Conclusions

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Key messages

- There is a high level of expectation of benefits from water resources across a wide spectrum of economic, social, and environmental values.
- Australia has sufficient water resources to meet its needs, but the locus of use around the major cities and in the Murray–Darling Basin creates problems of regional over-use and the need to find alternative water supplies.
- Demands on water resources are growing – from increased urban populations, increased prospects for irrigated agriculture, and the booming minerals and gas sectors – while, at the same time, society recognises the need to provide water for the environment.
- Climate change poses an additional pressure on water resources but Australia's adaptability to droughts and floods will help the management of further adaptation to climate change for a few decades at least.
- Australia is in a strong position to face its water challenges: having safe and reliable supplies of water, having achieved significant water reforms, and having solid institutions and many opportunities for innovation.

Australia's valued water resources

Australians treasure their water for a range of economic, environmental, social, and cultural values. Water resources are an input into the production of most goods, especially food and fibres. Australians also highly appreciate their rivers, lakes, estuaries, and wetlands because they are associated with a strong sense of place, and they have a desire to protect water resources and environments, both for future generations and for their intrinsic biological value.

Over time, demands on water have grown, not just as the population and economy has grown, but as the broader values of water have been appreciated. As water use has increased, and as water environments became polluted by other uses, water ecosystems started to degrade and there has been a growing awareness of the need to protect water quality and retain sufficient water for the environment. It has also been recognised that some community values for water, such as Indigenous values, have been poorly appreciated or understood.

Adelaide Hills, South Australia. Photo: CSIRO.

Much of the water debate today is about resolving conflicts in values and finding ways to use water more effectively to meet a broader set of aspirations. Science has helped inform this debate: revealing the degradation of ecosystems and consequences of pollution; documenting community values; better evaluating the multiple benefits obtained from water; and providing solutions for more effective uses of water.

Status of Australia's water resources

Australians have always had a strong sense of living in a parched continent, even though that is only partly true. Overall, Australia has sufficient water resources to support its current uses, consuming 6% of renewable water each year – a lower percentage of use than other regions of the world, because, although Australia may be a dry continent, it is also sparsely populated.

Challenges emerge from the very uneven distribution and use of water resources across Australia. River flows are notoriously unreliable from year to year and high rates of potential evaporation create high demand for water for irrigation and gardens, as well leading to large losses of water from dams and rivers.

The population is highly concentrated in coastal cities, which make heavy use of water from surrounding catchments, and irrigation is concentrated in a few valleys of the Murray–Darling Basin where levels of use are considered to be environmentally unsustainable. The unprecedented intensity of the millennium drought showed that these catchments cannot always be relied upon to meet society's needs, at least at current levels of use.

Water resources in other parts of the country are relatively undeveloped, but some of these places are also highly valued for their aquatic ecosystems, or there are other factors, such as land or crop suitability that limit water use. The challenge is to find ways of using these resources in a profitable way without causing expensive and unacceptable environmental damage, and by learning lessons from past over-use of water resources.

The vast, slowly changing stores of groundwater may offer more reliable supplies, but there are the same concerns over sustainable extraction limits – recognising that many wetlands, rivers, and lakes depend on groundwater, especially during the dry season. Over-use can also result in increased salinity that may not be detected for several decades.

The extent of groundwater resources and how much of it can be safely used is poorly understood, as are other parts of the water balance, such as the amount of water going to floodplains and wetlands, and that seeping from irrigation canals. As water resources become more heavily used, it will become important to better understand all parts of the water balance. There are excellent opportunities to do this by combining traditional on-ground measurements with satellite remote sensing, geochemical techniques, and hydrological models.

Future challenges

There will be strong future demands on Australia's water resources, from population growth, growing global and domestic demand for food, and the rapidly growing minerals and gas sectors. Australia's eight largest cities are forecast to require an extra 1150 GL/year by 2050, the equivalent to supplying two new cities the size of Sydney. There are more sustainable ways of providing those supplies than bringing ever more water into cities from ever more distant catchments, only to dispose of much of that water, plus stormwater, into rivers, estuaries, and the sea. The main solutions to date have been to reduce demand and build desalination plants, but there are other potential solutions, including recycling, and capturing and reusing stormwater. These solutions have higher energy requirements than traditional supplies, but there are a good prospects for improving the efficiency and cost of these technologies. Community concerns over recycled water for potable use will also need to be overcome, especially in the context of possible contamination from products such as pharmaceuticals, personal care products, and endocrine disrupting chemicals.

Achieving environmental sustainability of water use is becoming an overarching challenge. Australia's aquatic ecosystems, as well as being of high intrinsic value, support economic uses such as fisheries and tourism and provide ecosystem services such as flood mitigation, water quality, and habitat. These ecosystems require surface water flows or access to groundwater to survive, but it is not just adequate volumes of water they need, it is also the right seasonal

pattern, water quality, and variety of conditions. Providing water for consumption while providing for ecosystems often involves trade-offs or compromises. A good understanding of the response of ecosystems to different regimes of water use can help to make these trade-offs clear to all communities and help to identify ways to reduce them.

A major focus at present is rehabilitation of aquatic ecosystems in the Murray–Darling Basin. Research has revealed how changes to flow have impacted these ecosystems and is continuing to reveal the ecosystems' responses that might be expected if flows are returned to the environment. Although the extent of degradation is clear, there is inevitably some uncertainty over how best to achieve the planned outcomes, so, in a way, restoration can be viewed as a major landscape experiment. It requires careful monitoring, evaluation, and adaptive management as plans are implemented and as knowledge improves.

Global population growth and increasing standards of living will increase the demand for food. Irrigation is a profitable and productive form of agriculture, so demand for water for irrigation will grow, but in the Murray–Darling Basin it faces the prospect of reduced water availability as a result of climate change and the increased return of water to the environment. This drives research and innovation to improve the efficiency of irrigated agriculture through more water-efficient crops, improved farm management, precision applications of water, more efficient irrigation supply canals, and river management. Planning how irrigation can adapt to future conditions, informed by a good understanding of how irrigation and ecosystems use and influence water resources, will improve how sustainable use is achieved and reduce the conflict between the aspirations of different communities.

Lake Victoria, New South Wales. Photo: Michael Bell, © MDBA.

The mining industry is a major user of water and it is forecast to grow strongly in arid areas, where water supplies are limited and where there is potential for conflict with Indigenous water values and largely pristine water ecosystems. Coal seam gas, for example, is an emerging industry that can create potential impacts on surrounding aquifers, and requires the safe treatment and disposal of the saline water that is extracted. To be met with confidence, these challenges require a better understanding of deep groundwater aquifers and how they interact with each other. For this industry, water management intersects with other concerns such as threats to rural lifestyles.

Across southern Australia, climate change will intensify the future challenges, with the prospect that it will reduce river flows and recharge, intensify the impacts of droughts, and increase the demand for water. Temperature rises are happening now and there is some evidence that global warming is reducing runoff, but being so variable from year to year, trends in runoff are hard to detect. Runoff into Perth's reservoirs has clearly declined – by 55% since the 1970s – and the millennium drought across south-east Australia was historically unprecedented. By 2030, climate change is likely to reduce river flows by 10– 25% in some regions, with even larger changes by 2050 and 2070 if climate change is not mitigated. Australia's adaptations to highly variable water supplies – through means such as water trade, variable seasonal allocations, augmentation of supplies and water conservation – should be effective for mild reductions in water availability, because these are likely to be felt as more intense droughts. Ever improving skill to forecast water availability for the coming weeks and season is helping with those adaptations. Deeper reductions to water availability, such as those projected for 2070, would require more fundamental change, as the conditions experienced in the millennium drought could become the new average conditions, severely impairing urban water supplies and irrigated agriculture.

It is difficult to translate aspects of the global climate into the local rainfall and runoff patterns that dictate the floods and droughts typical of Australia's hydrology, but the ability to predict the consequences of climate change for water resources is improving all the time. This knowledge can be used in water plans to explore future scenarios, and help take full account of community and environmental costs and benefits of different ways of using water.

Water management is increasingly being integrated with broader societal challenges. Urban water planning is being integrated with overall city planning to improve the liveability and sustainability of cities. Processes to recover energy and nutrients by better wastewater treatment are being developed to reduce greenhouse gas emissions, protect downstream waterways, and provide a source of phosphorus and nitrogen fertilisers. In rural environments, the future of irrigation is intimately related to concerns over global food security, and water management may intersect with the mitigation of greenhouse gas emissions if forest plantations are used to offset carbon emissions. Plantations can reduce runoff and groundwater recharge, but the impacts can be minimised by avoiding the high water-yielding landscapes that supply major reservoirs, or avoiding situations where forests directly access groundwater aquifers that are already in use.

Wastewater treatment and recycling. Photo: CSIRO.

Prospects

Overall, Australia is in a strong position to face its water challenges. Almost all Australians have a reliable supply of very high quality water and safe and reliable treatment of wastewater. By contrast, the United Nations estimates that, globally, 900 million people still lack access to clean water and 2.6 billion people lack adequate sanitation. Although Australia faces significant challenges, it does so from a history of innovation in water management, resulting in part from continued maturing of the institutional arrangements for managing water. Some water resources remain largely unexploited, so Australia has an opportunity to protect its environments during future development, rather than embarking on the more difficult and costly task of restoration. Although some of Australia's aquatic ecosystems are degraded, remnants remain from which rehabilitation can occur.

Although Australia faces major challenges to provide water to meet all its economic, environmental, health, and social needs, it faces those from a position of strength. The challenges are being tackled with a clearer understanding of our water resources, and the strong potential for science and technology to support further innovation and efficiencies. Research successfully solved problems in the past, such as the causes of salinity, or pollution of water by heavy metals, and is answering many of the emerging questions – such as how ecosystems will respond to environmental flows and emerging contaminants, or how water resources will respond to changing climate and increased use of groundwater, or how to recover energy and nutrients from urban water supplies. With innovative water management, there should be little reason to feel that we cannot meet the multiple expectations placed on water resources, while still appreciating that we live in a 'dry country'.