections between them is also a serious mistake that in some cases we seem intent on making. The belief that we can restore our systems once they are degraded slows our efforts to address problems in their earliest stages, when our actions are most effective. Finally, the inability to recognise or gather the knowledge we need to better manage our inland river systems is a problem which has been discussed at this workshop. By avoiding these common ways to sabotage our efforts, good intentions can become actions and solutions.

Close and thanks

Leith Boully

On behalf of the National Rivers Consortium, it is a pleasure to get the last word in. Following compilation of the workshop proceedings, an outcomes report will be put together and sent out to you.

The outcomes report will be used to assist the Consortium in making decisions in future. It may also be useful to assist participants in their own planning and decision-making processes. I believe it is vital that we get a funding program on inland rivers set up as soon as possible to assist in understanding and managing these systems better.

Thanks to Land & Water Australia, to Professor Cullen for your summation, and to the organising committee for their efforts. Thanks also go to Mike Williams, Elizabeth Medley and Fleur Flanery for your organisation. A special thanks also goes to Professor Kevin Rogers for the international perspective he provided to this workshop. Finally, thanks to all the participants for a tremendous workshop and a great outcome.

APPENDIXES

Appendix 1.
Inland Rivers Workshop Discussion Paper

As provided to participants in advance of the workshop

Brendan Edgar, Land & Water Australia

Introduction

Inland rivers occur across the vast arid region of the continent, comprising 70% of the land area of Australia. These rivers come and go, flood large terminal wetlands or lakes, wet vast floodplains, create diverging and converging channels, dissect new watercourses, and dry out to meandering braided channels, billabongs and waterholes.

What is it that characterises Australia's inland rivers?

Variability

Inland rivers are characterised by highly variable flows. In many rivers, flows are commonly very low or there is no flow, with flow regimes dominated by occasional large flows produced by high rainfall events. Northern draining rivers have highly seasonal flows, driven by monsoonal rains in the wet season and no rain in the dry season.

Scale

Inland river systems function at a landscape scale, influenced by geography, time, distance, the extensive nature of flood events, and the large size of properties. River flows and floodplain wetting can occur at great distances and long lag times from where rainfall occurs.

Biodiversity

Biodiversity exhibits 'boom and bust' cycles, coinciding with flood and drought. The biota is equipped to deal with such variability and respond rapidly to water. Diversity of habitats, from saline to freshwater, variability of flows, high temperatures and plenty of sunlight result in the high abundance and diversity of plants and animals on rivers and their floodplains.

Management

Inland river systems span State and Territory borders. Implementing effective management arrangements is difficult in the absence of formal agreements between States. Recent progress has been made with the signing of the Lake Eyre Basin Inter-governmental Agreement. Institutional arrangements are not well developed with the responsibility, capacity and legislative basis to act. Management regimes generally operate at a local or regional scale.

Water resource development

Diversions, regulation and floodplain development, including off-stream storage and interception of overland flows, are increasingly moving out into previously unregulated river systems. Property and development rights, and impacts on downstream users and the environment are major issues.

Land use

Pastoralism and rangeland grazing are the most extensive land uses, with the most productive areas located on the floodplains. Indigenous lands, oil and gas extraction, mining, and tourism are also major owners and land users.

Community

Inland Australia has low population densities, with people living on remote rural properties and stations, or in scattered settlements and towns. The Australian community living outside the region exercises a strong influence on policies affecting inland river systems.

Society

Inland rivers are strongly ingrained in Australian culture. Aboriginal land management and culture, droving, paddle steamers, Burke and Wills, Clancy of the Overflow and pastoralism, among others, influence how people feel about the management of inland rivers.

Research

Until recently, little research had been conducted on inland river systems and how they function. Contemporary ecosystem theories derived from temperate, perennial streams do not apply to inland rivers. Answers are needed that are specific to the management needs of these systems.

On what principles should inland river management be based?

We need to develop specialist policies on which to make decisions concerning inland river management. While our present knowledge may appear inadequate, the demand is urgent and we must respond to pressing management issues now.

A set of principles for inland river management may assist the community, policy-makers and managers to make decisions for a sustainable future. A set of principles upon which to base inland river management and policies could include:

1. Naturally variable flow regimes, the dry phase, and the maintenance of water quality are fundamental to the health of inland river ecosystems.
2. Flooding is essential to floodplain ecosystem processes and makes a significant contribution to pastoral activities.
3. Structures such as dams, weirs and levees can have a significant impact on the connectivity along rivers and between the river and its floodplain. Solutions are needed to either minimise these impacts or find alternatives.
4. Water is essential to rural industries and communities, who have the responsibility at the local level to manage water resources.
5. Catchment management, and integrated surface and groundwater management, are important concepts that need to be put into practice.
6. Sufficient knowledge exists to ensure that water resource allocation decisions are made on a sustainable basis. A strong commitment is needed to access and utilise best available scientific information.
7. New developments should be undertaken only after appraisal indicates they are economically viable and ecologically sustainable. Promoting greater water efficiency is essential to achieving sustainable industries.
8. High conservation value rivers need to be identified and, in some cases, protected in an unregulated state.
9. Stressed rivers need be identified, and priorities established for their rehabilitation.
10. Improved institutional and legal frameworks are needed to meet community river management aspirations.
11. With all parties making a commitment to work together, management regimes can be developed that are ecologically, economically, socially and culturally sustainable.

What are the research gaps?

Achieving a sustainable balance between water allocations for river health and for consumptive use requires an understanding of ecological processes. It is equally important to make knowledge accessible to all parties, to achieve lasting decisions with broad community ownership. High priority areas of research include:

Whole system management

An essential aspect of our understanding of inland rivers' functioning is to quantify the links between the different components of the system (wetland, river channel, floodplain). Relative contributions from each component under different flow regimes, and how the overall ecology depends on these interactions, need to be investigated in view of potential changes in flow regulation.

Social/institutional factors

Natural resource management is complex and the factors that influence the adoption of research results are often social, legal, economic, policy and institutional. It is important to understand the community's relationship to inland rivers and the nature of the drivers for change; socially, politically and economically. We need to know more about the institutions that implement change, and what capacity building within communities is required to move forward in a sustainable direction.

Understanding variability

Hydrological variability may be associated with increased habitat and food web complexity. It is likely that the persistence of many species in dryland rivers relies on maintenance of intermittency, although there is little information to support this hypothesis. The variable flow of rivers promotes a diversity of physical and chemical conditions and these, in turn, lead to habitat patchiness and increased biodiversity.

Understanding flood pulse

Each river has a flood pulse with unique patterns of stage, amplitude, flood timing, flood duration, rate of flood rise and fall, and flood frequency, and may differ in ways that have diverse biological consequences. An understanding of flow history is needed to identify independent measures of hydrological variability, each with biological significance, and the ecological ramifications of the hydrological features of the flood pulse.

Managing flows

We need to understand how flow and climate variability relates to indicators of river health. By integrating the climatic, hydrological and river health aspects of the system, we can determine better operating decisions on water releases for agriculture and the environment. The development of sophisticated flow management regimes is needed in regulated systems with environmental allocations. An experimental and adaptive management approach is needed — testing the performance of management systems as we go.

Understanding wetlands

Dependent wetlands are a critical component of inland river systems. They are often most affected by river regulation and diversions and an improved understanding of their role in river ecology is needed.

Floodplain management

What are the floodplain processes that drive inland river ecosystems? How do grazing, nutrients and contaminants affect floodplain and river processes, and what are the most effective management options for a sustainable future?

Appendix 2.
Workshop delegates

Title	Given name	Surname	Organisation	State
Mr	Kim	Alvarez	NSW Department of Land and Water Conservation	NSW
Ms	Jenny	Atkins	Central Land Council	NT
Mr	Peter	Baddiley	Bureau of Meteorology	QLD
Mr	Tom	Baker	Environment Australia	ACT
Mr	Jason	Barnetson	Arid NT Wetlands Inventory Project	NT
Mr	Colin	Beard	Bureau of Meteorology	NT
Mr	Paul	Bennett	Department of Natural Resources and Environment	VIC
Dr	Stuart	Blanch	Australian Conservation Foundation	NSW
Mr	Don	Blesing	Lake Eyre Basin Coordinating Group	SA
Mrs	Leith	Boully	Land & Water Australia	QLD
Ms	Jenny	Bourne	Environment and Heritage	SA
Mr	Lynn	Brake	Arid Areas Catchment Water Management Board	SA
Ms	Nora	Brandli	Lake Eyre Basin — Cooper Creek Catchment	QLD
Professor	Stuart	Bunn	CRC for Freshwater Ecology, Griffith University	QLD
Mr	Andrew	Campbell	Land & Water Australia	ACT
Dr	John	Childs	Department of Lands, Planning and Environment	NT
Ms	Bernice	Cohen	SA Department for Water Resources	SA
Professor	Peter	Cullen	CRC for Freshwater Ecology	ACT
Assoc. Professor	Peter	Davies	University of Western Australia	WA
Mr	Will	Dobbie	Centralian Land Management Association	NT
Mr	Angus	Duguid	Parks and Wildlife Commission of the Northern Territory	NT
Mr	Brendan	Edgar	Land & Water Australia	ACT
Mr	Angus	Emmott	Lake Eyre Basin Coordinating Group	QLD
Mr	Drew	English	North Central Catchment Management Authority	VIC

Title	Given name	Surname	Organisation	State
Dr	Max	Finlayson	Environmental Research Institute of the Supervising Scientist	NT
Ms	Fleur	Flanery	Land & Water Australia	ACT
Mrs	Carol	Godfrey	Lower Warrego Water Users Association	QLD
Mr	Michael	Good	SA Department for Water Resources	SA
Mr	Kevin	Goss	Murray–Darling Basin Commission	ACT
Mr	Graham	Griffin	CSIRO Sustainable Ecosystems	NT
Mr	Graham	Grootemaat	University of Wollongong	NSW
Mr	William	Haddrill	Lake Eyre Basin — Georgina–Diamantina Catchment	QLD
Professor	Barry	Hart	CRC for Freshwater Ecology	VIC
Mr	Robbie	Henderson	Water Watch	NT
Mr	Sean	Hoobin	World Wide Fund for Nature	QLD
Dr	Chris	Humphrey	Environmental Research Institute of the Supervising Scientist	NT
Dr	Craig	James	CSIRO Sustainable Ecosystems	NT
Dr	Richard	Kingsford	NSW National Parks and Wildlife Service	NSW
Mr	Ralph	Leutton	Cotton Australia	NSW
Dr	Siwan	Lovett	Land & Water Australia	ACT
Mrs	Lesley	Marshall	Desert Uplands Strategy Committee	QLD
Mr	Peter	McLeod	Lake Eyre Basin Coordinating Group	QLD
Assoc. Professor	Grant	McTainsh	Australian School of Environmental Studies	QLD
Mrs	Elizabeth	Medley	Conference Logistics	ACT
Ms	Kathryn	Mitchell	Santos Limited	SA
Mr	Scott	Parker	Environment Australia	ACT
Ms	Drusilla	Patkin	Land & Water Australia	ACT
Dr	Luke	Pen	Water & Rivers Commission	WA
Mr	Neil	Pettit	Edith Cowan University	WA
Mr	Jamie	Pittock	World Wide Fund for Nature	ACT
Mr	Tony	Rayner	Queensland Department Primary Industries	QLD
Mr	Julian	Reid	CSIRO Sustainable Ecosystems	ACT
Mr	Chris	Robson	Department of Natural Resources and Mines	QLD
Ms	Michelle	Rodrigo	Greening Australia NT	NT
Professor	Kevin	Rogers	University of the Witwatersrand	
Mr	Les	Russell	Department of Agriculture, Fisheries and Forestry	ACT
Mr	Justin	Sheed	Goulburn Broken Catchment Management Authority	VIC
Dr	Mark	Stafford Smith	CSIRO Sustainable Ecosystems	NT

Title	Given name	Surname	Organisation	State
Ms	Gayle	Stewart	Environment Australia	ACT
Assoc. Professor	Martin	Thoms	CRC for Freshwater Ecology	ACT
Dr	Simon	Townsend	Department of Lands, Planning and Environment	NT
Mr	Mark	Tucker	Environment Australia	ACT
Ms	Rose	Turner		SA
Mr	Tom	Vanderbyl	QLD Department of Natural Resources and Mines	
Ms	Maria	Vandergragt	World Wide Fund for Nature	QLD
Dr	Ian	Webster	CSIRO Land and Water	ACT
Ms	Renee	Webster	Murray–Darling Basin Commission	ACT
Mr	Trevor	Whitelaw	Santos Limited	SA
Ms	Kirsten	Willcox	Department of Agriculture, Fisheries and Forestry	ACT
Mr	Michael	Williams	Michael Williams and Associates Pty Ltd	NSW
Dr	Glenn	Wilson	CRC for Freshwater Ecology	QLD
Dr	Bill	Young	CSIRO Land and Water	ACT

Appendix 3. Workshop program

Day 1: Tuesday 27 March 2001

Knowledge What do we know about the driving forces behind Australia's inland river systems? Is this knowledge being effectively utilised in management and policy decisions?

Management Is research addressing the issues that managers need to know to manage these systems? What are the impediments to improved decision-making?

8.30am–9.00am **Opening and Welcome**

Welcome Fran Erlich
Mayor, Alice Springs Town Council

Opening Brendan Edgar
Program Coordinator, Land & Water Australia

Introduction Michael Williams
Michael Williams & Associates Pty Ltd

9.00am–1:10pm **Session 1, Day 1**

How do inland river systems function and how are they being managed?

9.00am–9.20am What do we know about what drives inland river systems ecologically?

Professor Stuart Bunn
CRC for Freshwater Ecology, Griffith University

9.20am–9.40am Physical processes of inland rivers and their biological implications

Associate Professor Martin Thoms
Fluvial Geomorphology, CRC for Freshwater Ecology

9.40am–10.00am How the scale and variability of inland rivers influences wetlands and the pattern of usage of inland Australia for waterbirds

Dr Richard Kingsford
Principal Scientist — Wetland Ecologist, NSW National Parks and Wildlife Service

10.00am–10.20am The ARIDFLO Project

Julian Reid
CSIRO Sustainable Ecosystems

10.20am–10.45am Morning Tea

10.45am–11.10am Panel Discussion

Stuart Bunn, Martin Thoms, Richard Kingsford & Julian Reid

11.10am–11.40am Community Panel

Angus Emmett, Landowner, Deputy Chair Cooper Creek Catchment Committee
Carol Godfrey, Landowner, President, Lower Warrego Water Users Association
Landowner, Oodnadatta SA
Lesley Marshall, Landowner, Central Western Queensland
Trevor Whitelaw, Manager, Santos Ltd

The community members will be invited to:

- make a brief statement on the role of local knowledge and the key issues from their perspective for managing inland rivers
- respond to how well the science presented is being incorporated into policy and management

11.40pm–12.10pm Panel Discussion

Angus Emmett, Carol Godfrey, Andrew Clarke & Bob Morrish

12.10pm–12.40pm State/Territory Management Agencies Panel

Dr Luke Pen, River Ecologist, Program Manager, WA Water and Rivers Commission
Chris Robson, Regional Manager Water Resources, QLD Department of Natural Resources
Kim Alvarez, NSW Department of Land and Water Conservation
Simon Townsend, Manager, Water Monitoring Section, NT Department of Lands Planning and Environment
Bernice Cohen, Senior Policy Advisor, SA Department for Water Resources

The panel will be invited to:

- make a brief statement on the extent to which current management and policy decisions for inland rivers reflect scientific principles and community aspirations
- respond to questions

12.40pm–1.10 pm Panel Discussion

Luke Pen, Chris Robson, Kim Alvarez, Simon Townsend & Bernice Cohen

1.10 pm–2.15 pm Lunch

2.15pm–5.30pm Session 2, Day 1

On what principles and values should management of inland rivers be based?

What do we need to know to improve management?

2.15pm–2.30pm Summation: synthesis of the morning's presentations and panel discussions, focusing on the key convergences between the differing perspectives

Lynn Brake
Arid Areas Catchment Water Management Board

2.30pm–2.45pm Thought provoker on key management principles and knowledge gaps for inland river systems, to focus discussion in the workshops in the afternoon session

Andrew Campbell
Land & Water Australia

2.45pm–3.00pm Workshop format information

Michael Williams

Facilitators: *Stuart Bunn, Martin Thoms, Richard Kingsford, Julian Reid, Jamie Pittock, Sean Hoobin, Peter McLeod, Don Blesing*

3.00pm–4.20pm Small workshop groups

Workshop discussion topics

- On what principles and values should the management of inland rivers be based?

or

- What knowledge is required and on what principles should this knowledge be based to improve management of inland rivers?

4.20pm–5.00pm Reporting on discussion in small workshop groups (5 min each group)

5.00pm–5.30pm Synthesis: management principles and priority knowledge gaps for inland rivers

Andrew Campbell
Chief Executive Officer, Land & Water Australia

7.30pm Workshop Dinner, Madigans Restaurant, Desert Park, Alice Springs

International speaker

Professor Kevin Rogers,
Department of Animal Plant and Environmental Services
University of Witwatersrand, Johannesburg, South Africa

6.50pm; 7.10pm Buses departing from Rydges Plaza Hotel for restaurant

Day 2: Wednesday 28 March 2001

Future:
What are the aspirations for the management of inland rivers?

Opportunities/impediments/constraints:
What are the opportunities and impediments to improve our ability to manage these systems including knowledge, institutions, markets, legislation, policy?

Strategic Directions:
What are the priority values, principles and actions for managing inland rivers, based on our current state of knowledge?

Outcome:
A statement of the strategic directions including priority values, principles and actions to improve inland river management

9.00am–12.15pm Session 3 Day 2

How are our institutions and communities positioned to address the future needs of inland river management?

9.00am–9.20am The importance of effective frameworks and institutions to manage cross-border river systems

Kevin Goss
Deputy Chief Executive, Murray–Darling Basin Commission

9.20am–9.40am How community expectations are shaping future river management

Leith Boully
Landowner, Director, Land & Water Australia

9.40am–10.00am Building confidence in and mechanisms for sharing knowledge and data

Professor Peter Cullen
Chief Executive Officer, CRC for Freshwater Ecology

10.00am–10.30am Panel discussion

Kevin Goss, Peter Cullen & Leith Boully

10.00am–10.30am Morning Tea

11.00am–11.45am Commonwealth and Non-government Organisations Panel

Ross Dalton, General Manager, Water and Regional Projects, Agriculture, Fisheries and Forestry Australia
Mark Tucker, Assistant Secretary Water Branch, Environment Australia
Jamie Pittock, Program Leader, World Wide Fund for Nature Australia
Ralph Leutton, Policy and Legislation Manager, Cotton Australia
Dr Stuart Blanch, Healthy Rivers Campaign Coordinator, Australian Conservation Foundation
Jenny Atkin, Central Land Council

The panel will be invited to:

- make a brief statement on the future challenges, opportunities, constraints and principles for managing inland rivers;
- respond to previous speakers as to how they would change current arrangements or address principles to improve inland river management; and
- respond to questions

11.45am–12.15pm Panel Discussion

Ross Dalton, Mark Tucker, Jamie Pittock, Ralph Leutton, Stuart Blanch & Central Land Council representative

12.15pm–1.15pm Lunch

1.15pm–4.00pm Session 4, Day 2

Principles for improved management of inland rivers

Facilitators: *Stuart Bunn, Martin Thoms, Richard Kingsford, Julian Reid, Jamie Pittock, Sean Hoobin, Peter McLeod and Don Blesing*

Workshop discussion topics

- What are the principles that should underpin the institutional arrangements (incl. policy and legislation) at the national, State and regional levels to improve the management of inland rivers?

or

- What are the principles upon which future development of inland river systems should be based?

2.30pm–3.10pm Reporting, small working groups (5 min each)

3.10pm–3.20pm	Reflections from an international perspective on the emerging principles of inland river management *Professor Kevin Rogers* Department of Animal, Plant and Environmental Servics University of Witwatersrand, Johannesburg, South Africa
3.20pm–4.00pm	**Summation and close**
3.20pm–3.50pm	Synthesis of the principles for improved management of inland rivers *Professor Peter Cullen* CRC for Freshwater Ecology
3.50pm- 4.00pm	Close and thanks *Leith Boully* Director, Land & Water Australia Chair, National Rivers Consortium
4.00pm	Close allows Adelaide and Melbourne attendees to fly out on 5.05 pm flight.

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Vision of the National Rivers Consortium

To achieve continuous improvement in the management of Australia's rivers