

# Community involvement in natural resource management: lessons for future water management in coastal catchments of New South Wales

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## ABSTRACT

During the past 15 years in New South Wales (NSW), recommendations in relation to catchment and water management policy have been progressively made by regionally-based committees with government and community representation. This represents a shift in responsibility for decision-shaping from being mainly dominated by government to a government-community partnership. It has resulted in the need to reassess the ways in which scientific findings and technical information are communicated to, and understood by, members of these committees to achieve sustainable outcomes. Two examples from the 2001-2002 water sharing planning process in NSW under the *Water Management Act 2000* are compared, with a particular focus on the issues affecting water use. New approaches are outlined for the communication of scientific information to community-based decision-shapers. These include the tailoring of information to enhance members' understanding of the causal link between decisions and environmental outcomes and the incorporation of environmental costs and benefits in socio-economic evaluations of water use in coastal NSW.

**Key words:** Regional community-based committees, environmental economics, estuarine ecosystems, water sharing plans, Water Management Act, river regulation, Hunter River, Macquarie River.

## Introduction

Environmental scientists report findings from their research to decision-makers in a variety of ways to extend the knowledge base about patterns and processes in the natural environment. Decision makers use this knowledge to inform policy and action on natural resource management issues. These decision-makers have generally included other natural resource scientists, managers and politicians. Educating the broader public about research findings may often be considered a function that is secondary to the main reporting objective and may sometimes not occur.

The degree of communication between scientists, managers and the community is of particular relevance to water resource management in NSW. Over the past 15 years, recommendations regarding regional water resource management have been devolved to community-based committees via the implementation of "catchment management" under the *Catchment Management Act 1989 (NSW)* and, more recently, the "water sharing planning" process under the *Water Management Act 2000 (NSW)*. Both acts are administered by the Department of Infrastructure, Planning and Natural Resources.

This paper examines recent developments in relation to water sharing planning by community-based committees in coastal and inland NSW. It highlights the importance of credible scientific information and advocates improved mechanisms for communication between scientists, managers and these community decision-shapers. In particular this paper:

- provides a brief overview of the issues for water sharing in coastal catchments in NSW,
- compares the recommendations made by two Water Management Committees to address the issue of water sharing between the environment and other water users,
- compares the information that was available to these two community-based committees,
- suggests possible improvements in the information being provided to community-based committees to inform their deliberations, and
- recommends several new approaches in the way scientists and managers communicate their findings and data to the general public and, more importantly, to members of community-based advisory committees.

## Catchment management and water sharing

"Catchment management" refers to the planning and implementation of catchment management plans (known as "catchment blueprints" in NSW), that outline management targets and actions within a catchment or region. They also focus and direct investment in natural resource management within that catchment or region (Department of Land and Water Conservation (DLWC) 2002). The blueprints also contribute to the regional implementation of legislation by setting targets and actions for water sharing. In December 1999, 18 Catchment Management Boards were established under the *Catchment*

*Management Act* in NSW and, along with three existing community consultative committees, were responsible for overseeing the development of 21 catchment blueprints covering the entire state. These blueprints were approved and gazetted in December 2002 (DLWC 2002).

“Water sharing” under the *Water Management Act 2000* is the allocation of water between the environment (which is given highest priority under this Act) and other water uses, such as town water, irrigation for agricultural purposes, stock and domestic use and power generation (DLWC 2002). Water sharing plans, once gazetted, have legal effect for ten years (DLWC 2002). In March 2001, 30 Water Management Committees were established as advisory committees under the *Water Management Act* to prepare draft water sharing plans for 39 priority water sources.

### Advisory bodies

The Catchment Management Boards and Water Management Committees are community-based advisory bodies that use consensus to make recommendations to Government on aspects of natural resource management outlined within their respective terms of reference.

Committee membership generally comprises an independent Chair, industry, community and local government representatives who are reliant on the use of the natural resource(s) under review, environmental and Aboriginal representatives, and representatives of the relevant state agencies for natural resource management. It is important to note that there are more community-based representatives than government agency representatives. In circumstances where consensus is not achieved, majority and minority views are recorded. During the recent water sharing planning process in NSW, 20 of the 39 draft water sharing plans did not achieve consensus (DLWC 2002).

The representatives include members of the local community with varying levels of knowledge, understanding and interest in often complex, technical water management issues. Community-based members of these committees often perceive scientists and government agency representatives as “outsiders”, who are unfamiliar with local issues. The outside representatives are often viewed with some suspicion until their ability and experience in the technical or management issues under discussion are tested and evaluated.

If scientists and natural resource managers are to interact effectively with these new bodies to allow them to formulate the best possible recommendations in the limited timeframes available, we propose that new approaches to the communication and understanding of the latest facts and predictions are needed.

### Issues for Water Sharing in Coastal Catchments in NSW

Many reports released during the past decade have highlighted a range of water quantity and quality issues affecting NSW coastal rivers, particularly in highly urbanised catchments such as the Hawkesbury-Nepean and Hunter Rivers (Recher *et al.* 1993; Environment Protection Authority 2000; Healthy Rivers Commission (HRC) 1998 and 2002).

The construction of dams and weirs for water storage and river regulation, and the extraction of water from rivers and creeks by pumps for a range of uses, have resulted in alterations to the natural flow of freshwater that has had a significant impact on stream and wetland ecology (Recher *et al.* 1993; Harris and Gehrke 1997; Australian State of the Environment Committee 2001; Bunn and Arthington 2002; Gillanders and Kingsford 2002). Changes to the natural regime include decreased frequency and magnitude of high and medium riverine flows (due to the effects of impoundments), reduced frequency and duration of over-bank flooding events and exacerbated low flow events (Gillanders and Kingsford 2002). Across coastal floodplains, the construction of levee banks, floodgates and tidal barrages has also altered the natural flow regime and alienated wetlands from rivers, reducing the extent and modifying the biodiversity of coastal wetlands (Australian State of the Environment Committee 2001; Gillanders and Kingsford 2002). Impoundment of freshwater has also increased the incidence of algal blooms by reducing flushing flows and increasing the potential for extended periods of high nutrient loading in coastal rivers (HRC 1998).

Further downstream are located the estuaries where freshwater mixes with marine water. In NSW there are over 130 estuaries, some of which are permanently open, while others are intermittently open and closed (West *et al.* 1985). In some estuaries, the tidal regime has been modified since European settlement. For example, this is the case in the Hacking River where the marine Sydney rock oyster *Saccostrea commercialis* grows on one side of the Audley Weir on the south side of Sydney and freshwater macrophytes grow on the other. The oyster usually tolerates salinity of no less than 10-15 parts per thousand (Nell and Dunkley 1984), and the installation of the weir, as well as impeding fish passage, has foreshortened the portion of the estuary in which low salinity conditions are normally found. Weirs have also modified tidal flow in the Parramatta and Georges Rivers.

There is growing evidence that the tidal regime in NSW estuaries is progressively extending further upstream (e.g. Hawkesbury-Nepean River - HRC 1998; Richmond River - Peirson *et al.* 2001; Hunter River - HRC 2002)). This is believed to be a result of the impoundment of freshwater flows in the upper catchment for agricultural, industrial and urban water use (HRC 1998; 2002) and other human alterations to the catchment, including dredging for navigation and sand and gravel extraction (Manley 1963; HRC 1998; 2002). One outcome of increased saline intrusion in the Hunter River is thought to be the upstream proliferation of mangroves over the past 50 years (Williams *et al.* 1998), although cyclical rainfall patterns may also be an influencing factor (Buckney 1992).

A number of other estuaries in NSW have had their tidal flow modified by civil works. These include the Tweed River due to sand extraction, Wallis Lake due to breakwater extension, and Botany Bay due to port and airport construction. The expansion of mangroves referred to in the Hunter River has not been reported for Wallis Lake, but there is evidence for the extension of

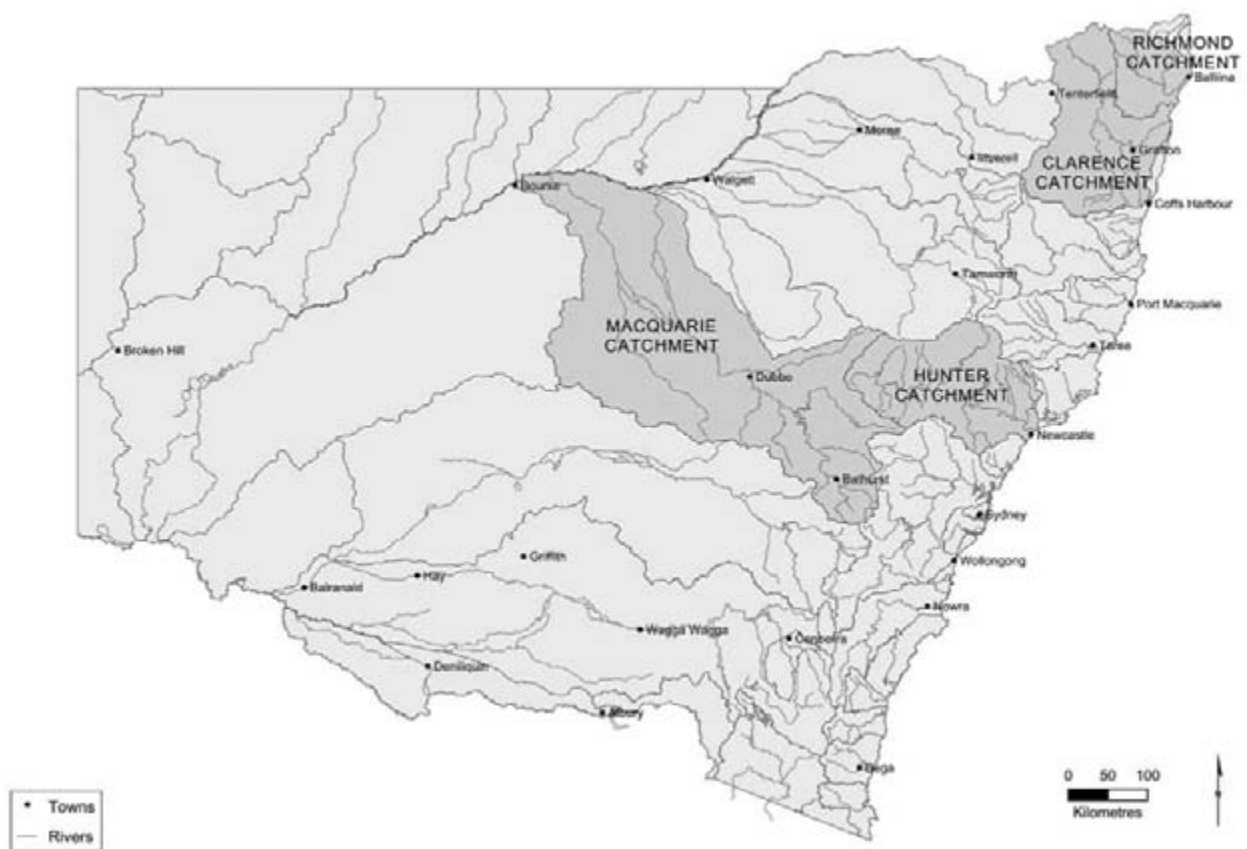
the cover of mangroves in the Tweed River (West 1993; Saintilan 1998) and Botany Bay (Pickthall *et al.* in press). Saintilan and Williams (1999) indicated that mangroves have transgressed into saltmarsh in several estuaries from central Queensland to South Australia. In some cases, the shift appears to be related to small-scale works, such as flood mitigation and drainage that have influenced local tidal regimes. In other cases, larger scale civil works have altered the tidal regime, or the rise in housing density has increased the input of sediments and nutrients (Saintilan and Williams 1999). Subsidence may also have played a role. Saintilan and Williams (2000) listed 28 locations at which these transgressions were reported.

While there is evidence to indicate that quantity, flow, and quality (particularly salinity) of water are important influences on riverine health and aquatic biodiversity (Schlacher and Wooldridge 1996; Bunn and Arthington 2002; Gillanders and Kingsford 2002), some people perceive that water flowing to the sea is “wasted” (Loneragan and Bunn 1999). This perception is due in part to the lack of information on the quantity and timing of flows required to optimise ecological processes for downstream areas (Bunn and Arthington 2002; Gillanders and Kingsford 2002; HRC 2002). Indeed, the ecological needs of estuaries have rarely been considered in allocating freshwater flows in NSW, or Australia (Zann 1996).

### Case studies on water sharing in regulated rivers: the Hunter and Macquarie Regulated River Water Sharing Plans

The NSW Government initiated the Water Reforms program in 1995 to address a range of water management issues including the environmental impacts of water extraction (<http://www.dlwc.nsw.gov.au/care/water/wr/pdfs/12.pdf>). In 2001, the Government announced its intention to develop and implement ten-year statutory water sharing plans under the *Water Management Act 2000*. These plans would address the requirement for improved water sharing arrangements between environmental needs and water users. The plans were developed by community-based Water Management Committees, which were required to provide recommendations for the sharing of water within their respective jurisdictions by December 2001 to the then Minister for Land and Water Conservation.

The Hunter and Macquarie catchments have similar features (Figure 1). Both have their freshwater inflows regulated by two large dams, installed primarily to store water for industrial and agricultural water supply. Both also have extensive floodplain and wetland systems that rely on freshwater inflows (the Hunter estuarine wetlands and Macquarie Marshes respectively).



**Figure 1:** Location map of the Hunter; Macquarie, Richmond and Clarence River catchments in New South Wales, Australia.

## The Hunter Regulated River Water Sharing Plan

The draft plan, completed in December 2001, included recommendations for water sharing arrangements for the major part of the regulated portion of the river, that is, the stretch below Glenbawn and Glennies Creek dams, but excluded the regulated Paterson River. One of several major water sharing issues considered by the committee was the total amount of water that should be available for extraction. The total volume of licensed entitlement that previously had been issued to water users in the regulated part of the river was 304 gegalitres/year, but the actual use of the entitlement was only 154 gegalitres/year. The committee recommended that the total volume of licensed extraction remain at 304 gegalitres/year, potentially doubling water extraction from the water source if all entitlements were activated.

The Hunter Regulated River Water Management Committee was subsequently asked by the Minister to reconsider this recommendation due to concerns for its potential to degrade the river's environmental values if full entitlement was realised. The representatives of the water user industries were able to present socio-economic data to support the draft extraction limit in relation to future industrial and agricultural uses of the water. They requested justification from the Committee's environmental representatives and state agencies of the water requirements for the river, particularly for the lower Hunter wetlands that are listed under the Ramsar Convention, the Japan and Australia Migratory Bird Agreement (JAMBA) and the China and Australia Migratory Bird Agreement (CAMBA). There are general reviews and scientific studies that establish the linkages between freshwater inflows and estuarine biodiversity and productivity in Australia (e.g. Ruello 1973; Loneragan and Bunn 1999; Bunn and Arthington 2002; Gillanders and Kingsford 2002; HRC 2002). However, there are few studies that quantify the specific needs for sustainable freshwater inflows to maintain healthy estuaries (Bunn and Arthington 2002). Without such ecological data to counteract the socio-economic arguments, the majority of the Committee re-endorsed the limit of 304 gegalitres/year in the final draft of their recommendations (in October 2002). One possible consequence of this recommendation is the progression of tidal water even further up river if total extraction levels increase to the proposed plan limit. This could potentially affect the ecology of the Hunter wetlands. At time of publication, the committee's recommendation is still under review by the Minister.

## The Macquarie Regulated River Water Sharing Plan

A different set of circumstances presented itself to the Macquarie Regulated River Water Management Committee. The committee did not have to set or review the upper limit for total water extraction within the river, as under the Murray Darling Basin Ministerial Cap, the total amount of water that could be extracted from the river had already been limited or "capped" to the long term average water diversion based on the 1993/94 level of development (Australian State of the Environment

Committee 2001). However, the committee was still required to review the share of the total water available for extraction between the environment and water users.

The way in which the water sharing planning process for the Macquarie Regulated River proceeded was quite different to that for the Hunter River. Several members of the committee had been working on the flow management of the river since 1995 and had an intimate understanding of the linkages between river flow and waterbird breeding events, and between river flow and agricultural production. Data collected over at least 50 years demonstrated direct links between environmental flows in the river and wetland bird breeding events in the Macquarie Marshes (Kingsford and Thomas 1995). The committee could clearly appreciate that, if environmental flows were reduced, bird breeding success rates would fall. They accepted the ecological information, in part because the scientists and managers who advised the committee had been working in the area for over 20 years and had ensured that their data and predictions were being communicated to, and understood by, the local community.

Water users and other community representatives therefore strongly supported the inclusion of an Environmental Contingency Allowance (ECA) of 160 gegalitres/year in their draft water-sharing plan. An ECA is an allocation of water set aside within dams on the regulated river system for use in delivering environmental flows, the intention being to use the water to reinstate components of a more natural flow regime. Recommended flow rules for the delivery of these environmental flows will be developed by an operational sub-committee of the Water Management Committee, and will be implemented by state water managers. This ECA was much larger than those recommended by Water Management Committees in other regulated river systems. The second largest is 90 gegalitres/year in the Gwydir Regulated River (<http://www.dlwc.nsw.gov.au/care/water/sharing/guides/gwydir-reg-guide.pdf>). Current ecological understanding suggests that these environmental flows will contribute to the maintenance of the wetlands on this river system.

## A comparison of available information for the decision-shapers

Several instructive conclusions can be drawn from the comparison of the two water-sharing processes. The major difference in outcomes (i.e. the final recommendations to the Minister) arose because there was, and still is, limited information to quantify the flow requirements for the environment's share in the Hunter River when weighed against the socio-economic data available to the committee. This restricted the ability of the Hunter Regulated River Water Management Committee to make an informed recommendation on a "sustainable" upper or total extraction limit for the river, and thus the share of water for the environment and other water users. Further, the committee did not challenge the original calculation of the upper extraction limit to examine whether it was likely to be sustainable. Nor did they implement the "precautionary principle" by recommending a more conservative limit until the necessary research had been done and made available within the five and ten year review periods for these statutory plans.

Peirson *et al.* (2001) and Gillanders and Kingsford (2002) note that reductions in freshwater inflows to estuaries are likely to significantly affect the make-up of key habitat types for aquatic fauna, including seagrasses, mangrove, saltmarsh and freshwater macrophytes. Even though general links between fishery production and freshwater inflows have been documented (Ruello 1973; Glaister 1978; Loneragan and Bunn 1999), these studies and reviews were not considered sufficient by the committee to allow estimation of the sustainable flow regime required for the environment's share of the water in the Hunter River. Unfortunately, with our limited current knowledge, it is not possible to estimate what flow regime should be recommended.

In the Healthy Rivers Commission's (HRC) (2002) recommendations in relation to water management in the Hunter River, it was noted that, "determination of the ecological requirements for stream flows throughout the catchment should be expedited, using rapid assessment methods where necessary. These should provide the basis for environmental flow rules, as the initial phase of an adaptive approach to flow management".

In contrast to the Hunter River, the Macquarie Regulated River Water Management Committee benefited from having long-term, quantitative data that showed a causal link between one key indicator of river health (bird breeding events) and inflows of water to the Macquarie Marshes. These data helped to better define the share of water for the environment and other water users. No analogous data for key indicators of estuarine health were available to the Hunter Regulated River Water Management Committee to assist their deliberations. Community-based members of this latter committee were hard pressed to establish flow criteria and to explain such criteria to their constituents (other water users). In the absence of any specific information, the committee was therefore unwilling to change the status quo.

There are strong imperatives from the Commonwealth Government, water users and environmental interest groups to finalise water-sharing plans for all water sources in NSW, including the remaining coastal catchments. With human population growth expanding along the NSW coast, the demand for water for urban, industrial and agricultural use will continue to grow, and the pressure to limit or reduce the environment's share of available water will increase. There is an urgent need for targeted, ecological research that rigorously examines possible causal links between the flow requirements of the estuary and ecosystem health. Such information will assist community-based committees to formulate recommendations for the ecologically sustainable use of water in these coastal catchments.

### Valuing the costs and benefits of water sharing

These days, almost all natural resource management recommendations require a consideration of the socio-economic costs and benefits of the options put forward to government. The water sharing planning process is no exception and Water Management Committees are required to conduct such an assessment on each of the options considered for sharing of water between the environment and other uses. Some assessments, such as the one done by the Hunter Regulated River Water Management

Committee, are weighted in favour of existing industries that use a lot of water (e.g. power generation and irrigation-dependent agriculture) because they have quantitative and credible socio-economic data. That is, the dollar value of a loss of a megalitre of water to an industry could be readily estimated in terms of overall agricultural production and jobs potentially lost to the local community.

In contrast, the potential economic impacts of the loss of a megalitre of water from the Hunter River to non-extractive water-dependent businesses, such as tourism and commercial fishing, were not presented because they could not be fully quantified. Nor was there consideration of the long-term costs of environmental degradation of the river if natural water flows were further reduced. Concern with such unbalanced assessments was noted by Gillanders and Kingsford (2002) who stated: "ecosystem services derived from estuaries are not adequately quantified compared with those derived from irrigation and, therefore, they are often given too little weight in policy decisions". Similarly, impacts on the health and well-being of the community, including Aboriginal spiritual and cultural values, were not evaluated. Therefore, we contend that inadequate information was provided to properly evaluate and balance the socio-economic and environmental costs and benefits of proposed water sharing arrangements outlined in draft plans like the one for the Hunter River.

Examples are starting to emerge of improved assessment processes that more explicitly consider the impacts to passive water users (such as tourism, fishing, cultural value or recreational use) in relation to the socio-economic benefits derived from extracted water. For example, Van Bueren and Bennett (2000), working on a NSW South Coast catchment, used an approach based on valuation and investment principles to develop options for river rehabilitation. In order to re-establish populations of two native fish species it was estimated that water quality would need to be improved by 15 per cent, and that 5 per cent of the native vegetation would need to be rehabilitated, requiring an investment in the catchment of \$81,000 by the local population of 4,000 people. Further, the achievement of these outcomes had an estimated aggregate value for a population of 1.8 million households of \$32 million throughout the state. Such studies can assist the community and government to consider the total costs of allowing existing human practices, such as water extraction, to continue. Further research and assessment is needed in this area to better inform community-based deliberations in order to assess the real costs and benefits of trade-offs being considered in natural resource management. The ultimate problem is how the costs and benefits are distributed and how to decide who pays.

### Presenting scientific information to community-based decision-shapers

The general public is constantly provided with information and reports on Australia's environmental challenges, from land clearing to water pollution to loss of biodiversity (e.g. State of the Environment Reports, NSW Healthy Rivers Commission inquiries, NSW Salinity Strategy,

NSW Biodiversity Strategy). Often, this information does not enlighten thinking or modify behaviour to affect important environmental issues.

We submit that the promulgation of relevant scientific information needs to be improved so that members of the public and, in particular, members of advisory committees are better able to make informed decisions. Experience with the water sharing process has shown that committee members who have a good understanding of relevant scientific information (if it is available in the first place) tend to be more committed to sustainable environmental outcomes. The Macquarie Regulated River Water Sharing planning process provided an example of this approach. The scientific findings relating to bird breeding events in the Macquarie Marshes were made widely available and led to an effective engagement of the community and the media in water management issues in the Macquarie River. Members of that committee could individually relate to the water management issues at hand and see how their recommendations could affect environmental outcomes.

A similar approach has been effective in influencing water sharing in the Richmond and Clarence River coastal catchments in northern NSW (Figure 1). NSW Fisheries was able to demonstrate to the relevant Water Management Committees the existence of a likely causal link between river flows and passage of a local, endangered fish species, the eastern freshwater cod *Maccullochella ikei*. An expert panel assessed the available scientific literature on the life history and flow requirements of *M. ikei* to inform the water sharing planning process. The panel determined the minimum water depth at the mid point of riffle systems that is required for juvenile and adult cod to complete their life history stages, in particular for breeding and recruitment. (This information has been incorporated into the final NSW Recovery Plan for Eastern Freshwater Cod, due to be released later in 2003.) These depths were field tested and converted to flows at critical riffle reference points. The information was used by the committees to determine water-sharing rules, in particular to ascertain low flow threshold limits for water users during the critical seasons for cod movement.

The use of this particular species in this example was considered appropriate because it is the largest fish species and highest order predator within the Richmond and Clarence Rivers. Moreover, this species was not used alone in estimating the flow requirements for the river ecosystem. Data on current and natural flow conditions for the rivers were also evaluated to determine environmental flow recommendations. However, in this instance the flow requirements for an individual species were used to encourage the committee to recommend more conservative environmental flow requirements for low flow protection. Without such clear indicators, Water Management Committees for other coastal catchments have generally recommended less stringent low-flow limits (<http://www.dlwc.nsw.gov.au/care/water/sharing/>).

Ecological research often attempts to identify clear causal links for the decision-shapers to allow them to determine how their recommendation(s) will affect an environmental outcome. Overall, more ecological

data are needed. In particular, more scientific studies examining the links between water quantity and flow and key indicators of riverine health, which may include so-called “icon” species, are recommended to assist in decision making processes.

At the same time, aquatic scientists should take advantage of the experiment that has been set up (i.e. changing flow regimes in some catchments but not in others) and should be encouraged to examine the impacts of altered flow regimes and measure ecosystem responses (Peirson *et al.* 2001; Bunn and Arthington 2002). These studies are particularly important if information is to be of use to Water Management Committees during the next round of water sharing planning, and the major five-year and ten-year review phases of this first round of water sharing plans in NSW. Sufficient information on ecosystems, as well as social and economic factors, and the interrelationships of these factors are needed to inform recommendations and ultimately decisions that provide optimal outcomes, with appropriate adjustment mechanisms.

## Conclusions

- Members of community-based committees are the new decision-shapers for catchment and water management in NSW. Members of these committees have differing levels of interest, understanding and technical background in the management issues being discussed and recommendations formulated.
- Scientific data and their interpretations need to be first collected in a rigorous scientific way.
- Then this information needs to be presented in ways that are easily understood by the general public and members of community-based committees. This will assist these audiences to relate to the environmental management issues at hand and help them appreciate how their recommendations may cause an impact and what actions may ameliorate that impact.
- If a particular aquatic species (e.g. an endangered fish) or group of species (e.g. waterbirds) can be identified as key indicators, this may help demonstrate potential effects of water sharing regimes and alterations to river flows in NSW.
- Environmental economics must be used to balance the findings of socio-economic assessments in examining trade-offs and options in natural resource management. Community-based committees, the public and the media require such information in order to comprehensively assess the impact of their deliberations. Such assessments must produce dollar values that are credible and should take heed of social and environmental values that are often difficult to cost.
- If community-based consultation and committee processes continue to play a major part in natural resource management decision-making, environmental scientists and managers must take up the challenge of obtaining information and then providing it in accessible and credible ways into these processes to promote sustainable environmental outcomes.

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