

Multi-level Water Governance for Closed and Closing Systems

The Murray-Darling Basin, Australia

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Risks created by dysfunctional multi level governance

Rivers and groundwater systems divided between states and provinces provide the essential water supply for much of the population living in Australia, the United States, Europe, China and India (For the purposes of water management Europe now operates as a single united federation with the links between the central and national governments at least as strong as in any of the other federations under discussion.) Most of these large hydrological systems have declining environmental conditions and supply security according to a wide range of criteria. A major cause is incomplete institutional coverage of key issues, in part due to the arbitrary division of catchments into competing jurisdictions within these political systems. In most nations water management has traditionally been a local or state function with central governments only becoming involved in response to increasing conflict. Even in China, a nation famous for highly centralized water management, the trend over the last two or three decades has, until very recently, been towards decentralization. However there are many water management functions which require central coordination. In all the political systems under consideration there has been a struggle in recent years to get the balance right between centralization and decentralization.

The first task is to define the principles that should apply when deciding what is appropriate. Second is the need to design institutions that can implement those principles. How can an effective system of devolution based on the principle of subsidiarity be implemented? The challenge is that the geographical and organizational division of roles and responsibilities needed to manage water effectively frequently does not match the established division of roles and responsibilities. This often causes great gaps in the capacity of water governance systems to develop a coordinated response to the issues that threaten their environmental condition and resource security.

Typically the management of large cross-border rivers and groundwater aquifers in federal political systems is characterized by considerable intergovernmental and interagency conflict, low decision making transparency and accountability, high transaction costs and ad hoc deals between competing sub-national governments that

undermine best practice water management. When water managers are responsible for only part of a catchment they are under pressure to favour the section for which they are accountable. This encourages them to export the costs of pollution or water shortages across borders wherever possible. Cost benefit analysis are almost invariably conducted from the perspective of each sub-basin and not that of the whole biophysical region. Polluting industries are placed near downstream borders, economic activities of marginal benefit within-border are given preference over economic activities of much greater overall benefit on the other side of borders etc. Within each sub-basin costs and benefits are highlighted but usually minimal information for the overall basin is collected. In these decentralized systems data collection is usually organized by sub-basins, often with different units of measurement and auditing approaches. This makes comparisons and whole-of-basin aggregations to compare different approaches very difficult.

As a result large hydrological systems which cross borders are highly exposed to the risks attached to what are known as open resources. In 1968 Garrett Hardin published a short paper titled *The Tragedy of the Commons* in which he argued that it was difficult to restrain over exploitation of common resources such as shared pastures, fish and water¹. Critics subsequently nominated many examples of successful management of natural resource systems owned in common and suggested that his thesis was more applicable to open access resources which lack any effective overarching institutional framework able to control and regulate the behaviour of would-be users as a group. In the case of an open access resource it is in the interests of each individual user to expand their own consumption indefinitely because any restraint will only increase the volume available for their competitors. The eventual result is the complete destruction of the resource to the disadvantage of everybody. That is the fate currently being experienced by most large international hydrological systems. This project argues, however, that the containment of the conflicting states and provinces with a single political systems such as Australia, Europe or China, should provide opportunities for coordination which are currently not being fully realized.

Case Study Murray-Darling Basin (MDB)

The MDB is just over a million square kilometres in size, has a diverse range of landscapes, ecosystems, land uses and climates and includes over 30,000 wetlands, eleven of which are listed under the Ramsar Convention of Wetlands of International Importance. Divided between the southern and eastern Australian states of New South Wales, Victoria, South Australia and Queensland and the Australian Capital Territory - each with their different systems of water entitlements and management - the MDB is home to just under two million people and supplies much of the water used by another million in South Australia. Those three million people and various industrial activities use about 4 percent of the water diverted from the regions rivers. The other 96 percent is used by irrigated agriculture and supports nearly three quarters of that activity conducted nation-wide. From all sources the MDB produces approximately 40 percent of Australia's gross value of agriculture². Despite the existence of a near century old inter-jurisdictional water management framework that brings together six governments, however, environmental degradation of the region's surface and groundwater bodies and their catchments is intensifying. Consequently, the debate about the future of the inter-jurisdictional institutions in the MDB is gathering momentum.

Water management in Australia's Murray-Darling Basin is in crisis due to a combination of inadequate governance and the worst drought since records began to be kept in the late nineteenth century. A central issue is whether water should be used to maintain riverine environments during times of such high stress. The economic impacts of the drought in the southern section of the MDB along the River Murray are increasingly severe and the lower lakes near the outlet to the sea are on the verge of environmental collapse. In response the six governments with responsibilities in the region are attempting to implement the most radical institutional and policy changes since intergovernmental coordination was first attempted nearly a century ago. The reforms include a plan to buy back a large volume of water for environmental flows. Over three billion dollars has been allocated for that purpose by the national government but the method that should be used to purchase the water, the speed with which it should happen and the regime that should be put in place to manage the environmental water fund once it is established are now all matters of intense political controversy. This is a pivotal point in the evolution of Australian water management. For better or worse the decisions made about environmental flows in the MDB over the next two years will have a decisive influence on the campaign to rehabilitate Australia's major

river systems for many years to come. However, the focus for efforts to implement more environmentally sustainable water management regimes should be widened to include the institutional frameworks within which they are implemented. Unless a whole-of- hydrological-system approach is taken environmental decline will continue.

Ambivalence about the priority that should be given to environmental water is evident in many areas of government policy. This reflects a wide range of public opinion about how rivers operate and the priorities that should be applied to water management. To take just one example, in January 2007 the then Prime Minister John Howard announced a \$10 billion dollar package for the MDB which included \$3 billion to buy back water entitlements and reduce over-allocation. In outlining how this program would be conducted the policy also stated that this water could be used to provide drought relief in extreme circumstances. Given the political pressure that builds up in times of drought this created the very real prospect that in practice its use for that purpose could become the first priority. Environmental water so-called would then only be available for the environment during non-drought years. Behind this proposition is the argument that the environment is used to periodic drought and would not suffer unduly from this diversion. In general terms it is correct that the catchment of the MDB has experienced periodic severe droughts for many thousands of years. However those droughts occurred within a context where drought was not exacerbated by the impacts of large scale extraction. To divert water away from the environment under current conditions is to subject it to conditions and drought frequencies way outside the range experienced in the pre-development past.

The controversy about allocations to the environment in the MDB can be discussed on a number of levels. There are cases where water designated for the environment has been redirected by governments to provide drought relief. In other situations water designated for the environment has been retained in storage and not used for its designated purpose because of community opposition. At a more structural level is the operation of deeply entrenched principles within established water policy and management frameworks which result in most of the reductions in available water resulting from drought and climate change coming from the environmental flow rather than the production side of the equation. More fundamental, however, is the threat posed by the extremely slow implementation of the water planning framework outlined in the National Water Initiative approved by the Council of Australian Governments in 2004. Central to that policy is the imperative to stabilize environmental conditions and the level of resource security at a politically determined level of modification within a whole-of-hydrological system framework. It is only by taking such a perspective that the full costs and benefits of the trade-offs between social, economic and environmental demands can be evaluated. Introduction of

1 Hardin, G., 1968, 'The Tragedy of the Commons'.

2 Blackmore, D, 2002, 'Protecting the future', p. 7; Regarding irrigation see Murray-Darling Basin Ministerial Council, June 1995, An Audit of Water Use, Table 1, p.7; For additional statistical information about the MDB see Crabb, P., 1996, Murray-Darling Basin Resources.

a whole-of-hydrological-system policy and management framework would require large scale institutional change to produce institutional integration both across and within the political borders that divide the MDB. So far governments have shown themselves reluctant to make those large scale changes. With the passing of the Commonwealth Water Act 2007 and subsequent amendments, however, they are now taking tentative steps in that direction.

The debate about environmental flows is a subset of a wider debate about the priorities that should apply to water planning in general. In the same way that there is disagreement about allocating water to environmental flows there are similar conflicts about diverting water from agriculture to urban use. One of the most contentious proposals in play in the Australian water debate in 2008 is a plan to pipe water out of one of the southern tributaries to the River Murray to storages that supply the large city of Melbourne on the other side of the Great Dividing Range. Water would be made available by efficiency improvements in the delivery system and the savings split three ways equally to irrigators, the environment and to Melbourne. The amount of water that would be diverted to Melbourne would be quite small compared with the volumes currently diverted for agriculture much of it of quite low value but it would significantly increase the water security of Melbourne.

The plan is currently being opposed by a coalition of green and some irrigation interests and a wide range of people concerned about the cost. (The scheme was originally proposed by irrigation groups with the water for Melbourne and the environment included to justify a very large public investment to restore aged irrigation infrastructure.) The Green party - which has recently become quite significant in the federal senate - argues that Melbourne should improve its water security by more recycling and that no water should leave the MDB when that region is over-allocated and in such an environmentally degraded state. Those irrigator groups which are opposed to the scheme describe the plan as urban theft of rural water.

At the centre of these controversies is the iconic status still accorded to agriculture and rural communities in Australia. Evidence of that status can be seen in both the success in obtaining a commitment from the Victorian and federal governments for a large public investment in infrastructure which many argue will largely benefit private irrigation interests and in the wide public opposition to diverting water from irrigation to Melbourne under any circumstances no matter what the financial compensation.

The National Water Initiative

The attempt by governments to step back from their traditional role as the developers and leading advocates of irrigation development to that of umpire adjudicating between competing interests has been a central theme of the conflicts shaping Australian water policy since at least the 1980s. The most recent episode in this struggle began

in earnest with the passing of the Commonwealth Water 2007 with its requirements for an integrated basin plan that would be able to achieve environmental sustainability. That act was based on the National Water Initiative adopted by the Council of Australian Governments in 2004. It is through a detailed analysis of the NWI and the way it has been implemented since that the debate about the future of Australian water management can be best understood.

The National Water Initiative (NWI) is a dense but short document whose sections provide a check list of most of the major issues that have shaped the history of water management in the various states over the past century. It has its faults - there is not much discussion about water quality issues or the complexities involved in managing water in combination with the many other aspects of the catchment with which it interacts such as biodiversity - but it is overall a very ambitious and impressive document particularly given that the process of producing it required it to survive the critiques of nine governments and many interest groups.

The NWI combines recognition of the enormous economic benefits to be gained from water with a stress on the need to make the overall management regime sustainable, thereby protecting the interests of future users, broadly defined, and current users in the future. It also shows awareness that to protect economic benefits the water management regime must be accepted by the wider community. This means that other claims, environmental, social, cultural, aesthetic and religious, in addition to those with an economic base, must be taken into account if economic activity and water management are to be conducted in a politically stable environment.

The National Water Initiative reflects a changing relationship between governments, public water authorities and private water users, principally irrigators, after more than a century of relative stability. For many decades the interests of governments and water users were very similar. Governments used water as a tool to promote the growth of communities and there was little concern about environmental issues. During this period even though water entitlements were usually vaguely defined from a legal perspective the reliability of supply was relatively high in light of the biophysical circumstances. Variations were usually the result of administrative decisions made in response to drought and concerns about future supply and the decisions were accepted as sensible and necessary in the communities affected. In more recent times this congruence of interests has broken down. The growth in diversions in the second half of the twentieth century has caused serious environmental problems and intensified competition between water users. Increasing insecurity about the reliability of supply has resulted in calls for greater legal security of entitlements at a time when governments have decreasing capacity to satisfy such demands.

Tension between promoting economic activity by giving greater certainty, and the need to retain or improve management flexibility to protect the environment, can be resolved if the rights created apply to a sufficiently modest proportion of the resource that enough is left unclaimed to allow public policy goals to be pursued. In principle the NWI attempts to resolve this conflict by requiring that all systems be, or be restored to, environmental sustainability before perpetual rights are allocated. The risk is that the process of establishing an environmentally sustainable regime will not be rigorous enough to regain the volumes of water and flexibility needed to achieve that condition. Given the political strength of demands for greater legal recognition of a wide range of different types of water entitlements, and the unanswered questions that persist about who can represent and protect the environment, there is a real danger that water property rights will be locked in at too high a proportion of total flow. If that happens riverine environments will continue to decline and resource security will be further eroded.

Environmental Stability-Sustainability First, Then Water For Production

According to the NWI the tensions between the many different and new demands that are being placed on hydrological systems are to be managed through the development of comprehensive water plans. It is through their preparation that the difficult issues involved in balancing the need for sustainability and the ambitions of production interests are to be resolved. The water plans are to include secure water access entitlements, statutory based planning, statutory provision for environmental and public benefit outcomes, plans for the restoration of over-allocated and stressed systems to 'environmentally sustainable levels of extraction', the removal of barriers to trade, clear assignment of risk for future changes in available water, comprehensive and public water accounting, policies focused on achieving water efficiency and innovation, capacity to address emerging issues and many more elements³. They are to provide for 'adaptive management of surface and groundwater systems'⁴ with their connectivity recognized where it is significant⁵. In addition, water plans must take account of Indigenous issues by making arrangements for Indigenous representation in water planning 'wherever possible' and provision for indigenous social, spiritual and customary objectives 'wherever they can be developed'. They should also include allowance for 'the possible existence of native title rights to water in the catchment or aquifer area'⁶.

The NWI states explicitly and repeatedly that the volume of flow needed to maintain environmental sustainability, at what ever level of modification has been defined as reasonable in the negotiations involved in the development of the relevant water plan, must be met first before allocations for extraction are determined⁷. Much of the NWI focuses on the promotion of economic activity but there are many sections that state the principle that all water bodies, no matter what level of modification is accepted as appropriate,

must be maintained in or restored to an environmentally sustainable condition as the first priority. This is not a drafting error in that it is a logical result of the definition of the task. It is hard to see how a national policy for the long term could advocate anything less than the protection of the basic resource upon which all else depends. However, this is a radical proposition in the context of Australian water management.

Such a requirement puts the NWI fundamentally at odds with many long established water management policies and programs in the MDB. One of the odd features of the on-going debate about the future of Australian water management is that almost no one puts forward an explicit in-principle defence of unsustainable management but so many take that approach in practice. When it is presented, the case for unsustainable practices is usually a defence of social and economic benefits threatened by efforts to achieve reform. Rarely is there any effort to confront the possibility that the capacity to maintain them will be eroded by continued business-as-usual. It seems that many people involved in water management do not accept the proposition that environmental sustainability is a necessary long-term foundation for economic activities. The release of the NWI highlights this disjunction and sets the scene for a widespread struggle about the fundamental assumptions underpinning water management in Australia.

Central to the NWI is the development of processes to define the requirements of environmental sustainability and institutions able to ensure that they are achieved and maintained. This gives the debate about the meaning of the concept 'environmental sustainability' a new urgency. Extrapolating from the Brundtland definition of sustainability and the relevant sections of the NWI there would seem to be two minimal criteria that need to be met for a modified environmental system to be defined as environmentally sustainable: its environmental condition needs to be stable from a system-wide perspective and politically acceptable to society in general.

The requirement that the level of environmental sustainability should be stable, durable and maintainable over a reasonable period of time and not in a state of continuing decline has many implications. The NWI appears to make no provision for a situation where a specific site is defined as sustainable (perhaps as a result of a locally focussed management regime) while the wider system of which it is a part is in a state of continuing decline⁸. This is made

3 NWI, 23, 25, Schedule E.

4 NWI, 25.

5 NWI, 23, x.

6 NWI, 52-54.

7 NWI, 23,25, 41-49.

clear in many sections of the NWI. It requires 'the return of all currently over allocated or overused systems to environmentally sustainable levels of extraction' and 'recognition of the connectivity between surface and groundwater resources and connected systems managed as a single resource'⁹. Similarly, the planning framework is to 'implement firm pathways and open processes for returning previously over allocated and/or overdrawn surface and groundwater systems to environmentally sustainable levels of extraction'¹⁰.

Efforts to achieve stability system-wide will depend on a strong capacity for scientific research and monitoring. Implementation will require detailed knowledge of the ecosystems in question so that the prerequisites for stability can be included in the relevant management programs. The historical record has shown that Australian ecosystems are highly variable, poorly understood and subject to unpredictable threshold changes so increased investment in science to gain a better understanding of ecosystem dynamics is essential. Crucially, when management plans are being negotiated, substantial scientific input will be needed to make sure that economic and social considerations do not result in compromises that will undermine environmental stability in the longer term. Given the considerable time lags that often exist between actions and their environmental consequences, it is easy for the rhetoric of the moment to disguise such a risk.

The environmental management regime agreed on through the water planning process also needs to be politically viable for a reasonable period of time. This assumes institutional arrangements that will encourage productive negotiations and help ensure that the resulting decisions are implemented in practice. Water plans should not be based on fragile ad hoc deals opportunistically made between key interests. Horse trading as it has often been conducted in the past is not likely to provide the security desired by production-based groups because political conflicts will continue to grow if the causes are not resolved.

It is essential that the negotiations required to produce the water plans not be dominated by economic considerations alone although they must be taken into account. Long-term costs and benefits defined in financial terms are usually so severely discounted that they are often only a minor influence on decision-making¹¹. Even at very conservative rates of return, cost and benefits that will be realised two

or three generations in the future are rendered insignificant in comparison with short-term costs and benefits. This creates pressure to minimise consideration of the long term but that is not appropriate for water policy. Except under exceptional circumstances such as large floods or severe droughts, biophysical conditions at any given time are usually the result of activities undertaken many years earlier.

The debate about the role of markets is central. They provide a desperately needed source of raw energy that can be used to achieve positive change. Used appropriately markets will promote both economic growth and more sustainable practices. However, all markets exist within a cultural and compliance framework. The question is how should they be designed or fostered? There are also the perennial battles about which costs should be included in the 'water price'. There is strong pressure to under-account for costs such as those created by the maintenance and replacement of the storages and distribution system, servicing the regulatory framework, environmental degradation, forced social change, impacts on future generations and this generation in the future. Costs that are difficult to calculate are often left out. Problems tend to be defined to fit solutions that are culturally acceptable. The very real costs created by ignoring issues that cannot be easily expressed or described are left for others to pay in the future.

An economic perspective also has limited capacity to respond to many moral and ethical issues even though powerful political threats can come from groups driven by such considerations. Those involved often lack market power but that does not mean that they lack political power. Examples in Australia include the Green and Indigenous land and water rights movements. Consequently, medium term security and predictability for management programs and water-based economic activities cannot be provided without a policy and management framework that is able to integrate many different interests, not just those that can exert market pressure, in ways that are acceptable to the wider community.

Centrality Of Water Planning

Central to the new policy are the water plans and the need for institutions that can ensure that they are comprehensive and implemented in practice. In most states in the MDB the long-established state government water management agencies have largely been dismantled and regional catchment authorities put in their place. Water management is now increasingly dominated by new and relatively untried institutional arrangements and unless or until they can be made effective, goal and target setting will have little effect in practice. Yet the subject of institutional development is one of the themes largely absent from the NWI beyond the very limited matter of measures to facilitate water trading. This is a major omission in that it is hard to see these issues being dealt with in any other policy context apart from that being created by the NWI.

8 Council of Australian Governments, 2004 June, Intergovernmental Agreement on a National Water Initiative. (The notation used throughout the thesis is NWI, number of paragraph, number of letter of subsection ie NWI, 63, ii (b)).

9 NWI, 23, iv and x.

10 NWI, 25, v.

11 Lee 1993 pp191-193

The policy and management context within which regional natural resources management bodies such as regional catchment authorities have to operate is extraordinarily complex. Much of the discussion about inter-jurisdictional water management in the MDB gives the misleading impression that interaction between the Commonwealth and state levels is highly structured but the reality is much more elusive. The independent centres of sovereign power provided by the Commonwealth and state jurisdictions create focal points around which contending interest groups arrange themselves, moving from one to the other as their members make strategic decisions about alliances and about how best to promote their goals or block those of others.

The new regional organisations are formally subordinate to state governments but have independent corporate standing, sometimes get Commonwealth funding and have ready access to state and federal parliamentarians representing their areas. In practice, decisions are not made through a top-down process but are the product of complex cycles of interaction in which the participants have varying degrees of influence but no single voice is dominant. Policy development and management in the MDB now involves complicated ongoing negotiations between a large number of individuals, groups, organisations and institutions including governments. The Commonwealth government supplies the bulk of project funds to a variety of recipients but usually has to rely on indirect processes of accountability to influence implementation. States have substantial direct regulatory power but limited funds. Research bodies and research and development corporations can provide findings that can bolster some positions in public controversies, discredit others and sometimes shift the basic assumptions upon which such debates are conducted.

Even more politically active are the industry bodies and large companies emerging as irrigation based agriculture becomes more business orientated. There are also non-government organizations such as the Australian Farmers Federation and the Australian Conservation Foundation that influence the wider electorate and whose support is needed by governments for major initiatives. In addition, local governments, although largely ignored by policy makers involved with environmental issues, have planning powers that can play a decisive role at the district level. Largely excluded from all these interactions are members of the general community. They tend to be involved only very intermittently but when activated in the mass can be a decisive and unpredictable political force.

The list of different interests and stakeholder groups influencing policy relevant to environmental rehabilitation is long and various but the institutional framework for managing their competing demands is very diffuse. In essence they are mediated through the general political/policy system used to process a wide range of different conflicts in the Australian federal system. Given the complexity involved and the consequences of failure a more focused approach is

needed. The National Water Initiative requires a review of policy and institutional arrangements in the various jurisdictions to ensure their compliance with the new regime but this has never been undertaken. Instead water continues to be managed through the long established net work of organizations set up in the past to administer a much less comprehensive set of policy goals. This makes it very difficult to implement whole-of-hydrological-system planning.

The southern Murray catchment of the MDB has had a basin-wide framework for nearly a century but it is very narrowly defined. Only some issues have been managed from a catchment-wide perspective and even in those cases the policy framework is fractured geographically and institutionally by both state borders and - within states - the division of responsibility between often competing agencies. Consequently the costs and benefits of many policies and actions are not brought together at a central point. Decision makers often incur costs - deliberately or in ignorance - that are manifest across borders in a different jurisdiction or in other policy areas that are not their responsibility. Conversely they often find themselves responding to costs caused by activities undertaken elsewhere by other decision makers reaping the benefits within their own sphere of operations.

Central to the Water Act 2007/8 is the preparation of a basin plan to promote environmentally sustainable management across the MDB. This new regime is to be implemented through accredited 10 year plans in each state. It can be seen as an attempt to overcome the lack of institutional integration described in the preceding paragraphs. This approach has the advantage of avoiding the political resistance that would be aroused by an attempt to change existing organizational arrangements. Instead they are largely left in place and a new layer is added on top. It is likely, however, that this will increase transaction costs in the long run. In addition, even though the new system will be subject to greater Commonwealth control the states have retained the right to veto any proposed change to the shares of water that go to each state. In addition the new regime is explicitly excluded from land and regional planning activities in the wider catchment that don't have obvious direct impacts on water runoff quantity or quality. These will remain the jealously guarded preserve of the relevant state. However many of these activities - such as different forms of landuse - are predicted to have major impacts.

Increasing transactions costs are one of the greatest threats to effort to improve Australian riverine environments. An issue that has been largely ignored so far in the national water debate is the shortage of skilled people able to do the range of tasks required for contemporary water management if it is conducted at the level required by the NWI. Management of hydrological systems is much more complex than it was only a few decades ago. Most regions of the MDB are now severely modified and more subject to competing pressures than was the case in the past. Experience with these systems when they were less modified is not

always a reliable guide for the present and future. In addition to long standing issues related to the level of extractions and salinisation, the list of water management issues in the MDB in the early twenty first century now extends to acid soils, nutrient pollution, carbon depletion, changing patterns of rainfall, run-off and recharge, loss of native vegetation, threatened biodiversity, declining connectivity between floodplains and streams channels, changes to the seasonal pattern of flows, thermal pollution downstream of dams, Indigenous issues, degraded amenity, the social impacts of economic and environmental change, climate change and more. Management is made even more complex by the fact that many of these problems involve different levels of government, occur on private land or are influenced by the activities of commercial companies.

Some of the skills required to deal with these issues were listed in 2002 by David Dole, then the General Manager of River Murray Water, the operational arm of the MDBC. He explained that the future water manager will have:

- technical knowledge of the hydrology and the hydraulics of whole river systems including their floodplains
- technical knowledge of whole catchment land/water processes
- technical engineering skills relevant to constructing, operating and managing physical works
- understanding of the biophysical relationships between water, land and environment, including skills in assessing the impacts of changing flow regimes on river ecosystems
- understanding of the water needs of natural systems as well as those of consumptive users
- technical skills in improving the efficiency and effectiveness of the processes that convey water from storage to root zone
- technical skills in managing and treating drainage waters and in achieving effective surface or sub-surface drainage
- a commitment to creating sustainable natural resource systems whilst also achieving reasonable economic outcomes
- the ability to work with communities to jointly build a sound knowledge base which will underpin the negotiation of future actions
- the confidence to recognise the limits of current knowledge of the impacts of society on natural systems and the integrity to recognise and promote the need for change¹².

Where will these new super water managers come from? Future demand will be much greater than now but there are already serious shortages of people with the necessary skills. This personnel gap is emerging at the same time as similar shortages are becoming serious in many other spheres of Australian life. Whether the subject is social welfare, transportation, medicine, engineering, business or sports administration, the level of skills required has increased dramatically in recent years. These shortages point to under-investment in Australian education and related services in all spheres and at all levels. Shortage of skilled personnel to manage Australia's highly modified hydrological systems, which is already making itself felt, could well prove the greatest source of risk to the NWI, Australian water management and the capacity to implement effective environmental rehabilitation regimes in the medium term.

Conclusion

Programs to reform water management are not without short-term costs and there is considerable opposition in some quarters to significant reductions in diversions if that is necessary to achieve sustainable levels of extraction and restore environmental values in the MDB. What will happen if the necessary steps are not taken to achieve environmental stability-sustainability? Some of the possible consequences were outlined by one of the consultancy groups who assisted with the five-year review on the MDB Cap on extractions undertaken in 2000. Discussing the potential implications for the MDB should it fail to implement an effective Cap and other environmental rehabilitation programs, Marsden Jacob, the authors of the second companion report to the review, predicted that resource sustainability would become a major issue. Under those circumstances they thought that increased irrigation development would undermine the security of established producers and provide a disincentive to new entrants. Degradation of the riverine environment and water quality would proceed at an accelerating pace and there would be increasing tensions between irrigation groups and surrounding regions as water supply security declined. Water trading would become more aggressive and the incomes and viability of irrigated enterprises and communities across the Basin would be increasingly sensitive to seasonal and climatic variation. Ultimately, as end of valley flows continued to fall and the damage to riverine environments became stark, irrigation communities would become increasingly alienated from the wider society and conflicts about water will become increasingly divisive within Australian society. Within that context creating a water management regime that takes account of in-stream environmental values will become very difficult. The only way to protect the environment in the longer term is to improve the overall quality of water management.

12 Dole, D., 2002, 'Managers for all seasons', in Connell, D. (Ed.), *Uncharted waters, Murray-Darling Basin Commission*, Canberra, pp. 30-42.

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