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> “We have extensively degraded many of our freshwater ecosystems. Some of this damage is beyond repair. Yet our very future rests not only on repairing as much as we can, but on adapting to the impacts of climate change ...”

Historical legacies of land-use change together with growing demands for water resources from agricultural, industrial and urban sectors have extensively degraded many of the freshwater ecosystems of Australia. Recent and rapid declines in the condition of these ecosystems indicate that current patterns of water consumption are ecologically unsustainable, particularly in agricultural landscapes.

PS Lake & NR Bond, 'Australian futures: Freshwater ecosystems and human water usage', *Futures*, vol. 39, 2007, pp. 288–305

The aquatic environment is much more important than many of us realise. A composite of rivers, streams, wetlands, estuaries, billabongs and bogs, it maintains a vast array of flora and fauna, as well as supporting all other life – ours included.

A sufficient quantity of fresh water of the right quality guarantees our food supply, the quality of life in our cities and towns and our public health and leisure activities. We are constantly extracting this water from our aquatic environments, yet we are not maintaining the health of those environments. In the past, we have used our waterways to dispose of waste and pollutants. We have also drained a large percentage of our wetlands to provide more land for farming.

There is no case for laying blame here. While the indigenous inhabitants understood this land, European arrivals did not. For most of us, this remains the case today. While early settlers soon realised that this was a very different climate and the soils were very different, inappropriate attitudes and practices have persisted to the present day. We were not aware, for example, of the vast quantities of salts in our soils or that the replacement of deep-rooted native vegetation with shallow-rooted crop species set the scene for major long-term changes in the hydrology of our catchments.

We have now, in Australia, a three-dimensional environmental problem.

We have to stabilise and repair ecosystems that have been extensively degraded and damaged by past inappropriate land-use practices. At the same time, we have to ensure that current developments and forms of land use don't repeat past ecological mistakes. Into the immediate and long-term future, we will also have to address the negative impacts of predicted climate change.

DEGRADATION OF AQUATIC ECOSYSTEMS

There is insufficient water being left in many of our rivers, streams and lakes to maintain them as healthy ecosystems and habitats. The extent of degradation of our aquatic environments is evidenced by the following:

- An assessment of 18 000 km of major rivers and tributaries in Victoria shows that only 27% are in good or excellent condition.[1]
- Surface water is over-allocated for most rivers in the NSW section of the Murray-Darling Basin (MDB), the rivers in western Victoria and on the eastern side of St Vincent Gulf in South Australia. [2.]
- In Victoria, most rivers north of the Great Divide and running into the Murray are fully allocated. Volumes of water being removed from the Queensland portion of the MDB are already at 70% of the sustainable yield. This situation is similar for rivers north of the basin, from Charleville to Townsville in Queensland; as it is for rivers northeast of Adelaide. With such high allocations and extended periods of very dry conditions, natural flows can become so low that the rivers and streams struggle to sustain aquatic ecosystems.
- River health, measured by the presence of aquatic invertebrates (such as worms, yabbies, beetles and countless others) is poor. A national assessment reveals a substantial reduction in river health along 22 000 km of river length. In NSW the loss is evident along 50% of river length. In the ACT and Western Australia, it is evident along 35% of river length, while for the remaining states and the Northern Territory, the loss is between 12% and 24%.[3]

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- Riparian vegetation (the grasses, bushes and trees growing alongside rivers and streams) is substantially degraded along 85% of these same rivers.[4]
- Australia's wetlands have been seriously affected by urban development and the expansion of agriculture. Vast areas of wetland, seen as swamps that could be completely drained, have been eliminated to make more land available for cultivation or housing developments. More recently, despite a better understanding of the importance of wetlands as ecosystems, wetland degradation continues.[5]
- With the exception of the top end of the Northern Territory and the north of Western Australia, most of Australia's large wetland systems are seriously degraded. Over 90% of the wetlands in the Murray-Darling Basin and 95% of the Gwydir Wetlands are gone. The Narran Lakes only receive 32% of their natural flow and the Macquarie Marshes and the Condamine-Balone systems are collapsing. Bird counts on these large wetlands have dropped by as much as 80%. Over-allocation of water for irrigation is a major cause of the current decline and, if these systems are to recover, they must urgently receive adequate volumes of environmental water.[6]
- Across Australia, approximately 85% of river length is in catchments whose natural condition has been altered, mainly by recent land clearing, changes in land use and broad-acre agriculture.[7]
- Each year, some 19 000 tonnes of phosphorus (from fertilisers) are transported by our rivers to be discharged into our estuaries. Over 80% of river length carries suspended sediment loads (i.e. the particles that make water cloudy) that are 10 to 200 times greater than normal.[8]
- Approximately 28% of Australia's estuaries have been significantly modified by pollutants, dam building, dredging, wetland drainage and other effects of human settlement.[9]
- Dryland salinity has a direct effect on reducing agricultural productivity and it can have off-site effects, too. The most significant of these is salinisation of freshwater rivers. On current trends in land-use practices, land clearing and the spread of dryland salinity, it is predicted that by 2050 the length of rivers and streams with salinised water will double in Western Australia and treble in Victoria. Little further agricultural development will be possible on the Lower Eyre Peninsula in South Australia and salt concentrations in the Murray River may rise significantly.[10]

REPAIRING DAMAGED ENVIRONMENTS

In the past 25 years a number of innovative programs have been initiated to stabilise, and then reverse, the environmental damage of the last 200 years of land use. They include the National Landcare Program, the Living Murray Initiative of the Murray-Darling Basin Commission; and the programs and services provided by catchment management authorities such as WaterKeepers, Healthy Rivers Campaigns and Coastcare. Commonly, these programs are government supported, community focused and ongoing.

Within these programs, community activities are usually directed towards changing land-use practices, stabilising affected areas, intercepting and reversing degradation processes, and improving local ecosystems and habitats. These approaches have been successful in many parts of Australia and should continue to be so.

However, there are questions about whether these well-intentioned programs can bring about positive change quickly enough, given the scale of the problems and the rate of decline of these ecosystems.

Two critical actions would lead to major changes in the overall health of our waterways and adjoining land areas. These are the re-establishment of adequate riparian vegetation and environmental flow regimes.

Riparian vegetation along rivers and streams has come under extreme pressure from human activities, to the extent that a great deal has been removed or degraded. Yet this band of vegetation represents an important micro-habitat. It contributes to improved water quality, aquatic and terrestrial biodiversity and the stabilisation of banks.

The second major action is the need to re-establish environmental flow regimes.[11] This is crucial to reversing some of the key processes involved in aquatic ecosystem degradation. With this agenda in mind, the 1994 Council of Australian Governments (COAG), made up of the prime minister, state premiers and territory chief ministers, agreed to implement a strategic framework to reform the Australian water industry. The framework established, for the first time in Australia, a legal recognition that water should be allocated for the benefit of the natural environment.[12]

To date, however, there has very been limited success in achieving agreement between competing users about the volumes of water required, and then actually finding the water to release. These quandaries are best illustrated by the slow rate of progress in releasing environmental flows into two of our iconic rivers: the Snowy River and the Murray.

THE SNOWY RIVER

On 6 October 2000, the Victorian, NSW and Commonwealth governments announced a $375 million agreement to breathe life back into the Snowy River and preserve a national icon for future generations. A long-term target was set to re-establish 28% of the river's natural flow, while protecting other river systems and water users. The subsequent agreement established a target flow rate of 21% to be returned to the Snowy River over a 10-year period. The remaining 7% should be achieved through new infrastructure projects involving the private sector.[13]

To date, the highest flow reached in the Snowy River (in 2005–06) was a mere 4.3% of the mean annual natural flow.[14] With only three years to go, it seems unlikely that the legal obligations agreed to will be met within the prescribed time frame.

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THE MURRAY–DARLING BASIN

In October 2003, following extensive consultation, the Murray-Darling Basin Ministerial Council (MDBC) announced an allocation of $500 million to be used to buy water for environmental flows, with the longer-term objective of making 500 GL available by 2009.[15]

Again, the identification and delivery of the water has proven problematic. Meanwhile, this major river system maintaining Australia's food bowl and a number of vital ecosystems, is dying a slow death. The 2007 Progress Report indicates that 253 GL will be delivered from projects now being implemented, with additional projects being developed to deliver a further 209 GL. Another 35 GL may become available through projects yet to be developed. Before 2006–07, NSW and Victoria had identified only 220 GL with 'year-to-year availability being subject to environmental conditions'.[16]

A CRITICAL STAGE

We have reached a critical stage in Australia regarding our use of agricultural land and water. It's time to think about how and where irrigation will continue to operate. Essentially, we need to embrace efficiency within existing irrigation schemes, stabilise degradation, enhance our natural environment and raise productivity with a lower water input. Alternatively, as hinted at in the prime minister's 2007 *A national plan for water security*[17], we can relocate a significant component of the agricultural sector to the north of Australia. In other words, we can leave our environmental problems behind, only to create new ones elsewhere.

Land and water reform will require a major shift in water efficiency in both the farming and mining sectors. It will also require a willingness to recognise that in some parts of the country irrigation is simply not sustainable. Some land will either have to revert to dryland farming or be taken out of production altogether. A key task will be to determine imaginative ways for using such land to obtain broad environmental gains.

Table 1: The slow death of a major river system

YEAR	ACTION or DEVELOPMENT
1991	1000 km of the Darling River is infested with blue-green algae, an early sign that the river is under stress.
1994	COAG's Water Policy Reform document decrees that river health should be factored into water management.
1996	Further removal of water from the Murray-Darling system is restricted through introduction of a cap set at 1993–94 levels. Surveillance of groundwater pumping is not increased.
1999	An audit finds that Adelaide's water will be unacceptably salty by 2050.
2002–03	Impacts of a severe drought begin to seriously hit farms, towns, businesses and communities in the Murray-Darling Basin. Dredging keeps the mouth of the Murray River open in South Australia. The governments of Australia, NSW, Victoria and South Australia commit $500 million to buy 500 GL from irrigators to increase environmental flows in the river system.
2004	The National Water Commission articulates its aim to increase the productivity and efficiency of Australia's water use, including introducing full water trading between the states.
2005	A survey of river red gums on parts of the Murray flood plain finds that 75% of the trees are stressed because of low flows due to the drought and because too much water is being removed for irrigation.
2006	The Murray-Darling Basin experiences its worst drought on record. Water allocated for irrigation is halved. Surface water flowing into the basin's rivers drops to 550 GL. In an average year the figure is 11 200 GL. The Murray-Darling Basin Commission (MDBC) has not been able to purchase any water to increase environmental flow in the Murray. Hydrological analysis of aquifers in the MDB indicates that groundwater pumping in NSW, SA and Victoria increased after introduction of the cap on surface water removal.
2007	A report on the wellbeing of river red gums on the Murray River flood plains below Euston in NSW indicates that most of the 200-year-old trees are either dead or dying. Prime Minister Howard intervenes and releases *A national plan for water security.*

Source: Adapted from an article by Asa Wahlquist, 'Running on empty', the *Australian*, 8 November 2006.

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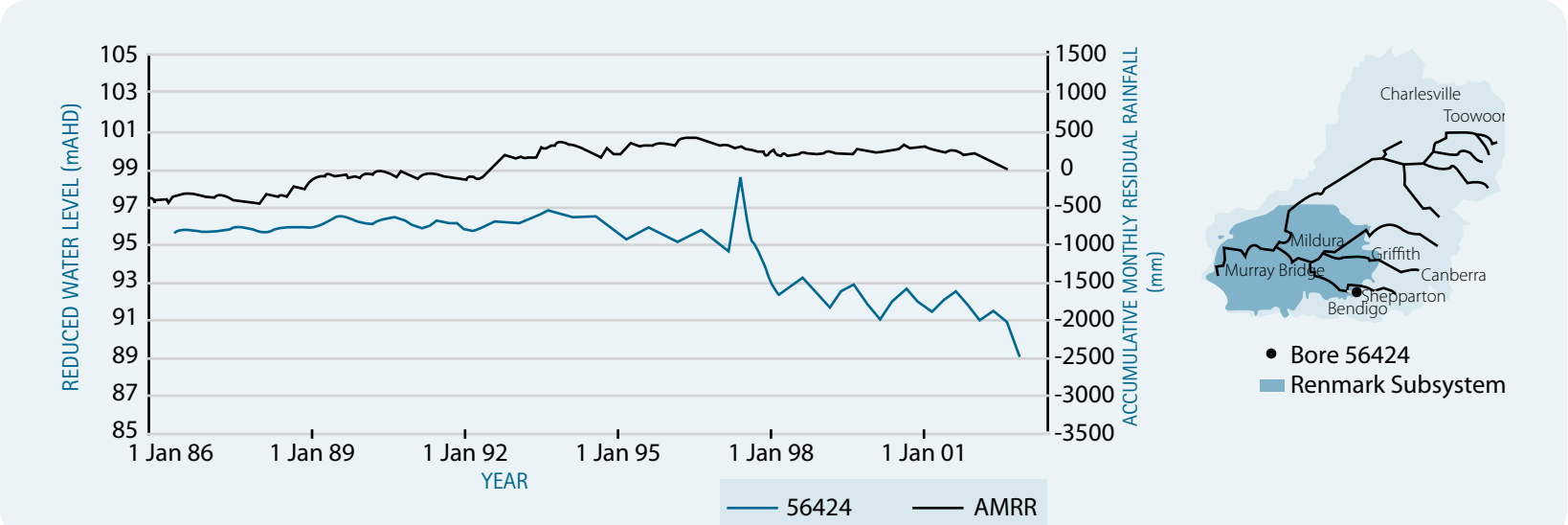

Figure 1. Shallow acquifers in the Murray–Darling Basin

The Murray-Darling Basin is a shallow geological feature with connections between the surface water in the rivers of the basin and three shallow acquifers. These are the Gunnedah, Shepparton and Renmark groundwater systems. The graph and map on this page show accumulating monthly rainfall and acquifer water levels in the Renmark system.

Starting in about 1994 groundwater usage increased sharply in areas of usable supply. In many parts of the basin rates of extraction exceeded the recharge capacity of the aquifers.

The hydrograph shown here indicates that declining groundwater levels are commonplace in productive areas of the catchment. The hydrograph also shows a strong correlation between rainfall, groundwater levels and usage. In the 1980s climatic conditions were wetter and groundwater levels showed a strong correlation to rainfall.

Source: D Ife & K Skelt, *Murray-Darling Basin groundwater and climate*, Australian Earth Science Convention 2006, <www.earth2006.org.au>.

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