

WINSTON
CHURCHILL
MEMORIAL
TRUST

love
every
drop

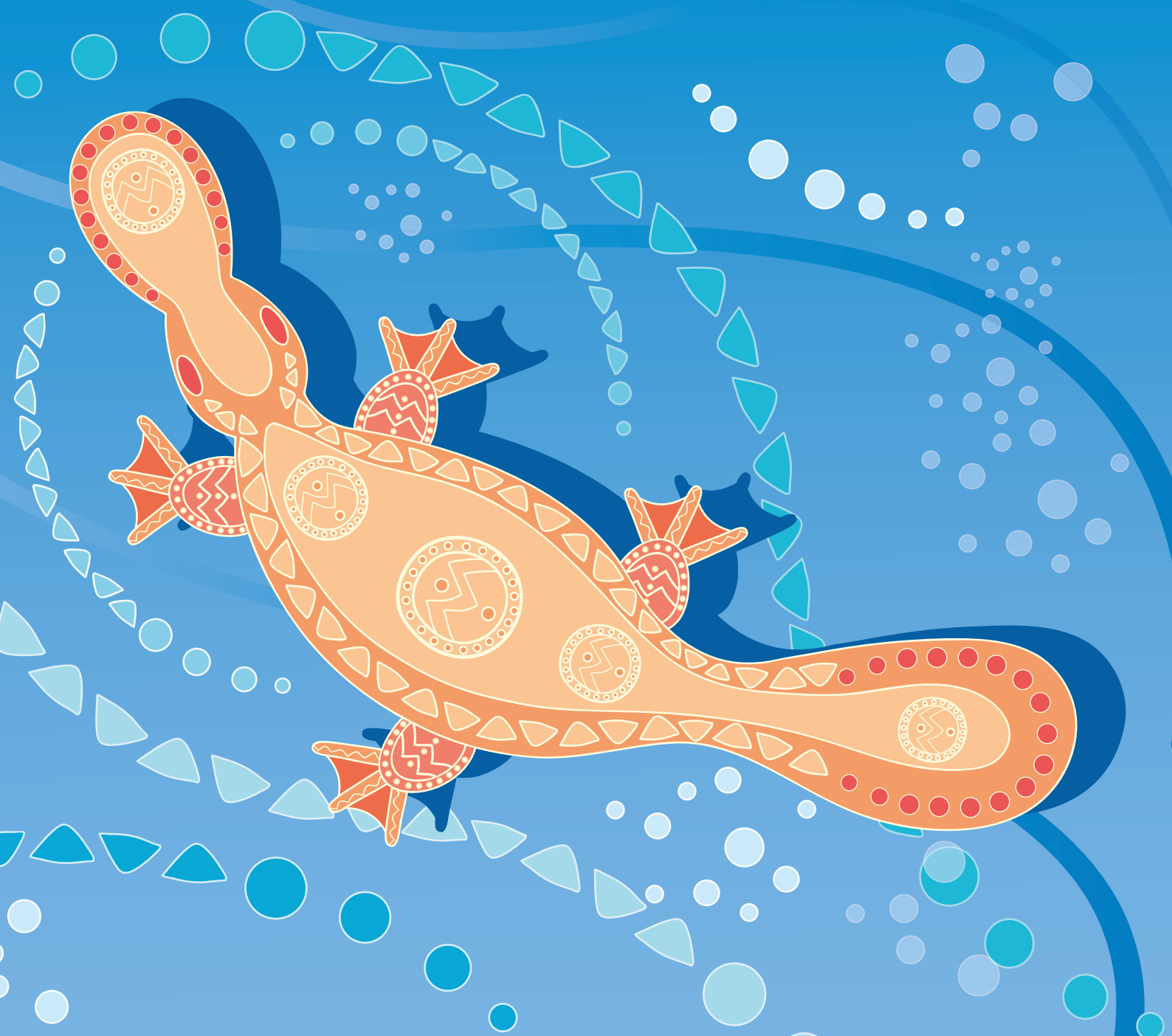


anglianwater

Markets, water shares and drought: Lessons from Australia

**What can the water industry in England and Wales
learn from Australia's water reform story?**

A report by Alice Piure



Acknowledgements

This project was made possible by the Winston Churchill Memorial Trust (WCMT) and Anglian Water. The WCMT awarded me a travel fellowship in 2014, which provided the necessary funding, and I also greatly benefited from the valuable advice and experience of staff at WCMT. Anglian Water have generously supported the project throughout, and provided me with the time and resources required to execute it. In addition, the input from colleagues at Anglian Water has been invaluable to help me think through what the research means, and to produce the report you see today.

Most importantly, this project would not have been possible without the generous and enthusiastic support and input of the many industry experts in Australia. In particular, the contribution of the following individuals stands out:

Mark Bailey

Manager Water Resources
Goulburn-Murray Water

John Day

Executive Manager Operations
North East Water

Professor Jane Doolan

Professorial Fellow
at University of Canberra

Campbell Fitzpatrick

Senior Advisor
Environmental Protection Authority Victoria

Matthew Hudson

Senior Hydrogeologist
Goulburn-Murray Water

Steve Hosking

Diversions Manager, Waterways
Melbourne Water

Sarah Gaskill

Senior Environmental Water Planner
Melbourne Water

Owen Gould

Water Resources Engineer
ACTEW Water

Alister Laidlaw

Water Systems Coordinator
North East Water

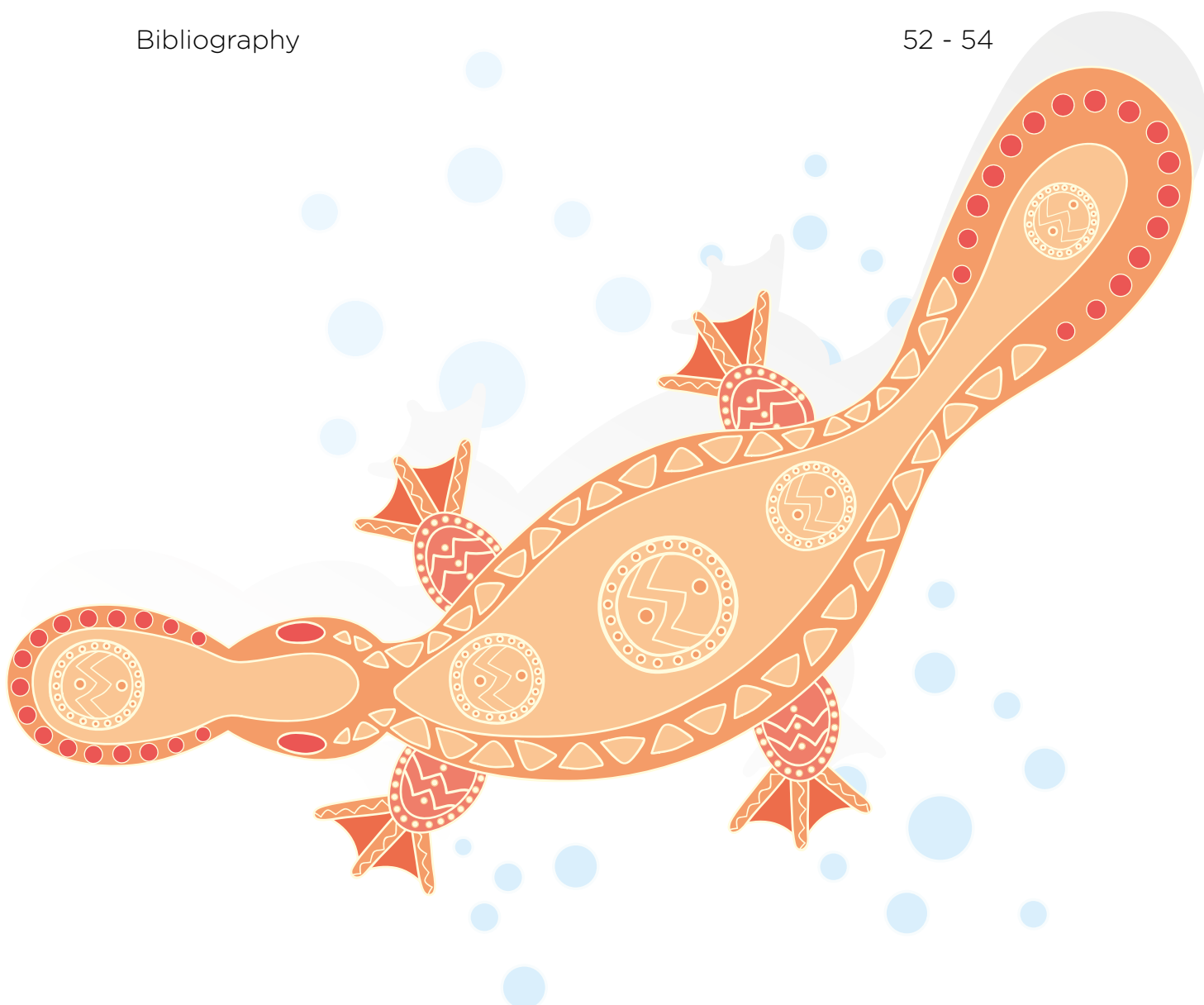
David Nicholls

Manager, Water Policy and Planning
Department of Primary Industry
Parks, Water and the Environment

The findings and conclusions in this article are those of the author and do not necessarily represent the views of Anglian Water or the Winston Churchill Memorial Trust.

Contents

Executive summary	i - viii
Introduction	1 - 8
The Australian context	9 - 17
Water rights reform	18 - 28
Coping with drought	29 - 31
Public water supply and the market	32 - 35
Lessons for reform in England and Wales	36 - 48
Annex 1: The mechanics of water shares	49 - 51
Bibliography	52 - 54



Executive summary

This report aims to provide evidence to inform the debate on abstraction reform in England and Wales by exploring Australian experiences of water reform. It has been written using the results of an extensive literature review, whilst drawing on interviews and case studies conducted in Australia. While it cannot definitively say whether reform in England and Wales is justified, or which of the two reform options proposed by Defra is preferable, it aims to provide new perspectives and shed light on how others have dealt with similar problems. Although the project focused on public water supply, it should be informative for anybody with an interest in abstraction reform in England and Wales.

There are important differences between water resources management in Australia and England and Wales. While it is possible to learn from the Australian experience, care must be taken to understand what learning is transferable, and what is not. Key differences include:

- Australia's climate is highly variable and characterised by recurring multi-season droughts;
- the management of water resources in Australia therefore requires reservoir storage capacity that is significantly larger than in England and Wales. In total, Australia has almost 84,000 Gegalitres (Gl) of storage capacity in large dams, compared with 1,600 Gl in England and Wales;
- river flow in many major river systems in Australia, including the Murray-Darling Basin, is controlled by regulated releases from large upstream reservoirs. These catchments are described as being 'regulated';
- irrigation accounts for the majority (65%) of abstractions in Australia, whereas public water supply in England and Wales accounts for half of the total volume of water abstracted, and agricultural abstractions are in the minority; and,
- the water industry in England and Wales was privatised in 1989, but water and wastewater services in Australia are provided by either state-owned corporations, local-authority owned corporations or local authorities (depending on the state).

Recognising these dissimilarities, there is much that we can learn from Australia's water reform story. Australian abstraction regimes evolved during a time when there was little competition for water resources because they were relatively abundant. Over a period of 25 years, abstraction management in Australia has been reformed to manage increasing scarcity and consequent competition for resources.

Similarly, the system of abstraction management in England and Wales was designed during a period of perceived surplus of water. It was not primarily designed to manage scarcity or competition for resources, and there is no effective mechanism to reallocate water between abstractors. There is now concern that the current system of abstraction management is not sufficiently flexible to manage the future pressures of growth and climate change.

Reform in England and Wales

The current abstraction regime was developed during the 1960s, at a time when there was a perceived surplus of water and little awareness of the environmental impacts of abstraction. In the future, climate change and population growth are expected to put increasing pressure on water resources, and the combined impact of these pressures could result in less water being available for consumption. Consequently, there is concern that the current system is not sufficiently flexible to cope with these future pressures.

As a result, the Government is committed to reforming the current abstraction regime, and Defra is proposing two alternative reform options:

- Current System Plus, which consists of reforms that build on the current system of water licences; and,
- Water Shares, which would be a more significant change, and would entail redefining water rights as a share of the water available for abstraction, as opposed to a maximum volumetric quantity.

More recently, Defra has also committed to consider a potential 'hybrid' option, which is a mixture of different aspects of Current System Plus and Water Shares.

Although there is agreement about the future pressures being faced, there is little consensus within the water industry about the appropriateness of Defra's abstraction reform proposals, which are concerning many in the industry.

The most common concerns include:

- a scepticism about the case for reform, many believing that the current system is sufficiently flexible to cope with future challenges;
- that the transition to the new system might accelerate investment through the water resources management planning process;
- that there is insufficient consideration of the need for investment in strategic infrastructure alongside reform; and,
- that the performance of the reform options during dry periods or severe drought has not been properly considered.

What can we learn from the Australian example about how Defra's Water Shares would work in practice?

There is concern in the water industry that a shares based system would introduce too much uncertainty to enable water companies to fulfil their statutory duty to supply water. Information about how Water Shares would work in practice is limited. In particular, the proposal to introduce a short allocation period (fortnightly) raises questions about how companies would plan for the long term or manage their abstractions on a daily basis.

The Australian system, where existing rights are defined as a share of the water available, has influenced the development of reform options, particularly Water Shares.¹ However, Water Shares is substantially different to Australian water shares systems in several respects.

- The concept of water shares in Australia is predicated on large-scale multi-sector catchment storage that was built (and financed) by governments prior to reform. Water in these systems is allocated as a share of the available water in storage.
- New South Wales is the only state in Australia that has introduced a system of water shares in catchments without this sort of storage. However, some aspects of water reform, including carryover and catchment-wide limits on total annual and daily abstractions, have yet to be fully implemented in these catchments because the majority of abstractions are unmetered.
- In all catchments where water shares have been introduced, the allocation period is annual. There is nothing comparable to the fortnightly allocation period proposed in Defra's consultation document.
- While Australian water shares yield a smaller volume of water in dry periods, they do not yield a greater volume of water in wetter periods. Under Water Shares, an abstractor could abstract more water during wetter periods.²

¹ See Young (2012), Towards a generic framework for the abstraction and utilisation of water in England and Wales; and Young & Esau (2013) Detailed case study of the costs and benefits of abstraction reform in a catchment in Australia with relevant conditions to England and Wales.

² Defra (2013), Making the most of every drop: consultation on reforming the water abstraction management system, Page 29

- Finally, in catchments where water shares have been introduced, abstractors can 'carryover' unused allocation from one year to the next. The rules about how much water can be carried over, and how much water can be used in any one year, depend on the specific circumstances of the catchment.

As a result of the differences described above, exploring the Australian experience will not provide answers to specific water industry concerns about how a fortnightly allocation period would affect daily abstractions and long-term planning. However, it does not mean that Water Shares cannot be introduced in England and Wales, or that it could not be beneficial, but it would need to be carefully trialled before being widely implemented.

One aspect of Australian water shares that is not discussed in the consultation document is carryover. Carryover is an important tool that allows abstractors to manage the risk that their shares yield a low volume of water, or that they cannot abstract that volume of water because Hands-Off-Flow conditions have been triggered. The introduction of carryover arrangements in England and Wales could provide an additional risk management tool for abstractors, particularly where they have access to storage.

Recommendations

- The Environment Agency needs to ensure that there is sufficient catchment monitoring and metering of abstractions in place prior to implementing reform.
- Given its innovative nature, Water Shares should be carefully trialled in selected catchments to understand the impacts on all abstractors before being implemented more widely.
- Defra should explore the possibility of introducing carryover arrangements as part of the reform options.

How important has trading been to public water suppliers in Australia?

Trading has delivered substantial benefits to Australian abstractors by allowing for both short-term and long-term reallocation in response to climatic and other pressures, particularly within the Murray-Darling Basin where water markets are most developed.³

However, intersectoral trading is contentious in Australia, and consequently the potential benefits of trading to public water supply have not been fully realised, and are unlikely to be so in the immediate future.⁴ Despite this, public water suppliers have benefited from water markets, particularly in Victoria. Trading has allowed water corporations to maintain supplies to customers during the Millennium Drought. For example, during 2008-09 North East Water purchased an additional 4,362 ML of water to secure supplies, provide an additional reserve for 2009-10, and to relax restrictions on outdoor use. Following the drought, trading has provided an additional mechanism for water corporations to improve security of supply and prepare for future population growth.

In addition, there are examples where the market has driven innovation and efficiency in the water industry. Through the imaginative use of existing infrastructure, ACTEW Water (the water corporation serving Canberra and the Australian Capital Territory) has been able to access additional water to improve security of supply from markets in neighbouring New South Wales. During the drought, North-East Water, a regional Victorian water corporation, used its distribution networks to help its communities to access additional water on the market. This allowed schools, sporting associations, and local councils to keep sporting facilities and amenity areas open.

As water resources in England and Wales become increasingly allocated, the need to reallocate water between users will become more important, especially if there is a long-term decline in the availability of resource. Many believe that markets are the most appropriate way to reallocate water, because, in theory, trading results in a more efficient allocation of water and can drive innovation and improvements in productivity.

However, concerns have been raised about the feasibility of introducing water markets in England and Wales, given that catchments are small and have low levels of interconnectivity compared to those in Australia. The success of water markets in Australia does not mean that trading will definitely work in England and Wales. However, at the beginning of Australia's reform journey, nobody imagined that water markets would become as successful or widespread as they are today, and staff at water corporations could not have predicted the outcomes that trading would drive prior to the introduction of markets. This suggests that we should not dismiss the potential for markets to deliver benefits in England and Wales because we cannot imagine the specific outcomes and solutions that they could drive.

In addition, many abstractors in England and Wales have expressed concerns about the social consequences of water trading, and that water companies will dominate markets because they are the majority abstractor. Similarly, in Australia, there has been significant public debate about the potential for 'water barons' and foreign investors to buy up water rights, and the loss of water from some regions and sectors as a result of intersectoral or interstate trading. As a result, Australia has taken an incremental approach to the introduction of water markets.

Recommendations

- Reform in England and Wales should seek to introduce water markets, and reform options should be designed to facilitate trading in order to maximise the potential benefits. Features of reform that can promote trading include the separation of water and land rights and the introduction of water shares, because they reduce transaction costs and facilitate temporary trading.
- An incremental approach to water market development is probably appropriate given stakeholder concerns around trading (although potential benefits will be forgone if suboptimal arrangements are left in place too long).

Should public water supply be prioritised over other sectors?

Under the current abstraction regime, the Environment Agency has a special duty to have regard to public water supply requirements and duties imposed on water companies in the Water Industry Act 1991.⁵ Outside of drought conditions, public water supply is not prioritised above other sectors in any practical sense. For example, water company licences can be time limited and subject to HOF conditions. However, during a drought, public water supplies can be prioritised through various provisions, including Drought Permits and Orders. Defra's consultation document does not discuss the prioritisation of public water supply, which implies that it is not intended to change.

Prioritisation during an emergency

There has been some discussion amongst abstractors about the prioritisation of different sectors during a drought. Most agree that water for domestic use should be prioritised, but that water companies need to encourage and support their customers to use water efficiently, and may need to occasionally impose restrictions such as hosepipe bans. However, many farmers and growers have called for the removal of Section 57, which they perceive to be unfair because it applies only to spray irrigation.⁶ In addition, some have suggested that other sectors, including food processing and electricity generation, should also be prioritised.⁷

In Australia, all states prioritise water for essential human needs during an emergency (such as a severe drought or water quality event). It is appropriate that, in England and Wales, water for essential domestic use is prioritised during an emergency situation.

Prioritisation during 'normal' conditions

New South Wales and Victoria have taken very different approaches to the prioritisation of public water supply during 'normal' conditions.

⁵ EA & Ofwat (2011), The case for change – reforming water abstraction management in England, Page 28

⁶ Defra (2014), Making the most of every drop consultation on reforming the water abstraction management system Summary of consultation responses, Page 12

⁷ For example, see Defra's discussion website <http://defra.dialogue-app.com/water-abstraction-reform-and-drought/prioritising-water-use> (accessed on the 13/11/14)

In New South Wales, public water supply licences are described as 'highest priority', which means they have the highest level of reliability. In addition, if public water suppliers require additional water as a result of population growth, they can apply to the NSW Office of Water for additional water, rather than having to buy it on the market. The NSW Office of Water will provide this water by effectively taking it from others. Lower reliability rights were designed for and held predominately by annual cropping, and consequently this sector bears the risk of a future decline in aggregate water availability.

This is very different to the circumstances faced by water corporations in Victoria, where one use of water is not prioritised over others in normal conditions. Public water suppliers hold 'high reliability' rights, which can also be held by irrigators, industry and others. If high reliability rights are restricted, this restriction will be applied equally to all high reliability rights holders, including public water suppliers. In addition, water corporations are expected to manage population growth by buying additional water on the market.

The Victorian example suggests that it is possible to design a system where, during normal conditions, no use of water is given priority, and this effectively shares the risk of a decline in aggregate water availability across all sectors. Given that PWS is the minority user in Victoria, policy makers could be confident that water corporations would be able to buy sufficient quantities of water from irrigators as and when required.

However, the difference in outcomes between NSW and Victoria also suggests that, in order to achieve the benefits of trading, and encourage innovation, public water supply should not be shielded from reform or prioritised above other users during normal conditions. This includes meeting rising demand for water supplies as a result of population growth.

Public water supply accounts for over 50% of the water abstracted in England and Wales (and in some areas considerably more than this). As a result, it could be argued that it is not appropriate to expose the sector to the same level of risk to which it was exposed in Victoria. However, PWS is not prioritised above other sectors in the current system, and the industry is already managing the risks associated with growth and climate change. In theory, abstraction reform should provide companies with additional risk-management tools, such as the ability to trade water, and access to additional abstraction at very high flows.

Consequently, it would not be appropriate to afford PWS additional priority during normal circumstances at the expense of others. However, water companies in England and Wales have a legal obligation to meet demand for treated water supplies, and this obligation will continue to exist in the reformed system. It is important that they are able to continue to meet this obligation in the reformed system, and consequently the processes that determine how much water is available need to be transparent and as mechanistic as possible, so that there is limited scope for arbitrary regulatory judgment. This would be particularly important in Water Shares, so that companies can use rainfall and other data to forecast how much water their shares will yield in both the short-term allocation period, and over the 25 year period used for water resources management planning.

Recommendations

- Water for essential domestic use should continue to be prioritised during a drought situation, but water companies need to continue to encourage and support their customers to use water efficiently, and may need to occasionally impose restrictions on use.
- Public water supply should not be prioritised in normal conditions.
- In order to allow water companies to meet their statutory duties in the reformed system, the processes that determine how much water is available need to be transparent and predictable.

Is it important to reform proactively?

The Environment Agency's 'Case for Change' document demonstrates that, in many catchments, by 2050 there may be insufficient water to fulfil licensed demands and meet environmental requirements, even when environmental requirements are reduced in proportion to climate change impacts.⁸ Although the current system has mechanisms in place to manage drought, it is not clear what would happen if there is a permanent decline or a step change in the availability of water resources, and this creates substantial uncertainty for abstractors. Defra's proposals aim to reform the abstraction regime proactively, creating certainty for abstractors by defining upfront what would happen in this situation.

The importance of proactive reform is illustrated by the Victoria example, where reform began with the 1989 Water Act. Through the definition of Bulk Entitlements, the government sought to define rights and to agree how water would be shared in a severe drought, the like of which had not been experienced in Victoria since the World War II drought (1937-47). Prior to reform, it was not clear what protection or cutback would be applied to basic entitlements if this kind of drought were to repeat. The implementation of reform in the 1990s was important to help the state to get through the Millennium Drought period (1997 - 2010) and to avoid a chaotic bun-fight as abstractors sought to secure their water.

In order to convince abstractors of the need for reform, the Victorian government undertook comprehensive modelling at a catchment level. The modelling was based on 100 years' climatic data, and illustrated how water rights would be negatively impacted during the most severe drought on record. By sharing this work with abstractors via catchment committees, NRE convinced them of the need for reform, helped them to understand the risks they faced without reform, and empowered them to reach an agreement as to how water should be allocated during a severe drought.

Recommendations

- Given that there is likely to be a permanent decline in the availability of water resources in the future, it will be necessary to reform the current abstraction regime proactively. Reform should seek to provide certainty to abstractors about what would happen if the aggregate availability of water resources decreases, and build flexibility into the system so that it can adapt to changing supply and demand pressures.
- The Environment Agency should build on the existing CAMS process and undertake water resources modelling, that shows how individual abstractions could be affected in different future scenarios. This work should be shared with abstractors via catchment committees, both to help them understand the risks they face without reform, and to facilitate discussions about how to share resources and manage risk.

What can we learn from the Australian water industry's experience of the Millennium Drought?

While abstraction reform in Australia has played an important role in achieving secure, sustainable and resilient water resources, the experience of the Millennium Drought illustrates that abstraction reform also needs to be accompanied by effective strategic planning.

Although drought is not unusual in Australia, the Millennium Drought differed in that it was of unprecedented severity, duration and geographical extent. It affected most of the continent for over a decade including Sydney, Adelaide, Melbourne, Brisbane and Perth, as well as all the major agricultural regions.⁹ South-eastern Australia (including the Murray-Darling Basin) was particularly badly affected. Not only were the observed reductions in streamflow outside the scope of the historical record, they were more severe than the projected changes to mean climate for 2030.¹⁰

⁸ EA (2011) The case for change - current and future water availability, Page 32

⁹ However, it is important to note that the entire country was not in a drought all of the time. During this period, good rains in certain regions allowed water restrictions to be lifted and some agricultural enterprises to prosper.

¹⁰ CSIRO (2010) Climate variability and change in south-eastern Australia. A synthesis of findings from Phase 1 of the South Eastern Australian Climate Initiative (SEACI), Page 1

The fact that reductions in streamflow went well beyond what had been previously experienced, and were more severe than the projected changes to mean climate for 2030, put the drought outside the scope of water resources management planning. As a result, the Australian water industry was unprepared for the severity of the drought, which resulted in a crisis for the sector. Severe restrictions were imposed upon customers, and planning decisions were made without independent scrutiny, resulting in inefficient investments and large price increases for customers.

Currently, water companies in England and Wales plan for the long term and make investment decisions via the Water Resources Management Plan (WRMP) process. The Australian experience suggests that, although the WRMP process is both sophisticated and complex, it may not allow the water industry to best manage future uncertainty. This is because the process is deterministic, reliant on historic climate data, and has a narrow focus on least-cost. In addition, it does not facilitate a strategic approach to water resources planning that considers the needs of multiple sectors. In addition, the Australian experience demonstrates that failure is possible, and that the cost of failure is high.

The water industry in E&W is alive to these risks, and is actively thinking about how it can build upon the WRMP process to better manage future uncertainty and prepare for droughts that are more severe than those experienced in the historic record (such as three consecutive dry winters). For example, Anglian Water is developing the use of Robust Decision Making (RDM), an innovative stochastic modelling approach that can assess options over hundreds of possible future scenarios, as opposed to a possible few. RDM also allows the performance of options to be tested against multiple success criteria as opposed to a narrow focus on least cost.

In addition, the water industry is working to improve strategic planning through initiatives such as Water Resources East Anglia (WREA) and Water Resources in the South East. The WREA project aims to develop an affordable, reliable and sustainable system of supply for East Anglia which is resilient to the long-term effects of population growth and climate change. This includes extended periods of severe drought. WREA will work with all the water companies in the region, and representatives of other abstractors, to create the UK's first regional multi-sector WRMP. It will also draw on the outputs of RDM modelling.

Recommendations

- Abstraction reform needs to be accompanied by effective strategic planning to ensure that public water supplies are secure, sustainable and resilient.
- Through the development of abstraction reform proposals, Defra has the opportunity to encourage and support innovative approaches to supply-demand planning, such as strategic multi-sector planning, and stochastic modelling approaches including Robust Decision Making.

How were public water supply licences transitioned into the new system?

There is a clear body of evidence from Australia showing that, if possible, any over-allocation should be resolved prior to the introduction of markets. Failure to do so can result in previously unused licences becoming activated, thus increasing aggregate water use and exacerbating problems with over-abstraction.¹¹

Defra has been clear that existing powers will be used to resolve any over-abstraction prior to, and alongside, implementing reform. In addition, in order to ensure compliance with the Water Framework Directive 'no deterioration' obligation, Defra is proposing to remove 'unused' volumes from licences during the transition so abstractors will only be able to take what they have actually been using into the new system. Defra proposes to calculate 'recent use' with a single formula that will be applied to all licences in a transition catchment.¹²

While it is understandable that Defra wants to reduce the administrative burden associated with the transition, the Australia experience suggests that a one-size-fits-all approach is not appropriate, particularly in catchments where the transition is likely to be complex or contentious. Both Victoria and New South Wales have transitioned abstractors into the reformed system following considerable stakeholder representation via catchment-based committees.

¹¹ See for example NWC (2011) Water markets in Australia: A short history, Page 43; Quiggin (2008) Uncertainty, Risk and Water Management in Australia, Page 70; Crase & Dillery (2008) The institutional setting, Page 79

¹² Defra (2013) Making the most of every drop: Consultation on reforming the water abstraction management system, Page 51

The Victoria example shows that extensive consultation with abstractors was required to understand each catchment's unique circumstances and to achieve a transition that did not disproportionately affect any group of abstractors or the environment. In addition, a key advantage of the catchment-based committee approach to transition is that it allows abstractors to understand each others' particular circumstances, and to agree an approach to transition that is perceived to be fair and legitimate.

Fairness and legitimacy are likely to be important to the success of reform in England and Wales. Many abstractors in England and Wales are already expressing concerns about fairness, in particular that water companies will dominate a future water market, and will be able to drive up prices to the detriment of other abstractors.

The catchment-based committee approach, however, is challenging, because it requires complex water sharing issues to be worked through by communities with disparate views. In both Victoria and NSW it took over a decade for the whole state to transition into the reformed system. In NSW, the task was made more difficult because the government attempted to transition 31 water catchments simultaneously, which placed a considerable strain on government resources. In addition, the details of reform had yet to be thoroughly worked through, and consequently the new framework continued to evolve, which undermined community confidence in reform.¹³

Recommendations

- Any problems with over-abstraction or over-allocation need to be resolved prior to the introduction of water markets. It is positive that this has been recognised by Defra and the Environment Agency.
- In catchments that require full reform, Defra and the Environment Agency should engage with abstractors and other stakeholders extensively via catchment-based committees. Instead of using a formula to calculate recent use, the catchment-based committee should be responsible for agreeing the volume of water abstractors are allowed to transition into the reformed system. In addition, catchment-based committees should be used to resolve any difficulties that arise as a result of catchment-specific circumstances.
- Recognising that a catchment-based committee approach to transition is challenging, Defra should seek to transition a small number of catchments initially.

¹³ Young & Esau (2013) Detailed case study of the costs and benefits of abstraction reform in a catchment in Australia with relevant conditions to England and Wales, Pages 11-12



Introduction

The Government has made a commitment in the Water Act 2014 to reform the current system of abstraction management. The two key policy drivers for reform are:

- the expectation that climate change will result in greater pressure on water resources and more volatility than we have seen to date; and,
- that water resources could be allocated in a way that better serves economic growth.

There is concern that the current system is not sufficiently flexible to cope with these pressures, and that failure to reform could result in water shortages and constrain economic growth.

In its consultation, 'Making the most of every drop', Defra is proposing two alternative reform options: Current System Plus, which consists of reforms which build on the current system of water licences; and Water Shares, which would be a more significant change, and would entail redefining water rights as a share of the water available for abstraction, as opposed to a maximum volumetric quantity.¹⁴ As in the current system, neither of the reform options will guarantee that water is always available.

Defra has sought to learn from international experience, and the Australian example in particular has influenced the development of reform options.¹⁵ Australia is unusual in that it operates a market-based system where existing rights are defined as a share of the water available, which is often described as 'world leading'¹⁶.

There is, however, very little research which describes how the reform of the abstraction regime in Australia has affected public water suppliers, or how public water suppliers operate within a shares-based system. Water supply and sanitation in Australia are universal and of high quality, which implies that it is possible for public water suppliers to operate within a shares-based system. Exploring how public water suppliers were affected by abstraction reforms, manage their daily abstractions, and plan for the long term, could help to inform the debate around abstraction reform and development of policy options for England and Wales. It could also help water companies in England and Wales to understand what issues and risks may be associated with abstraction reform.

Although there is agreement about the future pressures being faced, there is little consensus within the water industry about the appropriateness of Defra's abstraction reform proposals. Many in the industry are concerned about Defra's abstraction reform proposals. The most common concerns include:

- a scepticism about the case for reform, many believing that the current system is sufficiently flexible to cope with future challenges;
- that the transition to the new system might accelerate investment through the water resources management planning process;
- that there is insufficient consideration of the need for investment in strategic infrastructure alongside reform; and,
- that the performance of the reform options during dry periods or severe drought has not been properly considered.

More detail about the reform proposals and water industry concerns can be found on pages 7-8.

¹⁴ Defra (2013), Making the most of every drop: consultation on reforming the water abstraction management system.

¹⁵ See Young (2012), Towards a generic framework for the abstraction and utilisation of water in England and Wales; and Young & Esau (2013) Detailed case study of the costs and benefits of abstraction reform in a catchment in Australia with relevant conditions to England and Wales.

¹⁶ See, for example, ACCC (2014), Australian Competition & Consumer Commission: Submission to the review of the Water Act 2007, Page 3; NWC (2011), Strengthening Australia's water markets 2011 Page 8



The case for reform in England and Wales

The current abstraction regime was developed during the 1960s, at a time when there was a perceived surplus of water and little awareness of the environmental impacts of abstraction. Parts of the system have been updated since it was first established, such as the introduction of time-limited licences in 2001. Despite this, there is concern that the current system is not sufficiently flexible to manage the future pressures of growth and climate change, and that water resources could be reallocated in a way that better serves economic growth.

Over the next 25 years, climate change and population growth are expected to put increasing pressure on water resources, and the combined impact of these pressures could result in less water being available for consumption. There is, however, significant uncertainty regarding when and where the impacts of climate change and growth will manifest, and in order to manage this uncertainty effectively we will need a system of abstraction management that is flexible and allows for adaptation.

The Environment Agency's (EA) 'Case for Change' document demonstrates that water resources are already under pressure in some catchments. A quarter of water bodies in England will only provide a reliable source for new consumptive abstraction for less than 30% of the time.¹⁷ In these catchments, access to reliable water for direct abstraction can only be obtained from another abstractor, rather than the issuing of a new licence. Although trading is possible in the current system, it is ineffective, taking up to four months to be approved by the EA.¹⁸

In addition, the EA's modelling work shows that by 2050 there may be insufficient water to fulfil licensed demands and meet environmental requirements, even when environmental requirements are reduced in proportion to climate change impacts.¹⁹ It is not clear what would happen in this situation, or what cutback would be applied to whom, and this creates substantial regulatory uncertainty for abstractors.

There is concern that it is not sufficiently flexible to allow abstractors to manage these future risks effectively. Particular problems associated with the current system include:

- licences cannot be changed quickly enough so that abstractions reflect the availability of water in the environment, at both high and low flows;
- current licences may result in unsustainable abstractions if there is a long-term reduction in water availability;
- there is no effective mechanism for reallocating water resources between users, meaning that water is prevented from being used where it is most valued, and this in turn dampens the incentives to use it efficiently; and,
- abstractors are not incentivised to manage the risks from climate change, because the Environment Agency must compensate them if a reduction in their licensed volume is required to protect the environment.²⁰

¹⁷ EA (2011) The case for change – current and future water availability, Page 11

¹⁸ Defra (2013), Making the most of every drop: consultation on reforming the water abstraction management system, Page 38

¹⁹ EA (2011) The case for change – current and future water availability, Page 32

²⁰ Defra (2013) Impact assessment: Future water resources management: Reform of the water abstraction regulation system, Page 7



Project scope and aims

In February 2014, Alice Piure, Strategy and Policy Analyst at Anglian Water, was awarded a Travelling Fellowship by the Winston Churchill Memorial Trust (www.wcmt.org.uk) to research how abstraction reform in Australia has affected public water suppliers. As part of the project, she spent four weeks conducting fieldwork in Australia during July 2014.

The project aims to provide evidence to inform the debate on abstraction reform in England and Wales by using examples from the Australian experience to provide insight into areas where there are water industry concerns. It does not profess to have all the answers, and cannot definitively say whether reform is justified, or which of the two reform options are preferable. However, it can shed light on how others have dealt with similar problems and provide new perspectives. The project sought to explore the questions listed below.

- Is the Australian experience relevant to the water resources management context in England and Wales?
- What can we learn from the Australian example about how Defra's Water Shares would work in practice?
- How important has trading been to public water suppliers in Australia?
- Should public water supply be prioritised over other sectors?
- Is it important to reform proactively?
- What can we learn from the Australian water industry's experience of the Millennium Drought?
- How were public water supply licences transitioned into the new system?

While in Australia, Alice travelled to Canberra (the Australian Capital Territory or ACT), New South Wales (NSW), Victoria and Tasmania, and spent time with a variety of public water suppliers, regulators, government departments and others.

- NSW and Victoria were selected because they have introduced water shares, and are situated within the Murray-Darling basin.
- Although the ACT has not introduced water shares, there is evidence that public water supply has been active in water markets in neighbouring NSW.
- Tasmania was selected because it has a very different water resources situation to mainland Australia: namely catchments are small, there is a low level of connectivity, and water resources are still available.
- Western Australia and the Northern Territory were excluded from the research because these states have not implemented key reforms including water shares.

This report uses the results of an extensive literature review to understand water reform at a national level, whilst drawing on interviews and case studies conducted in Australia. There is a greater focus on examples that can provide relevant lessons for reform in England and Wales.



State	Organisation name	Water services provision	Government department	Regulation	Resource manager	Licensing authority	Other
ACT	ACTEW Water	X					
	National Water Commission						X
	Murray-Darling Basin Authority						X
NSW	NSW Office for Water			X		X	
	Sydney Catchment Authority				X		
Tasmania	Department of Primary Industries, Parks, Water and the Environment (DPIPWE)		X			X	
	Environmental Protection Agency			X			
	Otter			X			
	TasWater	X					
Victoria	Environmental Protection Agency		X				
	Department of Environment and Primary Industries (DEPI)		X				
	Goulburn Murray Water			X	X	X	
	Goulburn Valley Water	X					
	Melbourne Water			X	X	X	
	North East Water	X					
	Victorian Environmental Water Holder						X



The language of water rights

The vocabulary associated with abstraction can be confusing, and is often used to mean different things in different contexts. This report uses the terms ‘water rights’, ‘security of rights’ and ‘reliability of rights’ to describe distinct concepts:

‘Water rights’ define the rights and obligations a party has over a water resource. Users’ rights typically define the water volume that can be taken and set other conditions around abstraction. They can be defined in statute or in other legal instruments such as contracts. In England and Wales they are more commonly referred to as abstraction licences, whereas in Australia they are commonly termed water entitlements.

It is important to note that water rights do not guarantee the holder a specific volume, because water is an inherently variable resource, and nobody can guarantee that it will be available when required.

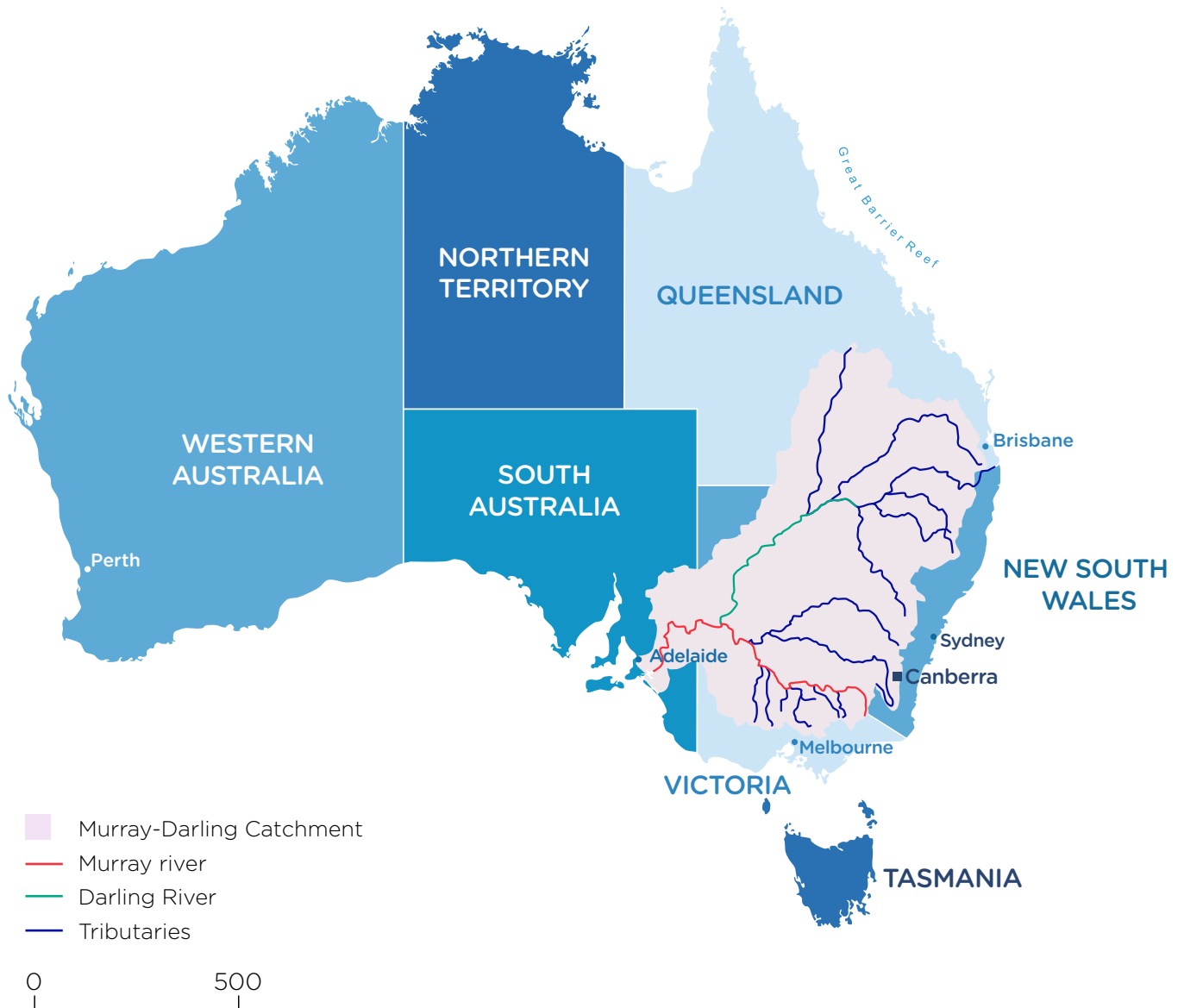
‘Security of rights’ refers to the security of tenure the holder has over the right itself, or in other words, the security of the property right. For example, a secure right cannot be expropriated or easily changed.

‘Reliability of rights’ refers to the frequency with which the holder can access the full volume of water defined in their right. For example, a highly reliable right will almost always yield the maximum amount of water that the holder is entitled to, whereas the yield of a low reliability right may be regularly constrained because the water is not physically available to abstract.

In Victoria, the terms reliability and security are used consistently with the definitions set out above. However, in NSW, security is used to describe what is described here as reliability.

In addition, it is important to note that there are key differences in terminology between Australia and the UK which can be confusing (see table below). This report uses UK terminology throughout.

UK	Australia
Abstract	Extract / Take / Divert
Public water supply	Urban water
Water industry	Urban water industry
Hands off Flow	Cease to take / Cease to pump
When a reservoir overflows	Spill





Summary of the reform proposals

The aim of abstraction reform is 'to promote resilient economic growth while protecting the environment in a manner which is fair and adaptable to future uncertainty at a reasonable cost.'²¹ The reform proposals aim to provide greater certainty for abstractors, by defining upfront what would happen if there is a decline in the aggregate water available for abstraction.

In their consultation, 'Making the most of every drop', Defra is proposing two alternative reform options: Current System Plus and Water Shares. As in the current system, neither of the reform options will guarantee that water is always available. The key features of the two systems are summarised below:

Current System Plus: this option is similar to the current system, the main differences include:

- Existing Hands Off Flow (HOF) conditions, which tend to be either on or off in existing licences, will be made more graduated. Thus restrictions on abstraction will increase as flows get lower.
- The removal of seasonal restrictions on licences. Instead, abstractors will be able to abstract at any time of the year, as long as flows are above pre-specified thresholds.
- Where licences have a HOF condition in the current system, this will be grandfathered into the reformed system.

Water Shares: under this option abstraction licences would not entitle the holder to a volumetric quantity of water (as in the current system), rather, to a share of the water available for abstraction (above the environmental threshold).

- The EA would regularly (every 2 weeks) assess how much water is available to abstract and allocate that volume to abstractors in line with the shares they hold.

- For any given body of water there will be separate 'reliability groups' of which each abstractor may have a share. A share of high reliability water would be more likely to allow for actual abstraction at times of low flows than a share of low reliability water.

Both systems include measures to encourage permanent and temporary trading, such as pre-approving certain trades, but a greater number of trades would be possible under the Water Shares.

The consultation assumes that current levels of over-abstraction will be resolved through the Environment Agency's Restoring Sustainable Abstraction (RSA) programme before abstraction reform is implemented. The new system will need to ensure Water Framework Directive objectives (in particular 'no deterioration') continue to be met.

Time limits on licences would be removed, making licences perpetual. However, the new system includes a process to make changes to abstraction licences if conditions in the catchment change. The proposed period for review is six years, to align with the River Basin Management Planning cycle. If the total amount of abstraction needed to be reduced, the reduction would be shared amongst all abstractors, who would have a six year period to make changes.

Legislation is planned for 2016, with implementation starting in the early 2020s. The new proposals will be implemented (at first) to different extents in different catchments, depending on need. "Enhanced" catchments will have the full package, whereas only limited reforms will be made in "Basic" catchments.

More recently, Defra has also committed to consider a potential 'hybrid' option, which is a mixture of different aspects of Current System Plus and Water Shares. Under the hybrid option, rights would legally be defined as a share, but the allocation period would be annual. Daily abstractions would continue to be managed using HOFs.



Summary of water industry concerns

It is important to note that the water industry in England and Wales is not united in its response to Defra's abstraction reform proposals, and there is no single consensus view. However, it is certain that many within the industry are worried about abstraction reform, and common areas of concern are summarised below.

Perhaps the most fundamental area of concern is that there is no case for reform, and that the current system is flexible enough to deal effectively with the future pressures of climate change and growth. Water companies are already preparing for these challenges through the Water Resources Management Planning process. Environmentally damaging licences are being dealt with through the Environment Agency's Restoring Sustainable Abstraction programme, which will ensure water company compliance with the Water Framework Directive in the 2020s. Finally, severe and long-term droughts are effectively managed through robust drought management procedures.²²

How best to transition to the reformed system is probably the most controversial area of reform for all abstractors, including water companies. A particular concern for water companies is that the transition to the new system may result in a reduction of their Deployable Output (DO)²³ (a metric used in the water resources management planning process), which in turn could trigger high levels of investment through the Water Resources Management Plan and price review processes. In addition, it is not clear how the proposal to reduce licensed volumes to reflect recent use will align with the EA's RSA programme.

In addition, many believe that the current system gives companies certainty over the amount of water they will be able to abstract from a source, which in turn gives them the confidence to make investment in storage, treatment and distribution infrastructure. There is concern in the water industry that a shares based system would introduce too much uncertainty to enable water companies to fulfil their statutory duty to supply water. Information about how Water Shares would work in practice is limited. In particular, the proposal to introduce a short allocation period (fortnightly) raises questions about how companies would plan for the long term or manage their abstractions on a daily basis.

Under both reform options, and without any reform, investment in storage and transfer assets will be required to manage the increasing imbalance between water availability and demand. The water industry has recognised that there is a greater need for strategic planning of regional storage and transfer assets, and are working to address this need through groups such as Water Resources East Anglia and Water Resources in the South East. However, there is little explicit discussion about the need for investment in infrastructure alongside reform in the consultation document, or how reform could support this investment.

In addition, many felt that insufficient thought had been given to the performance of the two reform options at low flows, and how current drought management proposals would work alongside them during severe droughts.

The potential for trading has also been questioned, particularly in small catchments where the total number of abstractors is likely to be small.

²² Water UK, Water UK response to the abstraction licence reform consultation, Page 1

²³ As part of the Water Resources Management Planning (WRMP) process, water companies need to determine how much water is available to them. They do this through calculating deployable output (DO), which is essentially the volume of water that each water treatment works can put into supply. Multiple factors are considered in the calculation of DO, including the hydrological yield of abstraction sources (assessed against the historic hydrological record), treatment works capacity, licensed volume and any licence constraints, such as HOF conditions.



The Australian context

Water resources

Water resources management in Australia is complicated by extreme levels of climatic variability, which means that, in terms of water abstraction, much of the water is in the wrong place, or arrives at the wrong time. For example, Australia's largest river system and its most important area for irrigated agriculture, the Murray-Darling Basin, has not only the lowest but the most variable and unpredictable rainfall of any of the world's major river systems.²⁴ Drought is a normal and recurring feature of the climate; since reliable records began in 1860, there has been major drought somewhere on the continent in 82 out of 150 years.²⁵ However, although Australia is widely regarded as the world's driest inhabited continent, it is not generally recognised that on average it has more per capita renewable water resources than France, Germany or Japan.²⁶

This extreme variability has implications for the management of water resources; firstly, the management of uncertainty is a central part of water management in Australia, and has driven calls to 'drought proof', or 'climate proof', water supply systems as far as possible. Secondly, storages in Australia need to be much larger than their European counterparts. In total, Australia has almost 84,000 Gigalitres (GL) of storage capacity in large dams, compared with 1,600 GL in England and Wales. For example, Lake Hume and Lake Dartmouth, headwater dams on the River Murray, have a storage capacity of 3,000 GL and 3,800 GL respectively, whereas the capacity of England's two largest reservoirs, Kielda Water and Rutland Water, is 200 GL and 124 GL respectively.

Storage capacity in large dams (2005)²⁷

State	Storage capacity GL
New South Wales	24,629
Tasmania ²⁸	23,652
Western Australia	12,148
Victoria	12,109
Queensland	10,657
Northern Territory	280
South Australia	258
Australian Capital Territory	120
Total	83,853

¹⁴ Quiggin (2008) Uncertainty, risk and water management in Australia, Page 62

²⁵ Heberger (2012), Australia's Millennium Drought: Impacts and Responses, Page 98

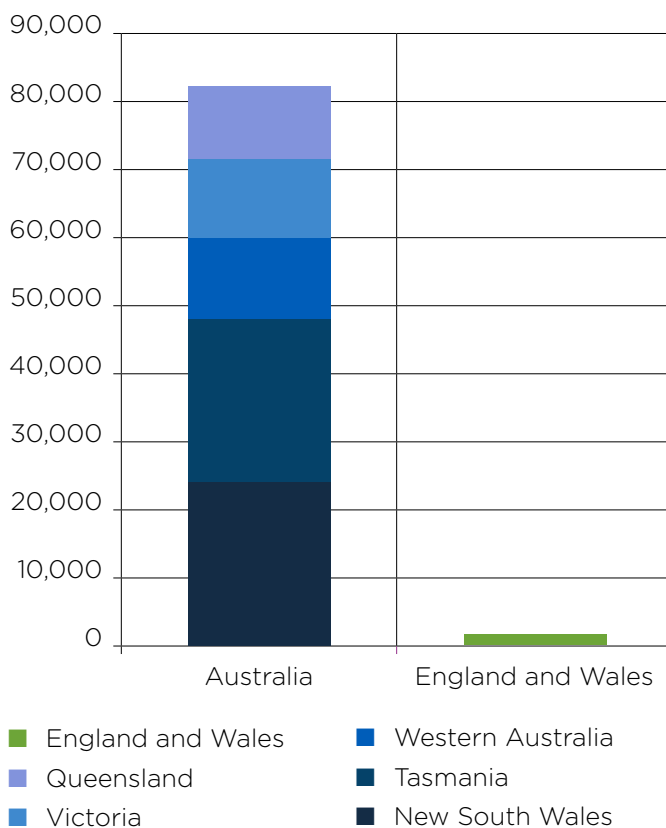
²⁶ Heberger (2012), Australia's Millennium Drought: Impacts and Responses, Page 98

²⁷ Data from NWC (2005) http://www.water.gov.au/WaterAvailability/WhatIsOurTotalWaterResource/WaterStorage/index.aspx?Menu=Level1_3_1_7 accessed on 04/11/2014

²⁸ It is worth noting that Tasmania's large storages are primarily for hydropower and located in the sparsely inhabited west of the island.



Comparison of large reservoir storage capacity (GI)



Typically, storages are built in-stream and located at the top of catchments. This has significant implications for flow regimes, which, in all but exceptional flood events are determined by the water released from the reservoir. Such rivers are described as being 'regulated', as opposed to 'unregulated' rivers where flows are dependent upon weather conditions. Regulated rivers are managed very differently to unregulated rivers. In Victoria, NSW and the ACT, the majority of abstractions occur on regulated rivers, primarily within the Murray-Darling Basin.

The concept of 'regulated' rivers does not exist in England and Wales in the same way that it does in Australia. There are some examples of rivers in England and Wales where the flows are regulated to a degree, for example, reservoirs have been constructed on the River Dee to store winter flows, which are then released in the summer to support public water supply abstractions. However, the majority of rivers would be considered 'unregulated' by Australian standards.

Agriculture is the majority abstractor in Australia. In 2004-05, agriculture accounted for 65% of water consumption (the majority of which was used to irrigate crops and pastures), whereas domestic consumption accounted for only 11%. In contrast, in England and Wales in 2008 almost 50% of the water abstracted was for public water supply, and agriculture accounted for just 1%.

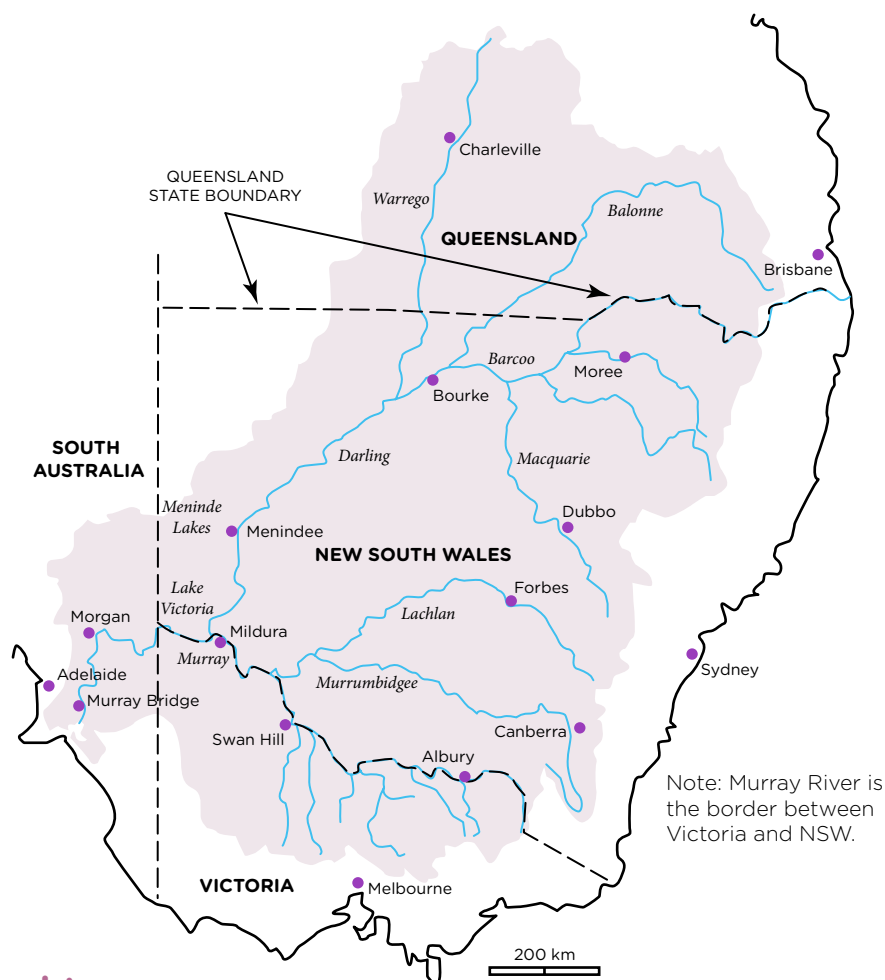
Volume of total licenced abstractions GI (2012-13)²⁹

	ACT	New South Wales	Victoria
Regulated surface water	73	8,000	4,782
Unregulated surface water	0	3,188	907
Groundwater	1	2,109	933
Mixed surface and groundwater	3	0	0
Total	77	13,297	6,622

Tasmania has a very different water resource situation to the mainland states. Many catchments in Tasmania are not fully allocated and the state is actively encouraging the development of irrigation. The majority of catchments are small, unregulated and physically unconnected. There are large storages in the west of Tasmania, but these were developed for hydroelectric generation as opposed to agriculture, and today are run by Hydro Tasmania.

²⁹ NWC (2013), Australian water markets report 2012-13

The Murray-Darling Basin



The Millennium Drought

The Millennium Drought began around 1997 and lasted until 2010, having a profound impact on the environment, economy and national psyche. Its history is an integral part of Australia's water reform story; it both accelerated reforms that were already underway, and drove additional reforms.

Although drought is not unusual in Australia, the Millennium Drought differed in that it was of unprecedented severity, duration and geographical extent. It affected most of the continent for over a decade including Sydney, Adelaide, Melbourne, Brisbane and Perth, as well as all the major agricultural regions.³⁰

South-eastern Australia (including the Murray-Darling Basin) was particularly badly affected. There was a significant decline in modelled (naturalised) annual streamflow compared to the historical average. Streamflow reduction during previous droughts was 23% (World War II Drought) and 27% (Federation Drought), and 44% over the Millennium Drought

period.³¹ For example, until 1997, annual net inflow to Melbourne's four major harvesting reservoirs fluctuated around a long-term average of 615 GL per year. During the Millennium Drought, reduced precipitation caused annual net inflow to drop to approximately 376 GL per year, a 39% decline relative to the long-term average. In addition, unlike previous droughts, there were no comparatively 'wet' years during the Millennium Drought period that enabled storage levels to recover.

Australia was not prepared for a drought of this magnitude. Not only were the observed reductions in streamflow outside the scope of the historical record, they were more severe than the projected changes to mean climate for 2030.³² Both of these factors put the drought outside the scope of water resources management planning.

³⁰ However, it is important to note that the entire country was not in a drought all of the time. During this period, good rains in certain regions allowed water restrictions to be lifted and some agricultural enterprises to prosper.

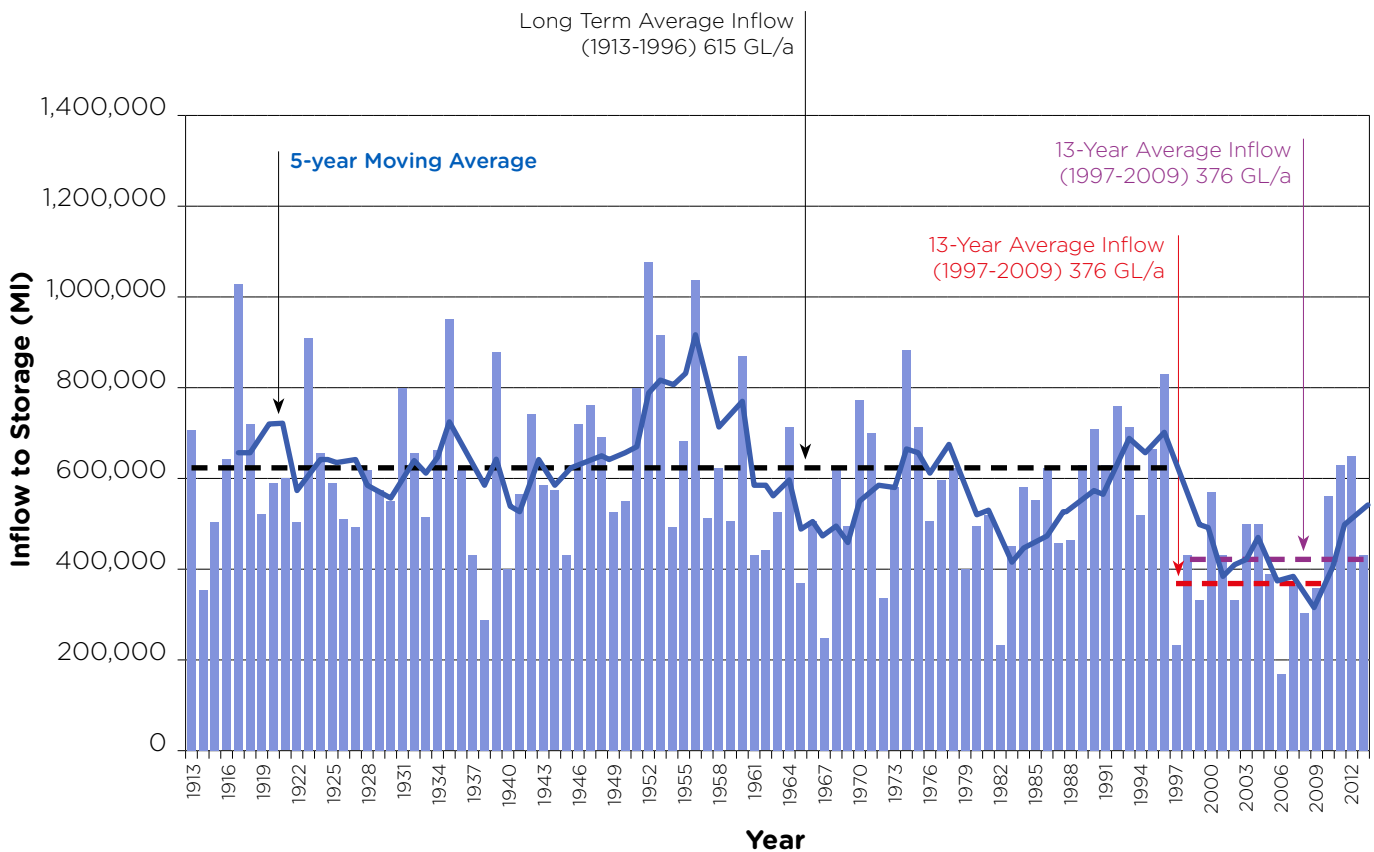
³¹ CSIRO (2010) Climate variability and change in south-eastern Australia. A synthesis of findings from Phase 1 of the South Eastern Australian Climate Initiative (SEACI), Page 1

³² CSIRO (2010) Climate variability and change in south-eastern Australia. A synthesis of findings from Phase 1 of the South Eastern Australian Climate Initiative (SEACI), Page 1



Annual Streamflow at Melbourne's Major Harvesting Reservoirs

(Thomson, Upper Yarra, O'Shannassy and Maroondah Reservoirs)



Data provided courtesy of Melbourne Water



Australia's water reform story

The three phases of Australian water policy

Australian water policy can be broadly divided into three phases. During the first phase, state governments assumed control over water resources. This was followed by the 'development phase' where governments focused on increasing irrigation through the construction of infrastructure. Once it was recognised that the continued development of water resources was unsustainable, water policy transitioned to the third and current phase, which is focused on the sustainable management of water resources.³³

The first phase

During the period of European settlement, water had been managed using the riparian doctrine, which gives landholders constitutional rights to access and use waters adjoining their land. It soon became clear, however, that the riparian doctrine was inadequate in such an arid and variable climate. Starting with Victoria in 1886, all state governments vested control of water in the state and created bureaucracies to manage rural water development, and state responsibility for water resources was later enshrined in the Australian Constitution.

The second phase

The second 'development phase' was characterised by the construction of dams and infrastructure in order to increase the total area of irrigable land. It coincided with Australia's large migration intake after the Second World War, and the 'nation-building' construction of the Snowy Mountains Hydro-electric Scheme. The prevailing culture was one of 'greening the desert' and 'turning water into gold';³⁴ water was comparatively plentiful and there was little or no competitive pressure for resources. Between 1940 and 1990, there was a tenfold increase in the capacity of major dams in Australia. These schemes were built and operated by state governments and publically financed.

In policy circles, the provision of water supply infrastructure was seen as an unequivocal public good. Governments of all persuasions intrinsically linked the expansion of irrigation to nation building, and social objectives such as soldier settlement and the promotion of small scale yeomanry farming ('closer settlement').³⁵

Although early attempts were made to recover government investment in water supply infrastructure, from 1919 onwards it was essentially accepted that irrigation would not be profitable after the costs of the provision of water had been met.³⁶ However, this did nothing to halt the expansion of irrigation, which had considerable political and community support.

Each state established statutory licensing systems, whereby rights to use water were granted in the form of statutory privileges (such as licences and permits to take water), rather than property or proprietary rights in the legal sense. Licences were generally issued based on the area of irrigable land. Although water rights were essentially allocated on a 'first come first served' basis, once granted there was no seniority of attributes as in the Western US. This meant that, as more rights were granted, the reliability of existing licence holders' rights was compromised.

The third phase

A confluence of several pressures brought an end to the development paradigm around the late 1980s, including concern about environmental degradation, pressure on state governments' finances, and an increasing questioning of the economic efficiency of irrigation. Increasing scarcity of, and competition for, water resources increased the need for effective management of that resource.

Between the late 1960s and the early 1980s, governments began to replace area-based water rights with volumetric licences, and to introduce embargoes on the issuing of new licences. These embargoes, however, did not apply to all water sources or attempt to return abstraction to sustainable levels. In water sources where embargoes were introduced, total abstraction continued to increase through the uptake of existing licenced volumes that had historically been under utilised. Between 1983-84 and 1996-97, aggregate water use in Australia increased by 65%.³⁷

The transition to the 'management phase', which is still prevalent today, did not begin seriously until the 1990s.

³³ Musgrave (2008), Historical development of water resources in Australia: Irrigation policy in the Murray-Darling Basin, Page 28

³⁴ Haisman (2005) Impacts of water reform in Australia, Page 117

³⁵ Crase (2008) An introduction to Australian water policy, Page 2

³⁶ Musgrave (2008), Historical development of water resources in Australia: Irrigation policy in the Murray-Darling Basin, Page 36

³⁷ NWC (2011) Water markets in Australia: A short history, Page 36



This phase is characterised by two broad shifts in policy thinking: firstly, from developmentalism to sustainability, and secondly, from state control of resources to individual control.³⁸ Commonwealth involvement in the management of water resources has increased through the development of a national reform agenda, in which it has had a substantial policy and financial role. Major intergovernmental initiatives during this period included the Council of Australian Government's (COAG) Water Reform Framework in 1994 and the National Water Initiative (NWI) in 2004. Also important was an agreement between Queensland, NSW, Victoria and South Australia to cap total abstractions in the Murray-Darling Basin in 1995.

Water for the environment

One of the key themes in Australian water management and policy over the last 25 years is the increasing prominence of the environment, and attempts by governments to deal with a legacy of over-abstraction.

There was a marked increase in awareness of environmental sustainability issues in the late 1980s and early 1990s. Intense use of water, coupled with European agricultural practices, resulted in a range of environmental issues including rising salinity, a decline in native fish species, loss of vegetation, degradation of soils and algal blooms. As a result, the broader community started to become concerned about the declining health of aquatic ecosystems, which in turn increased the importance of the environment in policy making.

In 1991 an algal bloom that covered over 1,000km of the Darling River prompted the Murray-Darling Basin Ministerial Council to audit the volume of water being abstracted from the Basin. The Council was concerned to find that total abstractions in the Basin were continuing to grow, and that without intervention, total abstraction would soon reach 90% of the natural (pre-irrigation) flow at the mouth of the Murray. Consequently, the Council imposed an immediate moratorium on growth in 1995 in the form of an 'interim cap' on abstraction. In 1997, Victoria, NSW and South Australia agreed to cap total abstractions in the Basin at 1993-4 levels of development. Importantly, the cap did not attempt to restore abstraction to a sustainable level, only to stop it from increasing.

In addition, the 1994 Council of Australian Governments (COAG) agreement required that allocations for the environment be created, and the environment be established as a legitimate user of water. Despite this commitment, problems with over-allocation persisted, particularly in the Murray-Darling Basin. The failure to resolve over-abstraction prior to the introduction of trading mechanisms resulted in previously unused licences becoming activated, which increased aggregate water use and worsened environmental stress.³⁹

The Millennium Drought led to a renewed focus on, and commitment to, environmental sustainability. As a result, one of the key objectives of the 2004 National Water Initiative (NWI) is to return catchments to sustainable levels of abstraction in order to ensure the restoration of ecological processes and the preservation of biodiversity in water-dependent ecosystems. All governments have made a commitment under the NWI to prepare water plans with provisions for the environment and to deal with over-allocated or stressed water systems.

Despite this commitment, state governments struggled to deal effectively with over-abstraction.

While the drought provided significant political impetus to move to sustainable levels of abstraction, it also brought the competing interests of environmental, urban and agricultural uses into sharper focus. Importantly, reductions in water for the environment during the drought were proportionally greater than reductions in consumptive use.⁴⁰

Within the context of the drought, state governments did not feel it would be politically, socially or economically acceptable to claw back water to provide for sustainable environmental flows without some form of adjustment assistance. Consequently, governments have used the market to buy back water for the environment, or they have invested in infrastructure upgrades designed to produce water savings, which can then be returned to the environment.

³⁸ Crase (2008)

³⁹ See for example NWC (2011) Water markets in Australia: A short history, Page 43; Quiggin (2008) Uncertainty, Risk and Water Management in Australia, Page 70; Crase & Dollery (2008) The institutional setting, Page 79

⁴⁰ NWC (2011) Water markets in Australia: A short history, Page 72



Frustrated by the slow progress made by state governments to return abstraction to sustainable levels in the Murray-Darling Basin, the Commonwealth government has taken a more direct role in its management through the Water Act 2007. The Act provided for the establishment of the Murray-Darling Basin Authority (MDBA), which is responsible for developing the Basin Plan for the integrated management of water resources in the Basin. The Commonwealth government also committed over \$10 billion of new funding to address over-allocation in rural Australia through investing in irrigation infrastructure and buying back water for the environment.

The MDBA published the Basin Plan in 2012, which sets 'sustainable diversion limits' (SDLs) on abstractions in the Murray-Darling Basin. In order to achieve the SDLs, abstractions in the Basin need to be reduced by 2,750 Gl per annum. Substantial progress has already been made towards achieving SDLs, as of September 2012, the government had recovered approximately 1,577 Gl of surface water through buy-backs and infrastructure upgrades, representing more than half of what is needed.⁴¹ In addition, the Commonwealth government has committed to recovering the water that remains without cutting or compulsorily acquiring rights.

The Australian water industry

During the 19th century, water and wastewater services were provided by local government in regional areas, and by large integrated public utility suppliers in the major cities. Public water supply relied predominantly on surface water captured through dams, and risks to supply were typically managed through the development of significant reserve capacity. As in the irrigation sector, policy development was dominated by engineering principles and supply augmentation, rather than demand management.

The period of the 1960s and 70s was characterised by rapid urban growth, which put significant pressure on water and wastewater networks. By the 1980s there was widespread concern about the performance of the water industry. Particular problems included:

- water and wastewater infrastructure was aging and reaching its capacity;
- prices were based mainly on the rateable value of properties and were heavily subsidised;
- prices were either determined by water authorities themselves, or they were determined politically. In some instances prices were set too low to allow for asset maintenance; and,
- investment decisions were made without independent scrutiny, and were often highly politicised.

The 1994 COAG Water Reform Framework required the separation of water utilities from regulation and resource management and the introduction of cost reflective pricing. However, unlike other government owned utilities and commercial activities, such as energy, communication and transport, the water industry was not privatised.

Progress in implementing the 1994 COAG agreement has been mixed. Most progress has been made in Victoria, where the sector was consolidated from around 130 local government water utilities to just 18 water corporations, owned by the state government, but governed by Ministerially appointed, skills-based boards.⁴²



State-owned water corporations were also established in the ACT and metropolitan NSW, and a local-authority-owned water corporation has recently been established in Tasmania.

In tandem with the formation of water corporations, independent regulatory bodies were established. Drinking water quality, environmental protection, water resources licensing and the economics of service provision are regulated separately by a mixture of government departments and independent authorities. However, in many ways regulation is not fully independent. For example, in Victoria and the ACT, ministerial approval is required for price determinations.

This can result in a conflict of interest as state governments are also the owners of water corporations.

Structural reform in regional NSW was not forthcoming. In particular, water and wastewater services stayed with local government, and the number of utilities has remained unchanged. The NSW government argues that local-authority provision of services is appropriate in regional communities that are typically small and dispersed. However, in 2009, Byrnes et al concluded that equivalent sized water corporations in Victoria were more efficient than those in NSW,⁴³ and in 2011 the National Water Commission (NWC) concluded that: “The absence of institutional reform in non-metropolitan New South Wales [...] is clearly limiting service level performance and transparency in these areas, and creating public health and environmental risks.”⁴⁴

The division of roles and responsibilities associated with public water supply between organisations differs between states and within states.

The provision of water and wastewater services

State	State-owned corporation	Local authority owned corporation	Local authority
ACT	X		
NSW	X		X
Tasmania		X	
Victoria	X		

⁴³ Byrnes et. al. (2009) The relative economic efficiency of urban water utilities in regional New South Wales and Victoria, Page 454

⁴⁴ NWC (2011) Urban water in Australia: Future directions, Page 27



Public water supply roles and responsibilities

Responsibility	ACT	Hobart	Melbourne	Sydney
Catchment management	ACT Territory and Municipal Services & Murrumbidgee Catchment Management Authority	TasWater	Melbourne Water, Port Phillip and Western Port Catchment Management Authority	Sydney Catchment Authority
Resource management (includes licencing)	Environment and planning directorate	Department of Primary Industries, Parks, Water and the Environment (DPIPWE)	Melbourne Water, Southern Rural Water	Sydney Catchment Authority
Water treatment	ACTEW Water	TasWater	Melbourne Water	Sydney Water
Treated water distribution through mains pipes	ACTEW Water	TasWater	Melbourne Water	Sydney Water
Retail and reticulation*	ACTEW Water	TasWater	City West Water South East Water Yarra Valley Water	Sydney Water
Wastewater treatment	ACTEW Water	TasWater	Melbourne Water City West Water South East Water Yarra Valley Water	Sydney Water
Supply demand planning	ACTEW Water and ACT Government	TasWater	Department of Environment and Primary Industries (DEPI) Melbourne Water City West Water South East Water Yarra Valley Water	Metropolitan Water Directorate

* Reticulation is the distribution of water through small pipe networks. It does not include distribution via mains pipes.



Water rights reform

Australia is a Commonwealth, where the power to manage natural resources, including water, is vested in state governments. As a result, each state has developed its own systems of water governance and regulation. Reforms have been developed at both state level and national level, and have influenced each other in complex ways. For example, despite the huge variation in water resources across Australia, reform at a national level has been dominated by events in the Murray-Darling Basin, which is itself an amalgam of policy in New South Wales, South Australia and Victoria.⁴⁵

Key national reforms, such as the 1994 Council of Australia Governments (COAG) Water Reform Framework and the 2004 National Water Initiative (NWI), provide a high level framework for reform. However, the detailed thinking about how each element of reform will work, and how it should be implemented, has been done at state level. By exploring how the decisions taken by different states, within a national reform framework, have led to different outcomes, there is an opportunity for learning.

National level reform

The development of markets and unbundling rights

The need for a mechanism to reallocate water between users was highlighted following the issuing of embargoes on new abstraction rights in the 1970s and 80s. The only way existing or new users could gain access to more water was by getting it from someone else who already held a licence. However, because water licences were tied to land, there were no readily available mechanisms to transfer water or licences from one user to another.

The development of markets has been an ongoing process since the late 1980s, when NSW, South Australia and Victoria began to permit some limited forms of trading (such as short term trading, or trade within irrigation districts). The Murray-Darling Basin cap was a major driver of moves to facilitate the reallocation of available water via trading. In 1995, NSW, South Australia and Victoria agreed to impose an interim cap on total abstractions from the Basin at 1993–94 levels of development, which was formalised in 1997.

It was the 1994 COAG agreement that represented a turning point away from an administrative system of water allocation towards a market-based approach. The COAG agreement required the development of clearly defined water property rights that were separate from land title, and the introduction of a market-based system of water allocation by 2005.

Different states have unbundled different elements of water rights, and there are differences in terminology. The main components, however, are common to all states:

- i. a tradeable water access entitlement (this is the part of a licence that would later be converted into a water share);
- ii. a water-use right, which is non-tradeable and site-specific, and defines the terms and conditions under which water can be used;
- iii. a works approval, which authorises the holder to construct and use a specified water supply work (e.g. to install and operate a pump, dam or bore) at a specified location.

Additional degrees of unbundling are also possible. For example, in Victoria they include a share of channel capacity in regulated surface water systems (a delivery share).

⁴⁵ Crase (2008) An introduction to Australian water policy, Page 7



Water shares

Water entitlement reform is a fundamental part of the 2004 National Water Initiative, which, in addition to the separation of land and water rights, states that water rights should be defined as a share of the available resource. 'The consumptive use of water will require a water access entitlement, separate from land, to be described as a perpetual or open-ended share of the consumptive pool of a specified water resource...'⁴⁶

The process of introducing water shares effectively converts the previous maximum volumetric quantity of water that could be abstracted, into a perpetual share of the available water in a specified water source.

To date, there has been significant progress by states to unbundle water rights and implement water shares in regulated rivers. However, there has been less progress in groundwater and unregulated rivers.

Water entitlement reform		ACT ⁴⁷	NSW	Tasmania	Victoria
Regulated surface water	Unbundling	✗	✓	✓	✓
	Shares	✗	✓	✗	✓
Unregulated surface water	Unbundling	✗	✓	✓	✓ ⁴⁸
	Shares	✗	✓	✗	✗
Groundwater	Unbundling	✗	✓	N/A ⁴⁹	✓
	Shares	✗	✓		✓

⁴⁶ NWI paragraph 28

⁴⁷ Implementation of unbundled water access entitlements is limited and the rate of future unbundling is tied to requests by licence holders for their water assets to be separated from their land, or occurs if the land is sold or transferred.

⁴⁸ In Victoria unregulated surface and groundwater licences have effectively been split into the right to take water, the right to build assets to take water and the right to use water on land. They are tradable. In addition, seasonal allocations are made to groundwater licences, which in effect provide a share of the consumptive pool.

⁴⁹ As yet, licensing of the abstraction of groundwater in Tasmania has only been undertaken in the Sassafras Wesley Vale area. Regulatory controls are in place to ensure that new well works are not undertaken without a permit. Well works permits are not granted where works would adversely affect other persons taking water from the water resource or a hydrologically linked water resource.



How do water shares work?

Although there are differences in the mechanics of water shares between states, the general principles of how they operate are the same. For a detailed explanation of how water shares work in different states please refer to Annex 1: The mechanics of water shares.

The 'water access entitlement' (created when water rights were unbundled from land rights) is the part of a licence that is converted into shares by separating it into two parts:

- the 'permanent entitlement', which is the total number of shares held by an abstractor; and,
- the volume of water that an entitlement yields over a particular period is referred to as the 'temporary allocation'.

Both the permanent entitlement and the temporary allocation are tradable.

In all catchments where water shares have been introduced, the allocation period is annual, and runs from July to June (described as the 'water year', also the Australian financial year).

In regulated systems, depending on reservoir levels, entitlement holders generally start the year with a low allocation. As the reservoir refills over the winter months, entitlement holders' allocations will increase until they reach 100%.

In unregulated systems, entitlement holders start the year with a 100% allocation, but they will not be able to take the water if low flows trigger HOF conditions. Entitlement holders would only receive less than a 100% allocation if total average abstractions exceed the 'Long Term Average Annual Extraction Limit' over a rolling three year period.

In regulated systems, there are different reliability classes. Both New South Wales and Victoria have created Higher Reliability (HR) and Lower Reliability (LR) shares. NSW has also created various other reliability groups, including 'Highest priority' shares created for specific uses of water, such as public water supply, stock and domestic and aboriginal rights.

Water will be allocated to meet HR and other upfront commitments (such as leakage and evaporation losses) first. Once HR shares reach a 100% allocation, water will then be banked for next years' upfront commitments and HR. If there is any water left over, it can then be allocated to LR.

If an abstractor does not use all their allocation during the year, they can carryover unused allocation from one year to the next. In regulated systems, carryover helps abstractors to manage the risk of a low opening allocation at the start of the water year. In unregulated systems, if an abstractor is unable to take their full allocation because HOF conditions have been triggered, carryover allows them to abstract this 'lost' water in the next period (assuming HOF conditions are not triggered). The specific rules about how much water abstractors are allowed to carryover, and how much water can be held at any one time, varies between different catchments and states, and tend to be more generous in Victoria than in New South Wales.

The security of rights

As a result of the drive to develop water markets, reforms have actively sought to increase the security of property rights to water, and to ensure that rights are well defined.⁵⁰

The NWI placed a particular emphasis on strengthening water rights as a means of improving water management. For example, it states that water access entitlements should be issued in perpetuity, as opposed to being time limited, and 'only be able to be cancelled at Ministerial and agency discretion where the responsibilities and obligations of the entitlement holder have clearly been breached...'⁵¹

There is a tension between ensuring that property rights to water are secure, whilst ensuring that there is the flexibility required for adaptive management as conditions change and scientific knowledge improves over time. The NWI seeks to deal with this tension by defining the circumstances when a right can be varied as a result of changes in the aggregate availability of water.

- This risk of any reduction arising from long term changes in climate, or seasonal events such as drought, is borne by water users.
- Any reduction due to improvements in the knowledge of sustainable abstraction limits is borne by water users up to 2014. After 2014 this risk is borne by Governments (except for the first 3% reduction).
- Any reduction arising as a result of a change in government policy such as new environmental objectives is to be borne by Governments.

⁵⁰ Crase & Dollery (2008) The institutional setting, Page 79

⁵¹ NWI paragraph 32



In practice, states have sought to resolve the tension between security and the need for flexibility by creating something less than property rights in the legal sense, whilst giving sufficient security to underpin a functioning market.⁵²

Water entitlement reform in Victoria

Water rights reform in Victoria started with the Water Act 1989, which created a three tier framework for water rights:

- Tier 1: the right to the “use, control and flow” of all surface water and groundwater is vested in the crown.
- Tier 2: includes environmental entitlements and Bulk Entitlements (defined below).
- Tier 3: Individual rights. Bulk Entitlements are the aggregate of the individual rights that sit underneath them (excluding limited riparian rights which are not included in Bulk Entitlements).

A Bulk Entitlement is a right to use and supply water, and can only be granted to water authorities (such as public water suppliers and irrigation districts). Bulk Entitlements clearly define the right to take or store water at defined locations subject to a range of conditions. The conditions cap total abstraction, thus protecting the environment and existing rights to water; establish rules about how water will be shared in a drought; and provide a basis for trading. They define the ‘consumptive pool’ used to operate the water supply system and supply individual rights.

Implementing reform

During the 1990s Victoria went through a 10 year process of defining and standardising water rights through the implementation of Bulk Entitlements in regulated and unregulated surface water systems. Prior to this process, existing rights were poorly defined, in terms of the volume of water associated with each right and its reliability.

When considering water in storage, defining the level of reliability in turn defined the water available for use. In the large regulated irrigation systems, water allocation rules were also defined to determine the volume of water to be allocated to individual rights depending upon climatically varying storage levels and inflows.

The definition and standardisation of rights, including what restrictions would apply to whom in the event of a severe drought, was a negotiated process conducted at a catchment level. Committees were established for each regulated system, with representatives of all stakeholder groups, including water users, irrigation industry groups, water corporations, environmental groups, and government authorities. Committees typically sat once a month for up to three years, and meetings were chaired by the Department of Natural Resources and Environment (NRE)⁵³.

The process of defining rights in Victoria was long (lasting almost a decade) and laborious; however, it resulted in a legitimate, and consequently lasting, agreement. This is a significant achievement, given that water allocation in Australia is highly politicised, and there are several examples where an incoming government has reversed a previously unpopular policy decision.⁵⁴

In order to establish trust with catchment-based committees, NRE took care not to push a particular agenda, but rather to act as an ‘honest broker’, providing the information required by committees to reach an agreement. Inevitably, abstractors were concerned about their rights being diminished, and NRE took care to allay those concerns by ‘erring on the side of generosity’ during negotiations, and not revoking or diminishing rights unless they could demonstrate ‘to a reasonable person’ there was a good reason for doing so.

In addition, NRE took care to define the need for reform in terms of improving the reliability of existing rights, rather than the need to protect the environment. Concern over environmental health was an important driver of reform; however, the definition of BEs was intended to cap total abstractions rather than reallocate water to the environment. In addition, officials at NRE were concerned that the irrigation community would not support the reform if they felt it was being driven by environmental requirements.

⁵² McKenzie (2009) Water Rights in NSW: Properly Property?, Page 463

⁵³ Now the Department of the Environment and Primary Industries (DEPI)

⁵⁴ For example, see the experience of the North-South Pipeline in Victoria, described on Page 35



Defining rights: volume

Public water supply:

Prior to reform, water corporations held licences to abstract water that did not specify the volume of water that could be abstracted.

Initially, public water supply Bulk Entitlements were based on the 'design intent', or maximum capacity, of their water treatment works. Bulk Entitlements were not based on recent use because the assets were in place and had been funded by the customer base. For example, Goulburn Valley Water (GVW) secured a Bulk Entitlement on the Goulburn regulated system (where the first Bulk Entitlements were negotiated) for 33 Gl per annum, where normal demand for treated water supplies is typically around 21 Gl per annum.

Following the imposition of the interim Murray-Darling Basin cap on total abstraction in 1995, the approach to defining public water supply Bulk Entitlements was changed to reflect recent use.

For example, on the Murray regulated system, the total design intent of water treatment works was 49 Gl per annum, but maximum public water supply usage was 43 Gl per annum, and recent usage was only 35 Gl per annum (demand in recent years had fallen due to changes to pricing structures). The committee was concerned that basing public water supply Bulk Entitlements on design intent would reduce the water available to irrigation, and consequently water corporations' Bulk Entitlements were defined to reflect maximum usage, totalling 43 Gl per annum.⁵⁵

This meant that water corporations on the Murray had less spare water than those on the Goulburn. While they had sufficient water to meet peak demand, and some spare capacity to meet growth, the committee recognised that, if demand for treated water supplies increased as a result of population growth, water corporations would need to buy additional water on the market.

Irrigation:

Between the late 1960s and the early 1980s the Victorian governments began to replace area-based water rights with volumetric licences.

In years where the available water surpassed the volume that was required to fulfil basic entitlements, irrigators were able to buy extra water known as 'sales' water. In addition, irrigators could access additional water to their basic entitlement when the dam was overflowing, known as 'off-quota water'. Although irrigators held licences defined in volumetric terms (their 'basic entitlement'), almost 25% of the water used by irrigation was additional sales and off-quota water. Many farms depended on this additional water; however, the volumes to which each irrigator was entitled were not reliably specified.

Through the process of defining Bulk Entitlements, it was decided that irrigators would be granted sales water equalling 30% of the volume of their volumetric licence. For example, irrigators who held 100 ML water right received an additional 30ML of sales water. Off-quota water was phased out.

The environment:

At the beginning of the process, environmental requirements were not specified at all. Typically, environmental requirements were defined as the water that was left over once other rights had been satisfied.

There were, however, some examples of where the environment was able to benefit from the definition of Bulk Entitlements. On the Murray River there are several large wetland forests that depend upon periodic flooding, one of which is the Barmah forest. The committee allocated 100 Gl of high reliability water and 50 Gl of low reliability water to the Barmah forest; however, between 200 and 800 Gl are required to achieve a successful flooding event. The Murray Water Entitlement Committee agreed that the environment should be able to use storage capacity so that it could save up its water, as long as there was no effect on other users. Two conditions were put in place that are still valid today:

- if the reservoir overflows, the environmental water is the first to be lost; and,
- environmental water is lent to high reliability water rights in dry years when their rights are restricted. This water is returned to the environment once restrictions on rights are lifted.

⁵⁵ Murray Water Entitlement Committee (1997), *Sharing the Murray: Proposal for defining people's entitlements to Victoria's water from the Murray*, Page 35



Defining rights: reliability

The years prior to the 1990s had been comparably wet, and although the state had experienced short periods of drought (e.g. 1982-83) there had not been a prolonged intense drought since the World War II Drought (1937-47). The government realised that there would be insufficient water to meet basic entitlements during this kind of severe drought, and it was not clear what protection or cutback would be applied to basic entitlements if they could not be met in full.⁵⁶

Traditionally, perennial plantings, such as fruit trees and vines, were treated as having a higher level of reliability than other types of agriculture.⁵⁷ In addition, domestic and stock rights are also considered a higher right and largely protected from restrictions and reductions applied to other rights.

The WA 1989, however, does not prioritise one use of water over others. Instead, it assigns different levels of priority to different classes of rights. Any restriction applied to a class of rights must be applied to all rights within that class equally, 'unless the Minister is of the opinion that the circumstances are so extreme as to justify some other basis.'⁵⁸

To help committees understand the reliability of supplies, NRE undertook comprehensive water resources modelling, based on 100 years' climatic data. This showed the frequency and severity of restrictions that would be applied to rights in dry years. While abstractors understood that it was necessary to restrict rights during a drought, they wanted to know that they would be treated equitably, and that they would have enough water to get through the drought. NRE's modelling allowed committees to understand the impact of their decisions on the reliability of rights at a catchment level. For example, it demonstrated how increasing reliability for one group of users undermined reliability for others. This allowed committees to define the reliability of Bulk Entitlements in such a way that, while all groups would be affected during a drought, each group felt it had been treated fairly.

The question arose as to whether some rights should have extra high reliability. For example, the Murray Water Entitlement Committee discussed whether an 'extra high reliability' right should be created for the irrigation district Sunraysia, where planting was dominated by permanent plantings that required uninterrupted supplies, such as vineyards. During a severe drought, such an 'extra high reliability' right might only be restricted by 20%. DNR's water resources modelling demonstrated that providing this special protection for Sunraysia would reduce the reliability of other abstractors' rights beyond a level that was felt to be acceptable to the rest of the Committee.

As a result of these discussions, the Committee concluded that there should be a single high reliability right that would be restricted by 40% during the worst year on record. 'Horticulturalists [Sunraysia] will need to manage the slight risk of a 60% water right year, just as they have had to deal with other common risks, like frost, hail and rain during harvest.'⁵⁹ The committee felt that a single high reliability right was fairer and simpler, and would consequently facilitate trading. Consequently, abstractors' basic entitlements were defined as 'high reliability' rights, previous sales water was defined as 'low reliability' rights.

Unbundling and the introduction of water shares

In regulated systems, water rights were unbundled and water shares introduced in 2007 (Northern Victoria) and 2008 (Southern Victoria). Rights were effectively grandfathered into water shares, so high reliability rights became high reliability water shares, and lower reliability rights (sales water) became low reliability shares.

Although rights were not legally defined as shares until 2007-08, it is important to note that abstractors on regulated systems were accustomed to receiving seasonal allocations, and so in practice the introduction of water shares did not represent a significant change in the daily management of abstractions.

⁵⁶ Murray Water Entitlement Committee (1997), *Sharing the Murray: Proposal for defining people's entitlements to Victoria's water from the Murray*, Page 12

⁵⁷ Murray Water Entitlement Committee (1997), *Sharing the Murray: Proposal for defining people's entitlements to Victoria's water from the Murray*, Page 26

⁵⁸ Water Act 1989, Paragraph 33AAC

⁵⁹ Murray Water Entitlement Committee (1997), *Sharing the Murray: Proposal for defining people's entitlements to Victoria's water from the Murray*, Page 27



Although Victoria has not unbundled rights, or introduced water shares, into either unregulated or groundwater systems, in practice some aspects of these reforms have been introduced. Unregulated surface and groundwater licences are tradable, and have effectively been split into the right to take water, the right to build assets to take water and the rights to use water on land. Although water shares have not been introduced into groundwater, seasonal allocations are made to groundwater licences, which in effect provide a share of the consumptive pool.

There is anecdotal evidence that some farmers would like water shares to be extended to unregulated surface water, in order that they can take advantage of financing opportunities (water shares are granted in perpetuity and consequently are mortgageable, whereas currently unregulated surface water licences are time-limited). The Department of the Environment and Primary Industries (formerly the NRE), however, does not currently plan to unbundle rights or introduce water shares into these systems. In part, this is because it is not confident that the environmental requirements are sufficiently understood to allow the introduction of perpetual shares, and in part because of scepticism as to whether the benefits of reform would justify the additional administrative costs. These systems continue to be managed in a similar way to those in England and Wales, with time limited licences, maximum daily and annual abstraction limits, and Hands Off Flow restrictions.

Making changes to water rights

Under the 1989 Water Act, the Water Minister can make a 'Qualification of Right' to affect permanent or temporary changes to water rights.

In 2005, the Victorian government amended the Water Act 1989 to include a state-wide long-term water resource assessment every 15 years, with the first due in 2019. The Minister can make a permanent Qualification if the assessment indicates a decline in the long-term availability of water that has had a disproportionate effect:

- on the environmental water reserve; or,
- on water allocated for consumptive purposes; or,
- that there has been a deterioration in waterway health for reasons related to flow.

This review process is the only opportunity available to the Water Minister to permanently amend rights in order to correct an imbalance between environmental and consumptive needs.

The WA 1989 is currently being reformed, and the new Water Act proposes to change the requirement from an automatic state-wide review, to a more targeted process. While the government describes the change as being more targeted and efficient, environmental groups are concerned that it represents a dilution of environmental protection. However, in practice, the Victorian government has never managed to permanently change rights in any substantial manner, and there are doubts as to whether it would be possible for any Water Minister to implement a permanent Qualification. In the event of a long-term decline in the availability of water resources, it is likely that other measures, such as reducing the maximum allocation a share could yield, would be more politically palatable.

A temporary Qualification of Rights can be used in extreme circumstances, such as a very bad drought or following a bushfire, to ensure critical human water needs are met. A Qualification must apply to all rights in any class in the same proportion, unless the Minister deems there are extreme circumstances that warrant differential Qualifications.

Temporary Qualifications were issued during the Millennium Drought to maintain water for essential human needs. Unlike other regulated systems, the Goulburn has a 30,000 ML reserve, established to provide additional water to abstractors in the event of a water quality incident. In 2007, a Qualification was issued that allowed Coliban Water and Central Highlands Water to access 10,000 ML from the Goulburn reserve to meet critical water shortages in Bendigo and Ballarat. The water corporations paid commercial rates for access to the additional water, with pricing arrangements agreed to by the Minister.⁶⁰

In 2008, Goulburn-Murray Water (the resource manager) issued a zero allocation to High Reliability Water Shares at the beginning of the water year. While carryover was still available, the Minister issued a Qualification that allowed abstractors to access additional water for prescribed purposes, including use inside the home, stock watering and dairy washdown while allocation was insufficient to meet these needs. The Qualification remained in place until HRWS reached a 20% allocation.⁶¹ This allowed water corporations to access water while irrigators could not (unless they had carryover from the previous year).

⁶⁰ G-MW (2009), Annual report 2008-09, Page 26

⁶¹ G-MW (2009), Annual report 2008-09, Page 23



Water entitlement reform in New South Wales

The Water Act (WA) of 1912 vested the right to the “use, control and flow” of all surface water and groundwater in the crown, and required all abstractions, apart from limited riparian rights, to have a licence.

By the 1990s it was clear that the WA 1912 was in need of a complete overhaul, and the Water Management Act (WMA) passed by the NSW Parliament in 2000 represented a significant reform. It was designed to better protect the environment, whilst increasing the security of property rights and facilitating trade.

Implementing reform

The WMA 2000 requires that statutory Water Sharing Plans are developed for each water management area (including regulated and unregulated surface water and groundwater), which set out the conditions for the sharing of water between water users and the environment, and rules for trading. Water Sharing Plans last for at least 10 years, but can be suspended by the minister in the event of severe water shortages (such as conditions experienced during the Millennium Drought).

The unbundling of rights and the introduction of water shares occurs when a Water Sharing Plan for a catchment comes into force (at this point the catchment will be governed under the Water Management Act 2000). Currently, Water Sharing Plans cover over 90% of the total water abstracted in NSW; the remaining 10% of abstraction that is not covered is either groundwater or unregulated surface water.⁶² The NSW Office of Water prepared Plans for regulated surface water first, because this is where the majority of abstraction occurs, but Plans for the remaining abstractions are currently being developed, and the NSW Office of Water expects them to be in place by June 2015.

NSW used a catchment-based committee approach similar to that in Victoria to prepare Water Sharing Plans. The development of Water Sharing Plans is challenging, because it requires complex water sharing issues to be worked through by communities with disparate views and sometimes conflicting objectives.

The task was made more difficult because NSW started preparing Water Sharing Plans simultaneously for 31 water sources, which placed a considerable strain on government resources. In addition, the details of reform had yet to be thoroughly worked through, and consequently the new framework continued to evolve, which undermined community confidence in the reform process.⁶³

It will have taken over ten years to develop and implement Water Sharing Plans for the entire state, and even then, key elements of reform in unregulated catchments have yet to be implemented, because the majority of abstractions are unmetered. The NSW Office of Water reports being criticised by licence holders for the length of time taken to implement reform. The unbundling of licences and specification of shares provide licence holders with a mortgageable and tradeable asset, which in some cases is more valuable than their land. These are outcomes that are strongly supported by licence holders.⁶⁴

Defining the volume

Initially, rights were defined in terms of the area of land that could be irrigated, and it was not until the 1980s that volumetric licences were introduced. At the same time, rivers were progressively closed to new licence applications.

During the preparation of Water Sharing Plans, there was considerable debate around the question of whether or not those people who held a licence but never used any of it, or had only used a portion of it, should be allowed to transition their full licenced volume into the water shares system. In surface water systems, the NSW government felt it would be fairer to honour these licences as they had market value and were already being traded,⁶⁵ and because of concerns about potential litigation. Consequently, the government chose to grandfather licences from the WA 1912 to the WA 2000, rather than basing the new entitlements on recent use. This approach was revised during the development of groundwater sharing plans, which placed a greater emphasis on historic use.

⁶² NSW Office of Water (2013), <http://www.water.nsw.gov.au/Water-management/Water-sharing-plans/Water-sharing> accessed on 1st October 2014

⁶³ Young & Esau (2013) Detailed case study of the costs and benefits of abstraction reform in a catchment in Australia with relevant conditions to England and Wales, Pages 11-12

⁶⁴ Harris M (2014) personal communication

⁶⁵ Gardner & Bowmer (2007) Environmental water allocations and their governance, Page 49 in Hussey & Dovers eds (2007) Managing Water for Australia: The Social and Institutional Challenges



Defining reliability

The WA 1912 also established a hierarchy of uses in regulated river systems during times of shortage. Water allocations for town water supply and domestic and stock purposes were granted the highest priority, followed by so called 'high security' purposes, intended for industries that need secure access to water, such as horticulture, mining and aquaculture. Under the WA 1912, a single licence could specify multiple purposes, each having a different level of priority.

The priority of water use under conditions of water shortage was revised by the WMA 2000 to recognise the rights of the environment. It created various priority classes:

- highest priority, which includes domestic water supply and basic landholder (riparian) rights;
- environmental needs;
- commercial water use (supplied by public water supply) and high security licences; and,
- general security licences (used for irrigation, normally held by annual cropping).

The priority of domestic water supply is expressed by the water shares system in various ways. The share component of 'Specific purpose licences' (local water utility and stock and domestic licences), continues to be expressed in megalitres, as opposed to a number of unit shares. These licences receive a 100% allocation in all but exceptional drought conditions.

It is important to note that the level of reliability enjoyed by a particular right in NSW is much more closely linked to use than in Victoria.

Water entitlement reform in Tasmania

The Water Management Act (WMA) 1999 and Irrigation Clauses Act 1973 provide the statutory basis for water management in the state.

Defining reliability

Given that the majority of Tasmanian catchments are unregulated, water licences are prioritised using a hierarchy of 'sureties' that are linked to flow classes. The Department of Primary Industries, Parks, Water and the Environment (DPIPWE) can issue restrictions on abstractions, which are generally applied on a catchment basis to different sureties, restricting the lower levels of surety first.

Level of surety	Description
Surety 1 water (expected to be available at greater than 95% reliability)	Rights for the taking of water for domestic purposes, consumption by livestock or firefighting.
Surety 2 water	The water provision allocated to supply the needs of ecosystems dependent on the water resource.
Surety 3 water	Generally for commercial purposes.
Surety 4 water	Rights of special licensees, such as Hydro Tasmania. Special licences are granted to a body corporate for the generation of electricity, or for purposes reasonably incidental to that purpose.
Surety 5 water (expected to be available at about 80% reliability, or 8 years in 10)	Winter storage in dams, irrigation or for other commercial purposes.
Surety 6 water (water available at less than about 80% reliability)	Winter storage in dams, irrigation or for other commercial purposes.
Surety 7 and Surety 8 water	Includes water provided under catchment- or site-specific limitations and conditions, such as water taken in flood peaks in Hydro Tasmania districts to fill dam storages.

PWS licences are defined as either Surety 1 or Surety 5. Two thirds of the total water held by PWS is Surety 1 - the water associated with essential human needs; the other third is Surety 5, and this is the water associated with discretionary outdoor use. When the Water Management Act 1999 commenced, it provided this outcome so that, in the event of a drought, the water available to PWS for non-essential use could be restricted whilst still ensuring there was sufficient to meet essential human needs.



Unbundling water rights and introducing water shares

Water rights were unbundled with the introduction of the Water Management Act 1999. However, there has been limited trading activity in Tasmania, in part because most catchments still have water available, and in part because catchments are small and there is little interconnection, which reduces the opportunity to trade.

Water shares have not been introduced in Tasmania. DPIPW does not feel that the introduction of water shares is justified in Tasmania's circumstances, namely where water is still available and there is little competition for resources.

Comparison of water shares in NSW and Victoria

Resource reliability is in many ways a 'zero-sum commodity', because the more reliability that is given to one group of users, the less there is for everybody else.⁶⁶

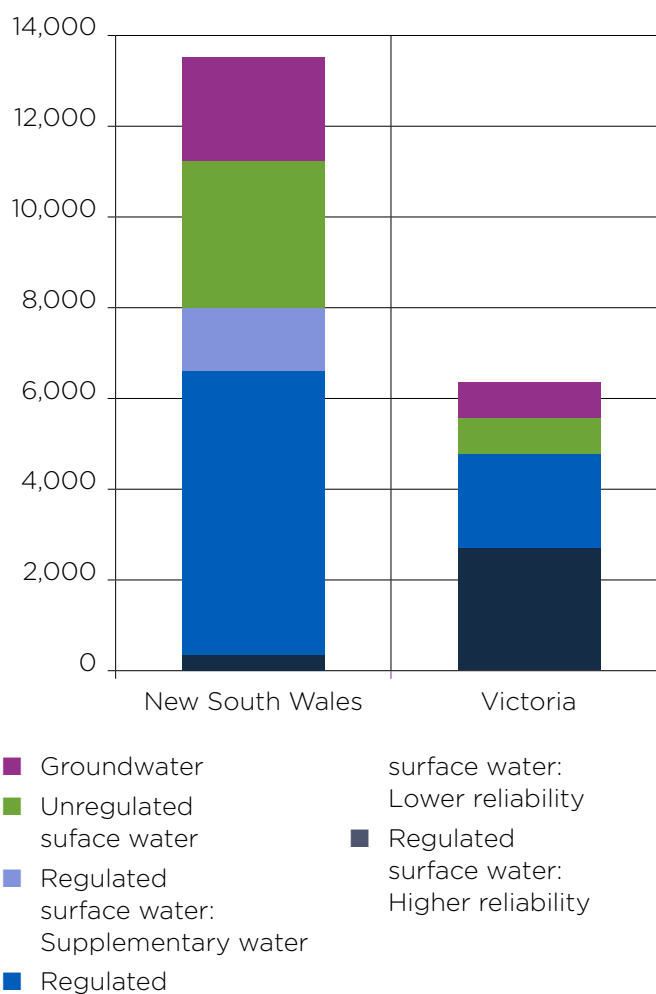
NSW and Victoria have taken different approaches to defining the reliability of water resources in regulated systems. In Victoria, the prevalence of high value perennial agriculture, such as citrus, stone fruit and vineyards, has led to an emphasis on the reliability of water rights and a conservative approach to the allocation of water in storage. In contrast, agriculture in NSW is dominated by annual cropping, such as rice and cotton, where farmers can benefit from an opportunistic use of water. As a result, NSW holds much less water back in storage for subsequent years than Victoria.

Both states have a system of higher reliability and lower reliability water shares. When Victoria went through the process of defining the reliability of rights in regulated systems, abstractors' basic entitlements were defined as high reliability rights, and additional 'sales water' was defined as low reliability rights. These were grandfathered into the water shares system to become high reliability and low reliability water shares.

In contrast, NSW defined the reliability of rights according to use. Industries that required secure access to water, such as perennial agriculture, mining and aquaculture, were granted a higher level of reliability than annual cropping.

Because the agricultural sector in NSW is dominated by annual cropping, both the number of licences, and volume of water, held by lower reliability licences is much greater than that of higher reliability licences.

Volume of entitlements on issue⁶⁷



In addition, carryover rules in Victoria offer abstractors more reliability than the equivalent rules in NSW, even where storages are shared between the states. For example, in the Murray system, Victorian abstractors can carryover up to 100% of their entitlement, and could use up to 200% of their entitlement the following year (assuming they receive another 100% allocation). A NSW abstractor with a general security entitlement on the same system can only carryover 50% of their entitlement, but can use no more than 110% of their entitlement the following year.

⁶⁶ Quiggin (2006), Uncertainty, risk and water management in Australia, Page 67

⁶⁷ Data from NWC (2013), Australian water markets report 2012-13



There is anecdotal evidence that, as a result of these differing reliability arrangements, farmers in NSW have been quick to realise that they can achieve a competitive advantage by holding Victorian entitlements, and have been actively buying them.

Both states follow a similar allocation process, where water is allocated first to meet upfront commitments and higher reliability water shares, then banked to meet these commitments in the following year, and then allocated to lower reliability water shares (if there is any left). This means that, in both states, lower reliability water shares bear the risk that the total water available will decline as a result of climate change. In NSW, where lower reliability rights were designed to be held by annual cropping, it means that this risk is born disproportionately by this sector.

Metering abstractions

Metering abstractions, and catchment monitoring, are important prerequisites to trading and the introduction of water shares. In the draft impact assessment, Defra has included the cost of smart meters (£850 each) which will be borne by individual abstractors.⁶⁸ Although it does not explicitly say so, this implies that abstractors will own, and be responsible for, the maintenance of the meter.

In Victoria and NSW there have been debates about what sort of meter is required, and who should own, and be responsible for, the maintenance of the meter. In both states, there is a need to enforce abstraction rights and ensure that abstractors do not take more than what they are entitled to. The writer Michael Cathcart recorded: "During the 1990s, I met irrigators who confessed to jamming their meters or to secretly pumping directly from the river in the dead of night."⁶⁹ In addition, Melbourne Water, the licensing and enforcement authority within Melbourne's supply catchment area, also reported experiencing problems with compliance and the illegal taking of water. Under the Water Act 1989 unauthorised abstraction carries a potential fine or jail term of up to 12 months.

Within Melbourne's Water supply area, meters are used primarily to enforce compliance, and abstraction charges do not vary according to consumption. Licence conditions require all water to pass through the meter and prohibit the licence holder from removing or interfering with the meter.

Given this focus on compliance, Melbourne Water felt that it was more appropriate for them to own the meters and to be responsible for their maintenance and replacement. This enables Melbourne Water to ensure the integrity of the meter including its accuracy and consequently to prove where an abstractor has been taking water illegally. The cost of this metering service is recovered through abstraction charges.

Currently, within Melbourne Water's supply area, all abstractors with a licensed volume greater than 5 ML per annum have a meter fitted that is read manually at least once a year. In identified catchments where stream flow management plans are in place Melbourne Water have fitted electronic data loggers to meters that can collect daily readings (about 50% of meters have data loggers fitted). This enables more effective management of water resources, particularly in tracking usage at levels when HOF conditions apply.

In addition, Melbourne Water has adopted a sophisticated approach to catchment monitoring. They have installed telemetered flow gauges into unregulated surface water catchments (water shares have not been introduced in these catchments), which send flow data automatically to their website at 5am each morning. If the flow drops below a certain level, a catchment-wide restriction will be imposed on abstractions. It is the responsibility of abstractors to check the website each morning to see if there are any restrictions in place that day. (See: <http://www.melbournewater.com.au/waterdata/waterwaydiversionstatus/Pages/waterway-diversion-status.aspx>)

Similarly, in NSW the Government prefers to own all meters and charge water users a fixed fee sufficient to cover the cost of reading them. However, most unregulated surface water abstractions are unmetered, and as a result some aspects of water reform, including carryover and catchment-wide limits on total annual and daily abstractions, have yet to be fully implemented. It has yet to be decided which licences require a meter and which could be exempt, what sort of meter is required, and who should own the meter and be responsible for its maintenance. NSW Office for Water hopes to make a draft policy available in early 2015.

⁶⁸ Defra (2013) Impact assessment, Future Water Resources Management: Reform of the Water Abstraction Regulation System, Page 38

⁶⁹ Quoted in Heberger (2012), Australia's Millennium Drought: Impacts and Responses, Page 110



Coping with drought

The Millennium Drought was more prolonged and severe than the planning parameters used to forecast urban water supply and demand. It caused a crisis for public water supply; although no city actually ran out of water, there were a number of close calls, and the restrictions that were imposed on customers were more severe and prolonged than expected.

Initially, public water suppliers responded to the Millennium Drought by focussing on demand management programmes, which included water efficiency campaigns and mandatory restrictions. Restrictions were not applied to the use of water in the home, but aimed at reducing or, in the most serious cases, disallowing outdoor use of water. The public were also asked to reduce their water consumption voluntarily, and there was a large focus on educating and supporting people to meet consumption targets. For example, in Victoria the public was urged to reduce their water use to 155 litres per person per day through activities such as limiting showers to 3 minutes, capturing rainwater from roofs for toilet flushing and gardening, and using grey water from sinks for gardening.⁷⁰

Generally, the Australian public was supportive of water restrictions and compliance with both mandatory restrictions and voluntary targets was very high. Between 2002 and 2008, average per capita consumption in Australia's cities declined by 37%.⁷¹ In Melbourne, demand for public water supplies decreased by 25% between 1995-96 and 2011-12, despite an increase in population from 2.87 to 4 million over the same period.⁷² Similarly, Goulburn Valley Water, a water corporation in regional Victoria, reported a decrease in annual demand from 30 GI in 2004-05 to 29 GI in 2012-13, despite a 7% increase in connections over the same period.

Since the drought, however, the use of such severe restrictions has been much criticised. It is important to note that restrictions on outdoor water use have a much higher impact on communities in Australia than on communities in the UK. In many parts of Australia, it is impossible to sustain parks and gardens without regular watering. Prolonged restrictions on outdoor use made it difficult to keep recreational areas green and attractive, and this has been blamed for a number of social ills. Participation in sports declined, and this had a knock-on effect on community health. Community pride and spirit were affected by the loss of amenity areas, including much-loved old trees. Certain industries (particularly nurseries and swimming pools) were hard hit by the restrictions and many companies went out of business resulting in job losses. In addition, restrictions also became a source of conflict within communities as neighbours began to police each other.

As the drought deepened, storages across south-eastern Australia dwindled, despite efforts to reduce demand. For example, Sydney and Melbourne's storage levels dropped to below 30% of total capacity and storage levels in south-eastern Queensland (population 2.8 million) dropped to less than 17% (equivalent to just 230 days of supply).⁷³ Many became concerned that demand management solutions alone would not be sufficient to secure public water supplies. Consequently, governments assumed control of water resources planning, and decided to invest in major supply augmentations, particularly desalination plants and indirect potable reuse. Perth was the first city to complete a desalination plant in 2006, and subsequently plants have been built in Melbourne, Sydney, Adelaide and Brisbane. In addition, both Perth and Brisbane have completed indirect potable reuse schemes.

⁷⁰ Grant et al (2013), *Adapting Urban Water Systems to a Changing Climate: Lessons from the Millennium Drought in Southeast Australia*, Page 10729

⁷¹ Heberger (2012), *Australia's Millennium Drought: Impacts and Responses*, Page 115

⁷² Grant et al (2013), *Adapting Urban Water Systems to a Changing Climate: Lessons from the Millennium Drought in Southeast Australia*, Page 10729

⁷³ NWC (2011) *Urban water in Australia: Future directions*, Pages 14 & 17



Typically, government decisions about supply options were made hurriedly, without the scrutiny of independent economic regulators or meaningful stakeholder engagement. In 2010, the National Water commission launched an investigation into the Australian water industry. As part of the project, they interviewed Australian policy and water management experts about their experience of the drought, which provided key insights into the decision making process. For example, one sector expert concluded:

“Recent experience suggests that the eastern part of Australia was largely caught unprepared by the recent drought. There is also anecdotal evidence to suggest that in some cases decisions on strategies to secure water were delayed to the extent that the lead times necessary to implement them effectively expired thus rendering further consideration of such options not feasible. Moreover, there appear to have been instances of where works were undertaken not because they represented value for money but because they could give the appearance of action.”⁷⁴

The Thompson Dam in 1997 and 2008

(The Thompson Dam represents 60% of Melbourne’s total storage capacity.)



Images provided courtesy
of Melbourne Water

⁷⁴ Quoted in NWC (2011) Urban water in Australia: Future directions, Page 21



The economic efficiency of the capital investment made to secure water supplies has been questioned. For example, the commissioning of a desalination plant for Sydney essentially as a drought reserve is contrary to the economics of the option, which to be competitive would be as a base load supplier rather than a drought reserve with expensive mothballing in between.

There is also concern that insufficient consideration was given to the option of buying additional water on the market. Although this would not be a feasible option for Sydney, for many of Australia's towns and cities, including Canberra and Melbourne, purchasing water from agriculture is feasible and often cheaper and more environmentally friendly than alternative options.⁷⁵ As will be shown in the next section, water corporations in Victoria and the ACT were active in the market during the drought. However, intersectoral trade that diverts water away from agriculture is deeply unpopular, and consequently the potential benefits of trading to public water supply have not been fully realised, and are unlikely to be so in the immediate term.⁷⁶

While official government policy is that the total cost of water infrastructure and delivery should be recovered through bills, both the Commonwealth and State governments provided funding and subsidies for water supply augmentations, primarily in the larger cities. For example, the Commonwealth committed \$328 million to the Adelaide desalination plant, and the Queensland government effectively subsidised the costs of the South-East Queensland WaterGrid by not requiring a commercial rate of return on assets.⁷⁷

Despite political pressure to minimise increases in water bills, they have risen substantially and will continue to do so for many years until prices return to a level that reflects full cost recovery. For example, over the period from 2008–09 to 2011–12, household bills are due to rise in real terms by around 8% per year in Sydney and by up to 13% per year in Melbourne. In Melbourne, this means average water bills are expected to double over the current five year regulatory period.⁷⁸ Bills are rising as a result of capital investment made during the drought, and because consumption has reduced, which in turn has reduced revenues.

During and since the drought, there have been efforts to improve supply-demand planning techniques. For example, in 2005 Victoria introduced a requirement to use climate change scenarios when forecasting supplies including a 'return to dry' scenario based on conditions experienced during the drought period. In addition, trigger points are now widely used to time infrastructure investments; for example, when storage drops below a certain level, the process of planning and designing the next water supply option is triggered.

⁷⁵ Quiggin (2006) Urban water supply in Australia: the option of diverting water from irrigation

⁷⁶ Crase (2008) Lessons from Australian water reform, Page 258

⁷⁷ NWC (2011) Urban water in Australia: Future directions, Page 18

⁷⁸ NWC (2011) Urban water in Australia: Future directions, Page 18

Public water supply and the market

In theory, trading results in a more efficient allocation of water, because it allows high-value users to gain access to water and it encourages low-value users to release their water. In addition, it can drive innovation and improvements in productivity. While there is a clear body of evidence that demonstrates that trading has delivered benefits to Australian abstractors (particularly those located within the Murray-Darling Basin), there is only limited evidence about the extent to which public water suppliers have been affected by, and benefitted from, the introduction of trading.

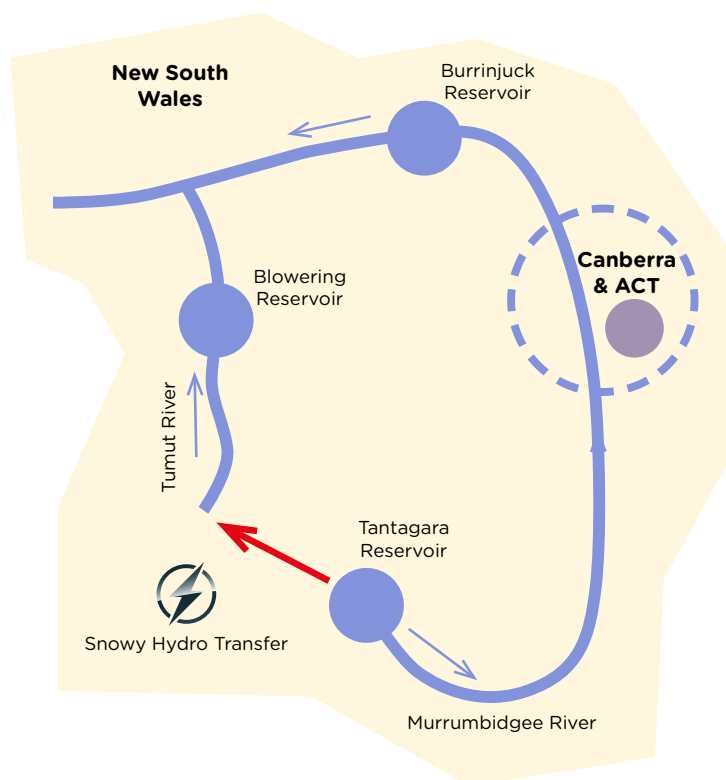
The extent to which public water suppliers have been active in water markets varies between and within states. While there has been no PWS activity in water markets in Tasmania, and only limited activity in New South Wales, trading has been important for Victorian water corporations. Examples of the sorts of trades PWS is undertaking, and in what circumstances, are discussed below.

ACT

The ACT is situated in the Murrumbidgee catchment within NSW. During the drought, ACTEW Water developed the Tantangara Transfer scheme as a means to augment Canberra's supplies. ACTEW Water purchased 9.5 GL of high security entitlements, and 12.5 GL of general security entitlements in the Regulated Murrumbidgee irrigation area that stores water in Blowering and Burrinjuck reservoirs. This region sits downstream of Canberra so before the water can be used it needs to be transferred upstream.

In order to move the water upstream, ACTEW Water came to a contractual agreement with Snowy Hydro. The Tantangara reservoir is part of the Snowy Mountains hydroelectricity scheme and as such it is owned and operated by Snowy Hydro (see diagram opposite). It is located at the head of the Murrumbidgee catchment. Normally, Snowy Hydro transfers water through tunnels from the Tantangara Reservoir to the head of the Tumut River, thereby generating electricity. The water released into the Tumut flows down into the Blowering reservoir, which is owned and operated by State Water. Irrigators and others hold shares of the water in the Blowering reservoir. When Canberra requires additional water, ACTEW Water can order it from Snowy Hydro, who will then release that water from the Tantangara reservoir into the Murrumbidgee (which flows through Canberra), instead of generating electricity by transferring it to the Tumut River. In exchange, ACTEW Water must compensate Snowy Hydro for the loss of electricity generation.

The Murrumbidgee Catchment and the ACT



In years when ACTEW Water does not require the water held in the Blowering and Burrinjuck reservoirs, it sells the temporary allocation on the market.

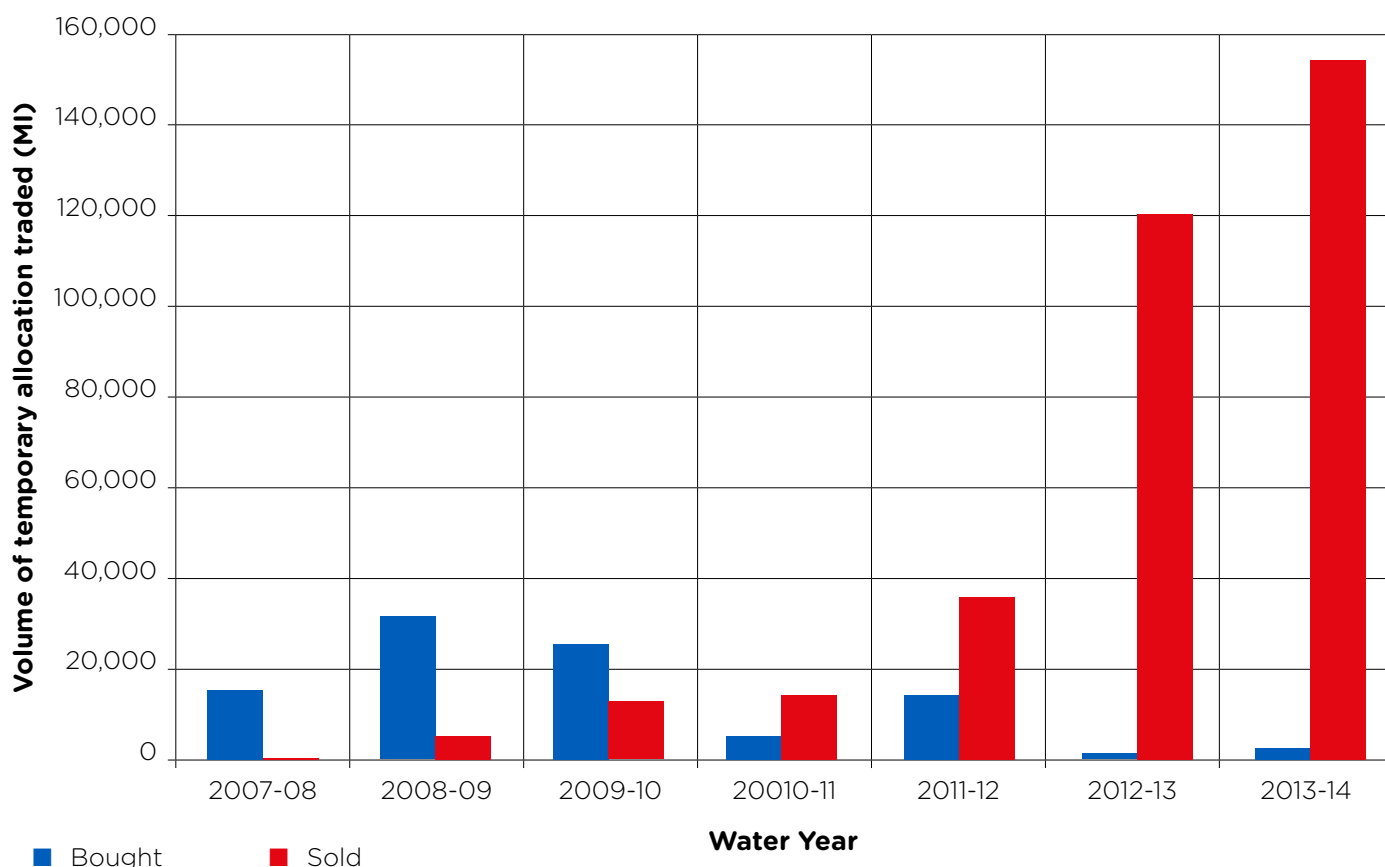
Victoria

Water corporations that source their water from regulated rivers are active in water markets. Water corporations that source their water from unregulated rivers and groundwater are not active in the market, but this is unsurprising since these markets are less developed, and rights have not been unbundled or converted into water shares.

There is no evidence of water corporations selling permanent entitlement. To do so would require ministerial approval, but even if this restraint were lifted, it is difficult to imagine circumstances where a water corporation would want to sell permanent entitlement.



PWS temporary allocation trading in Victoria⁷⁹



Trading during the drought

Between 2007 and 2010, several water corporations bought temporary allocation in order to maintain supplies to customers. For example, during 2008-09, the allocations on the Murray system opened at 0%, and during the year only reached 35%. North East Water, which serves several communities in the Murray catchment, did not have sufficient water in their allocation bank account to meet demand, even with the most severe restrictions in place (no outdoor use). During that year the company purchased an additional 4,362 ML of temporary allocation to secure supplies, provide an additional reserve for 2009-10, and to relax restrictions on outdoor use.⁸⁰

The facility to buy additional temporary allocation on the market allowed North East Water to maintain supply during a short term crisis situation, and

even reduce the severity of restrictions placed on customers. North East Water's situation in 2008-09 was not sustainable in the long-term, as they were selling treated water at the regulated price of \$650 per ML, while during the same year the price of temporary allocation peaked at over \$1,150 per ML. However, water corporations are able to mitigate their exposure to high market prices to some extent, because they are able to go into a deficit in their allocation bank account, as long as they have cleared the deficit by the end of the water year. This facility is not available to other abstractors.

During the drought period, corporations also bought additional permanent entitlement in order to augment supply, which often required the construction of transfer assets. Coliban Water invested \$10m to purchase additional 8 GL of permanent entitlement from the Goulburn regulated system to augment

⁷⁹ Data provided by Goulburn-Murray Water

⁸⁰ North East Water (2009) Annual report 2008-09 Adapting to drought: Securing our communities, Page 20



supplies. In addition, Coliban invested \$33m (the State and Commonwealth governments contributed a total of \$55m) to construct 45km of pipeline known as the 'Goldfields Superpipe'.⁸¹

Melbourne has also sought to access additional water from the irrigation sector. The Northern Victorian Irrigation Renewal Project was designed to upgrade irrigation infrastructure in order to save 225 GL per year. These savings were shared equally between irrigators, the environment, and Melbourne's three water retailers, City West Water, South East Water and Yarra Valley Water. Each of the water corporations made a financial contribution towards the project, in exchange for a new bulk entitlement, equating to 75 GL (jointly owned between the three corporations). In order to transport the water, Melbourne Water invested \$700m in a 70km pipeline known as the North-South Pipeline.⁸²

Between 2007-08 and 2009-10 North East Water operated an 'urban water trading scheme', whereby certain customers (businesses and community groups) were able to access additional water on the market and thus avoid water use restrictions. The scheme was initiated when Yarrawonga Bowls Club approached NEW to help them to access the market. As already noted, the severity of restrictions during the drought resulted in the loss of many community assets. Yarrawonga Bowls Club were reluctant to watch their green die, and so they began to look for additional water on the market. They successfully found a farmer who was prepared to sell 1 ML of temporary allocation, however they had no means of transporting the water to their bowling green. NEW bought the water on behalf of the bowls club, and then allowed them to use equivalent volume of treated water. NEW then charged the club the regulated price of the treated water, plus the market price of the additional allocation. Over the life of the scheme NEW delivered an additional 174 ML to 36 customers, who included schools, sporting associations, wineries and local councils.

Trading after the drought

Since the drought ended in 2010, Victorian water corporations continue to be active in the market. For example, North East Water (NEW) is currently buying additional permanent entitlement to increase security of supply, provide for future growth and allow for an increase in industrial demand. When this additional water is not required, the corporation sells the additional allocation on the market, and profits are reinvested in permanent entitlement.

As already noted, during the process of defining rights, Goulburn Valley Water (GVW) achieved bulk entitlement based on the design capacity of its water treatment works. The entitlement is much greater than demand, and so GVW regularly sells spare temporary allocation on the market.

Even though the drought ended in 2010, there is still demand for temporary allocation. Since 2008, the Commonwealth and Victorian governments have bought significant volumes of water for the environment. Many farmers took the opportunity to sell their permanent entitlement, and used the proceeds to restructure their businesses. They now rely on the purchase of temporary allocation as and when it is required. Consequently, many farmers are anxious that water corporations should release their spare allocation into the market, and would be concerned if they felt that water was being held back or hoarded.

New South Wales

There is limited public water supplier activity in the market in NSW. Sydney is separated from the Murray-Darling Basin by the Blue Mountains and consequently the options for transferring water to the city are limited. Even within the Murray-Darling Basin, however, there is limited PWS engagement in the market. The NSW Office of Water report anecdotally that some local authorities have bought permanent water entitlement on the market as a strategy for dealing with growth. State Water (a state-owned corporation responsible for managing temporary allocation trades) reports that local authorities traded a total of 2,675 ML of temporary allocation in 2013-14, and 1,139 ML in 2009-10.

⁸¹ Coliban Water (2014), http://www.coliban.com.au/site/root/projects/ColibanWater-_000.html accessed on 23.10.14

⁸² Grant et al (2013), Adapting Urban Water Systems to a Changing Climate: Lessons from the Millennium Drought in Southeast Australia, Page 10727



Comparison between NSW and Victoria

The volume of water traded by public water suppliers in NSW is significantly less than that in Victoria. While the opportunities for water trading in Sydney are limited, the majority of NSW's regional population centres are located within the Murray-Darling Basin and have access to water markets within regulated surface water systems. The discrepancy in trading activity is probably the result of two factors. Firstly, water services are provided by local authorities in regional NSW, which are often under-resourced. Their decision making capability is likely to be very different from their Victorian counterparts, which are intended to be run as private companies with an appointed board of directors.

Secondly, public water suppliers enjoy a much higher degree of protection in NSW than they do in Victoria. Local water authorities hold the highest priority shares, and as such they can expect to receive 100% allocation in all but the most serious droughts. Although local authority licences are legally defined as a share, in practice the share component of their licence continues to be expressed as a volumetric quantity. In addition, if towns require additional water as a result of population growth, they can apply to the NSW Office of Water for additional water, rather than having to buy it on the market. The NSW Office of Water will provide this water by taking it from the consumptive pool for general security shares, effectively reducing the yield and reliability of entitlements held by others.

This is very different to the circumstances faced by regional water corporations in Victoria, where one use of water is not prioritised over others (unless a Qualification of Right is in place). Victoria deliberately chose to minimise the number of possible rights in order to facilitate trading, and the assigned reliability did not depend on use. At the time rights were defined (during the 1990s), the expectation was that towns would have to buy additional water on the market to meet population growth.⁸³

Intersectoral trading remains contentious

Despite the fact that trading is often the cheapest and the most environmentally friendly way to augment supplies, intersectoral trade is contentious and politically fraught. The unpopularity of intersectoral trade has deep historical roots. Traditionally, Melbourne's supply system was run separately from the surrounding region as a stand-alone system, and an ideological divide between water for irrigation and public water supplies developed. This was encapsulated by the Victorian Premier Henry Bolte in 1964, when he stated that he would 'not allow one drop of water to be taken from north of the divide to augment Melbourne's supplies'.⁸⁴

The rural electorate has a disproportionate influence on the political process, and this makes it difficult for politicians to effect reform when it is perceived to be detrimental to the interests of the irrigation community.⁸⁵ Although the majority of farmers support trading within the irrigation sector, many are concerned that intersectoral trading will decrease the total volume of water available to irrigation, even though individual farmers may be willing sellers. Water moving away from irrigation has become particularly fraught given the scale of government purchases of water for the environment.

The unpopularity of intersectoral trading is best illustrated by the North-South Pipeline, which was used for a few months after its completion in 2010 and has not been used since. The pipeline was deeply unpopular outside of Melbourne because it was perceived to be reducing the total water available to irrigation (even though the additional water came from savings made by upgrading irrigation infrastructure). Following the end of the drought, and a change of government, the pipeline has effectively been mothballed, and can now only be used if Melbourne's storages drop to below 30%. The Melbourne water retailers still own the permanent entitlements on the Goulburn system, and sell the temporary allocation each year.

⁸³ Murray Water Entitlement Committee (1997), *Sharing the Murray: Proposal for defining people's entitlements to Victoria's water from the Murray*, Page 53

⁸⁴ NWC (2011) *Water markets in Australia: A short history*, Page 27

⁸⁵ Mark Stafford Smith, quoted in Heberger (2012), *Australia's Millennium Drought: Impacts and Responses*, Page 108



Lessons for reform in England and Wales

Is the Australian experience relevant to England and Wales?

Abstraction reform in Australia is a consequence of the continent's unique hydrology, history and political ecology. While it is possible to learn from the Australian experience, care must be taken to understand what learning is transferable to England and Wales, and what learning is not.

Differences between Australia and England and Wales

In contrast to Australia's climate, which is highly variable and characterised by recurring multi-season droughts, the UK's climate is temperate and temperature ranges are rarely extreme. In meteorological terms, the severity and duration of droughts experienced in the UK are less severe than those experienced in Australia. However, in socio-economic terms drought in the UK can still have severe consequences.

As a result of climatic differences, water resources are managed very differently in Australia to those in E&W. Australian reservoir capacity is significantly larger than in E&W, and the majority of abstractions in the ACT, NSW and Victoria are from regulated surface water systems. The concept of 'regulated' surface water does not exist in E&W in the same way that it does in Australia. There are some examples of rivers in E&W where the flows are regulated to some extent; for example, reservoirs have been constructed on the River Dee to store winter flows, which are then released in the summer to support public water supply abstractions. However, the majority of rivers would be considered 'unregulated' by Australian standards.

Water use is also very different in Australia, where agriculture accounts for the majority of abstractions (65%), and public water supply accounts for only 11%. In contrast, public water supply in E&W accounts for half of the total volume of water abstracted, and agricultural abstractions are in the minority.

The institutional governance of public water supply is very different in Australia and E&W. Whereas the water industry in E&W was privatised in 1989, it was not privatised in Australia. Institutional reform, and the introduction of independent regulation, has been affected to varying degrees in different states. However, even in the ACT and Victoria, where state-owned water corporations are well established, regulation is not completely independent.

A key difference between Australia and E&W is the timing of when over-abstraction has (or has not) been dealt with, and who has paid to deal with it. Over-abstraction in Australia was not resolved prior to the introduction of markets, which in many cases exacerbated environmental stress. In contrast, in E&W, the Environment Agency has made, and is making, significant progress to address over-abstraction and over-allocation through its Restoring Sustainable Abstraction (RSA) programme. The EA expects to resolve over-abstraction and over-allocation ahead of, and alongside reform.

Australian state governments have been reluctant to claw back water without making compensation, and consequently have preferred to buy water for the environment on the market, or invest in infrastructure upgrades designed to make water savings. This means that dealing with over-abstraction has been paid for largely by taxpayers. In contrast, in E&W, where water companies have had to make investment in alternative supplies as a result of the RSA programme, it has been paid for by water customers (through the price review process). Where other abstractors have reduced their abstractions and incurred a loss as a result of the RSA programme, they have been compensated through the Environmental Improvement Unit Charge (EIUC) fund, which is one component of abstraction charges paid by abstractors.



We can learn from the Australian experience

Recognising these dissimilarities, there is much that we can learn from Australia's water reform story.

We can learn from Australia's experience of reforming the abstraction management system to better deal with increasing scarcity and competition. Australian abstraction management systems evolved during a time when there was little competition for water resources because they were relatively abundant. Licences were issued on a first come first served basis, until water was fully or overallocated in many systems. As embargoes were issued on new licences, the need for a mechanism to reallocate water became increasingly apparent. Over a period of 25 years, abstraction management in Australia has been reformed to manage increasing scarcity and consequent competition for resources.

Similarly, the system of abstraction management in England and Wales was designed during a period of comparative abundance of water. It was not primarily designed to manage scarcity or competition for resources, and there is no effective mechanism to reallocate water between abstractors. However, there is concern that the availability of, and competition for, water resources could increase significantly in the future. The EA's 'Case for change' document states that a quarter of water bodies in England will only provide a reliable source for new consumptive abstraction for less than 30% of the time.⁸⁶ In these catchments, access to reliable water for new consumptive abstractions can only be obtained from another abstractor, rather than the issuing of a new licence. The need to reallocate water between users will become increasingly important if there is a long-term decline in the availability of water resources as a result of climate change.

In a review of the Australian water reform experience, the Australian economist Lin Crase concluded: 'countries with less variable hydrology [...] can still learn from [Australia's] experiences and should guard against complacency. In particular, the need to develop robust adaptive arrangements for the allocation of the resource cannot be understated.'⁸⁷

What can we learn from the Australian example about how Defra's Water Shares would work in practice?

There is concern in the water industry that Water Shares in particular could introduce uncertainty around the water available for abstraction. The amount of water a company could abstract would depend on how much their shares yield in a particular period. If the allocation period was short (fortnightly), it would raise questions about how companies would plan for the long term or manage their abstractions on a daily basis. In response to these concerns, this project sought to explore how public water suppliers operate within a shares based system.

The Water Shares option as proposed by Defra, however, is substantially different to Australian water shares systems in several respects:

- The concept of water shares in Australia is predicated on large-scale storage that was built (and financed) by governments prior to reform (regulated catchments). It is easy to conceive how water shares work in regulated surface water systems, where abstractors effectively hold a share of the water in storage. Consequently, states have made good progress to introduce water shares into regulated surface water systems, and only NSW has introduced water shares into unregulated systems.
- In all catchments where water shares have been introduced, the allocation period is annual. There is nothing comparable to the fortnightly allocation period proposed in Defra's consultation document.
- Shares do not yield a greater allocation during wet periods, but they do yield a smaller allocation during dry periods. Under Water Shares, an abstractor could abstract more water during wetter periods.⁸⁸

⁸⁶ EA (2011) The case for change – current and future water availability, Page 11

⁸⁷ Crase (2008) Lessons from Australian water reform, Page 257

⁸⁸ Defra (2013), Making the most of every drop: consultation on reforming the water abstraction management system, Page 29



- An important part of water shares in Australia is the facility for abstractors to carryover unused allocation from one year to the next. In regulated systems, it helps abstractors to manage the risk of a low opening allocation at the start of the water year. In unregulated systems, if an abstractor is unable to take their full allocation because HOF conditions have been triggered, carryover allows them to abstract this 'lost' water in the next period (assuming HOF conditions are not triggered).

The system of water shares in unregulated catchments in NSW is similar to the hybrid option currently being considered by Defra, and as such it is the example most relevant to England and Wales. Rights are legally defined as a share, but the allocation period is annual, and consequently daily abstractions continue to be managed using HOFs. However, NSW has yet to fully implement some aspects of water reform in unregulated catchments, including carryover and catchment-wide limits on total annual and daily abstractions, because the majority of abstractions in these catchments are unmetered. It has yet to be decided which licences require a meter and which could be exempt, what sort of meter is required, and who should own the meter and be responsible for its maintenance. NSW Office for Water hopes to make a draft policy available in early 2015.

This underlines the importance of catchment monitoring and metering as a prerequisite for water shares.

As a result of the differences described above, exploring the Australian experience will not provide answers to specific water industry concerns about how a fortnightly allocation period would affect daily abstractions and long-term planning. However, it does not mean that Water Shares cannot be introduced in England and Wales, or that it could not be beneficial, but it would need to be carefully trialled before being widely implemented.

These differences show that Defra has adapted an existing concept to specific circumstances in E&W, and has sought to be more innovative in the way that abstractions are linked to water availability in unregulated catchments. With innovation, however, comes risks and Water Shares would need to be carefully trialled in selected catchments to understand its impacts on abstractors, including water companies, before being implemented more widely.

One aspect of Australian water shares that is not discussed in the consultation document is carryover, particularly in unregulated catchments. Carryover does not allow abstractors to access additional water, because over a consecutive three year period they are not allowed to abstract more than 300% of their permanent entitlement. However, if an abstractor is unable to take their full allocation in year 1, because HOF conditions have been triggered, they can carryover all of their unused allocation into year 2. Assuming that HOF conditions are not triggered, they can then abstract the water carried over from year 1, plus their full allocation for year 2. HOF conditions remain in force at all times, and so in theory the environment remains protected, although it has never been tested because water shares have not been fully implemented.

Defra is proposing to allow abstractors to take additional water at times of very high flows; however, this is more similar to the provision of supplementary water in NSW at time of high flows. The aim of additional abstraction at very high flows, or supplementary water, is to allow abstractors to make the most of water resources while they are available. The purpose of carryover is to help abstractors manage the risk that they cannot take their allocation because HOF restrictions have kicked in. Carryover could be of particular benefit to water companies and other abstractors with access to storage, because it will help them to better manage reservoir levels. Defra should explore the possibility of introducing carryover arrangements as part of the reform options.

Recommendations

- The Environment Agency needs to ensure that there is sufficient catchment monitoring and metering of abstractions in place prior to implementing reform.
- Given its innovative nature, Water Shares should be carefully trialled in selected catchments to understand the impacts on all abstractors before being implemented more widely.
- Defra should explore the possibility of introducing carryover arrangements as part of the reform options.



How important has trading been to public water suppliers in Australia?

Trading has driven substantial benefits in the Murray-Darling Basin

In theory, trading results in a more efficient allocation of water, because it allows high-value users to gain access to water and it encourages low-value users to release their water. In addition, it can drive innovation and improvements in productivity.

Trading has delivered benefits to Australian abstractors; particularly those located within the Murray-Darling Basin where water markets are most developed. For example, in 2010 the National Water Commission published an extensive study looking at the impacts of water trading in the southern Murray-Darling Basin. The NWC concluded that:

‘This study demonstrates unequivocally that water markets and trading are making a major contribution to the achievement of the NWI objective of optimising the economic, social and environmental value of water. The overwhelming conclusion of the study is that water trading has significantly benefited individuals and communities across the southern MDB.’⁸⁹

‘Although water trading out of a region may in some cases accelerate existing social and economic changes, without the financial cushioning effects of water trading the impacts of drought would undoubtedly have been worse.’⁹⁰

In their case study of abstraction reform in the Gwydir catchment (NSW), Young & Esau concluded that:

‘Water trading is widespread in the region’s regulated river system and groundwater systems and is encouraging the efficient use of water. The result has been a considerable increase in investment and changes in the way that water is used throughout the region.’⁹¹

The Australian economist, Lin Crase, also concluded that:

‘The broad substantiation of volumetric rights for irrigators within state jurisdictions has yielded substantial gains once trade has been permitted. The sheer volume of seasonal trade in agriculture stands as testament to the enhanced allocation outcomes on this front and [...] trade has become a critical component of farmers’ risk management strategies.’⁹²

The studies quoted above are illustrative of a broad consensus around the benefits of trading in the Murray-Darling Basin; however, they do not consider the impacts of water markets on public water suppliers in any detail. This project shows that public water suppliers have also been able to benefit from trading, particularly in Victoria.

As demonstrated by the Millennium Drought, the introduction of markets has not guaranteed sustainable and resilient public water supplies. However, markets have delivered substantial benefits to water corporations in Victoria. Trading allowed water corporations to maintain supplies to customers during an unprecedented drought. All of the Victorian organisations who participated in this project agreed unanimously that the market was critical to maintaining supplies to customers during the drought. In addition, the market is now allowing water corporations to improve security of supply, and prepare for future population growth.

In addition, there are examples of where the market has driven innovation and efficiency in the water industry. Through the imaginative use of existing infrastructure, ACTEW Water has been able to access additional water from the market that is located downstream of Canberra to improve security of supply. North East Water’s urban water trading scheme is an example of innovation resulting from the market.

⁸⁹ NWC (2010) The impacts of water trading in the southern Murray-Darling Basin, Page v

⁹⁰ NWC (2010) The impacts of water trading in the southern Murray-Darling Basin, Page 100

⁹¹ Young & Esau (2013) Detailed case study of the costs and benefits of abstraction reform in a catchment in Australia with relevant conditions to England and Wales, Page 3

⁹² Crase (2008) Lessons from Australian water reform, Page 258



The potential for trading in England and Wales

As water resources in England and Wales become increasingly allocated, the need to reallocate water between users will become more important, especially if there is a long-term decline in the availability of water resources. The Australian experience demonstrates that trading can deliver substantial benefits to abstractors by allowing for both short-term and long-term reallocation in response to climatic and other pressures.

Based on this, reform in England and Wales should seek to introduce water markets, and reform options should be designed to facilitate trading in order to maximise the potential benefits. For example, Water Shares (in theory) has greater potential to realise the benefits associated with trading, because it allows a greater number of trades (including upstream trading), and the unbundling of land and water rights will reduce transaction costs and administrative complexity.

In addition, the separation of the long-term entitlement from the short-term allocation should facilitate short-term trading, allowing abstractors to engage in the market without having to permanently sell their rights.

Defra expects that the introduction of markets in England and Wales will, in some catchments, result in a more efficient allocation of resources, which will allow water companies to delay investment in new supplies.⁹³ The example of ACTEW Water and Snowy Hydro suggests that it is possible that markets would facilitate a better use of existing infrastructure as a precursor to additional storage. However, concerns have been raised about the feasibility of markets in England and Wales, given that catchments are small and have low levels of interconnectivity compared to those in Australia.

What is interesting about the Australian example is that at the time the 1994 COAG agreement was signed, nobody in Australia imagined that water markets would be as successful or widespread as they have become today.⁹⁴

Staff at ACTEW Water could not have imagined that they would be negotiating with Snowy Hydro to 'move' water upstream for use in Canberra, any more than individual abstractors in NSW could have imagined they would be buying permanent entitlements in Victoria, in order to benefit from more generous carryover arrangements. This does not mean that trading will definitely work in England and Wales, but it does mean that we shouldn't dismiss it because we cannot imagine the specific outcomes and solutions that it could drive.

Concerns about trading

The potential for markets to facilitate economic restructuring continues to cause concern in Australia, particularly within the irrigation sector. As a result, intersectoral trading can be so unpopular it has not been considered as a supply augmentation option by some public water suppliers. Intersectoral trading is likely to be contentious in England and Wales, particularly as water companies have been privatised and are the majority abstractor.

In addition, many have expressed concerns that water companies will dominate the market, and about the potential impacts of allowing those without a direct interest in using water to buy water. Similarly, in Australia, there has been significant public debate about the potential for 'water barons' and foreign investors to buy up water rights, and the loss of water from some regions and sectors as a result of intersectoral or interstate trading. As a result, Australia has taken an incremental approach to the introduction of water markets.

Recommendations

- Reform in England and Wales should seek to introduce water markets, and reform options should be designed to facilitate trading in order to maximise the potential benefits. Features of reform that can promote trading include the separation of water and land rights and the introduction of water shares, because they reduce transaction costs and facilitate temporary trading.
- An incremental approach to water market development is probably appropriate given stakeholder concerns around trading (although potential benefits will be forgone if suboptimal arrangements are left in place too long).

⁹³ Defra (2013) Impact assessment: Future water resources management: Reform of the water abstraction regulation system, Page 28

⁹⁴ NWC (2011) Water markets in Australia: A short history, Page 33



Should public water supply be prioritised over other sectors?

Prioritisation of public water supply in Australia

When considering the Australian water reform story, it is interesting to explore how different states have taken different approaches to the prioritisation of public water supply and other uses of water.

During an emergency (such as a severe drought or water quality event), all states prioritise water for essential human needs. States also prioritise different uses outside of emergencies through the definition of reliability classes. The prioritisation of different uses of water is most explicitly defined in Tasmania, where the use of water defines the level of surety associated with a licence. Similarly, New South Wales prioritises different uses through the definition of reliability classes. Victoria, however, has taken a different approach and has deliberately not connected reliability classes to use.

Although public water supply licences in NSW have been converted into shares in a legal sense, in practice, this has little meaning. The share component of PWS licences continues to be expressed as a volumetric quantity. PWS licences sit within the 'highest priority' reliability class, and as such they can expect to receive 100% allocation in all but emergency situations. In addition, if towns require additional water as a result of population growth, they can apply to the NSW Office of Water for additional water, rather than having to buy it on the market. The NSW Office of Water will provide this water by taking it from the consumptive pool for lower reliability shares, effectively reducing the yield and reliability of shares held by others.

This is very different to the circumstances faced by water corporations in Victoria, where one use of water is not prioritised over others. Victoria deliberately chose to minimise the number of reliability classes in order to facilitate trading, and consequently created only high reliability water shares (HRWS) and low reliability water shares (LRWS).

Abstractors' basic rights were assigned HRWS, and abstractors who held additional rights to 'sales water' (additional water available at times of very high flows) were assigned LRWS. If in any given year, HRWS receive an allocation that is less than 100%, this restriction will be applied equally to all HRWS holders, including irrigation, public water supply, industry and others. All abstractors are expected to use the market and carryover mechanisms to manage the risk of a low allocation. At the time rights were defined (the 1990s), the expectation was that towns would have to buy additional water on the market to meet population growth.⁹⁵

However, in an emergency situation, the Water Minister can make a temporary Qualification of Right to protect public water supplies. Several temporary Qualifications were made during the Millennium Drought.

The difference of approach between NSW and Victoria is probably explained in part by different public water supply governance arrangements. In regional NSW, water and wastewater services are provided by local authorities, which suffer from problems such as under resourcing and a small rate-payer base, which restricts their ability to make investment. In contrast, water services in Victoria are provided by state-owned water corporations, which are run like private companies and with an appointed board of directors.

As already noted, the volume of water traded by public water suppliers in NSW is significantly less than that in Victoria. While the opportunities for water trading in Sydney are limited, the majority of NSW's regional population centres are located within the Murray-Darling Basin and have access to water markets within regulated surface water systems. In part, the discrepancy in trading volumes probably results from governance arrangements; it is unlikely that local authorities in NSW have the same sort of decision making capability as water corporations in Victoria. However, in part it must also result from the additional protection afforded to public water suppliers in NSW.

⁹⁵ Murray Water Entitlement Committee (1997), *Sharing the Murray: Proposal for defining people's entitlements to Victoria's water from the Murray*, Page 53



Prioritisation of public water supply in England and Wales

Under the current abstraction regime, the Environment Agency has a special duty to have regard for public water supply requirements and duties imposed on water companies in the Water Industry Act 1991.⁹⁶ Outside of drought conditions, public water supply is not prioritised above other sectors in any practical sense. For example, water company licences can be time limited and subject to HOF conditions.

However, during a drought, public water supplies can be prioritised through various provisions, including:

- Section 57 of the Water Resources Act 1991, which enables the EA to stop or reduce abstraction for spray irrigation;
- Drought Permits, which are issued by the EA to help water companies maintain supplies to customers during a drought. Subject to conditions, Drought Permits allow water companies to alter restrictions on the sources it already uses (such as abstracting water below the HOF), or to take additional water supplies from sources the company does not normally use; and,
- Drought Orders, which are issued by the Secretary of State, and allow water companies to restrict the non-essential use of water.

Defra's consultation document does not discuss the prioritisation of public water supply, which implies that it is not intended to change. In addition, the consultation is clear that abstraction reform is not intended to replace current drought management tools. Defra states that, because the reforms are designed to better link abstraction to water availability, drought management tools should be required less frequently than under the current system.⁹⁷ This also implies that the provisions described above will continue to exist in the reformed system.

Prioritisation during an emergency

There has been some discussion amongst abstractors about the prioritisation of different sectors during a drought. Most agree that water for domestic use should be prioritised, but that water companies need to encourage and support their customers to use water efficiently, and may need to occasionally impose restrictions such as hosepipe bans. However, many farmers and growers have called for the removal of Section 57, which they perceive to be unfair because it applies only to spray irrigation.⁹⁸ In addition, some have suggested that other sectors, including food processing and electricity generation, should also be prioritised.⁹⁹

In Australia, all states prioritise water for essential human needs during an emergency (such as a severe drought or water quality event). It is appropriate that, in England and Wales, water for essential domestic use is prioritised during an emergency situation.

Prioritisation during 'normal' conditions

The Australian experience provides insight into the question of whether public water supply should be prioritised during normal conditions through the use of reliability classes. As already noted, it is not possible to assign additional reliability to one group of users without reducing the reliability afforded to other users. By linking reliability to use, the risk of a reduction in the aggregate water available for abstraction will be borne disproportionately by one sector. In NSW, lower reliability rights were designed for and held predominately by annual cropping, and consequently it is this sector that bears the risk of climate change.

In contrast, the Victorian example suggests that it is possible to design a system where, during normal conditions, no use of water is given priority, and this effectively shares the risk of a decline in aggregate water availability across all sectors. Given that PWS is the minority user in Victoria, policy makers could be confident that water corporations would be able to buy sufficient quantities of water from irrigators as and when required.

⁹⁶ EA & Ofwat (2011), The case for change – reforming water abstraction management in England, Page 28

⁹⁷ Defra (2014), Making the most of every drop consultation on reforming the water abstraction management system Page 57

⁹⁸ Defra (2014), Making the most of every drop consultation on reforming the water abstraction management system Summary of consultation responses, Page 12

⁹⁹ For example, see Defra's discussion website <http://defra.dialogue-app.com/water-abstraction-reform-and-drought/prioritising-water-use> (accessed on the 13/11/14)



However, the difference in outcomes between NSW and Victoria also suggests that, in order to achieve the benefits of trading, and encourage innovation, public water supply should not be shielded from reform or prioritised above other users during normal conditions. This includes meeting rising demand for water supplies as a result of population growth.

Public water supply accounts for over 50% of the water abstracted in England and Wales (and in some areas considerably more than this). As a result, it could be argued that it is not appropriate to expose the sector to the same level of risk to which it was exposed in Victoria. However, PWS is not prioritised above other sectors in the current system, and the industry is already managing the risks associated with growth and climate change. In theory, abstraction reform should provide companies with additional risk-management tools, such as the ability to trade water, and access to additional abstraction at very high flows. It would not be appropriate to afford PWS additional priority during normal circumstances at the expense of others.

However, water companies in England and Wales have a legal obligation to meet demand for treated water supplies, and this obligation will continue to exist in the reformed system. It is important that they are able to continue to meet this obligation in the reformed system, and consequently the processes that determine how much water is available are transparent and as mechanistic as possible, so that there is limited scope for arbitrary regulatory judgment. This would be particularly important in Water Shares, so that companies can use rainfall and other data to forecast how much water their shares will yield in both short-term allocation period, and over the 25 year period used for water resources management planning.

Recommendations

- Water for essential domestic use should continue to be prioritised during a drought situation, but water companies need to continue to encourage and support their customers to use water efficiently, and may need to occasionally impose restrictions on use.
- Public water supply should not be prioritised in normal conditions.
- In order to allow water companies to meet their statutory duties in the reformed system, the processes that determine how much water is available need to be transparent and predictable.

Is it important to reform proactively?

The importance of proactive reform is illustrated by the definition of Bulk Entitlements in Victoria. Although it is commonly stated that water reform in Australia was driven by the Millennium Drought, reform in Victoria started with the 1989 Water Act. Reform was in part driven by the realisation that, if the state were to experience the kind of long, intense drought that had occurred in the past, there would be insufficient water to fulfil all the rights that had been allocated to abstractors. The state had not experienced this kind of drought since the World War II drought (1937-47), and it was not clear what protection or cutback would be applied to basic entitlements if this kind of drought were to recur.

Through the definition of Bulk Entitlements, the government sought to define rights and to agree how water would be shared in a severe drought. For example, on the Murray River, rights were defined such that the lowest allocation a high reliability rights holder could expect was 60%.



However, as a result of the drought's unprecedented severity, the lowest allocation they actually received was just 35% in 2008-09. While this was significantly less than what was originally envisaged, the fact that the agreement was already in place is very important, because without it the drought could have resulted in a chaotic bun-fight as abstractors sought to secure their water. This underscores the importance of putting in place clear rules about what happens when there is insufficient water available to meet existing rights in full, before the situation arises.

The Environment Agency's 'Case for Change' document demonstrates that, in many catchments, by 2050 there may be insufficient water to fulfil licensed demands and meet environmental requirements, even when environmental requirements are reduced in proportion to climate change impacts.¹⁰⁰ Although the current system has mechanisms in place to manage drought, it is not clear what would happen if there is a permanent decline or a step change in the availability of water resources, and this creates substantial uncertainty for abstractors. As Ian Barker, from Water Policy International, observed:

'Maintaining the current system of abstraction licensing would mean that with climate change and evolving environmental needs existing licences would become progressively more unreliable, either because the water was physically not available or because the Environment Agency would need to vary them to maintain a balance with the environment.'¹⁰¹

Defra's proposals aim to reform the abstraction regime proactively, creating certainty for abstractors by defining upfront what would happen in this situation.

Proactive reform, however, can be challenging as there is little appreciation of the need for reform amongst abstractors. In this, we can also learn from the Victorian example. In order to establish the need for reform, NRE took care to define the need for reform in terms of improving the reliability of existing rights. To illustrate what would happen without reform, NRE undertook comprehensive water resources modelling at a catchment level.

The modelling was based on 100 years' climatic data, and illustrated how water rights would be negatively impacted during the most severe drought on record. By sharing this work with abstractors via catchment committees, NRE convinced them of the need for reform, helped them to understand the risks they faced without reform, and empowered them to reach an agreement as to how water should be allocated during a severe drought.

It would be possible for the Environment Agency to undertake similar work for Enhanced catchments by building on the CAMS process. This would include undertaking water resources modelling at a catchment level, showing how individual abstractions could be affected in different future scenarios. This work should be shared with abstractors via catchment committees, both to help them understand the risks they face without reform, and to facilitate discussions about how to share resources and manage risk.

Recommendations

- Given that there is likely to be a permanent decline in the availability of water resources in the future, it will be necessary to reform the current abstraction regime proactively. Reform should seek to provide certainty to abstractors about what would happen if the aggregate availability of water resources decreases, and build flexibility into the system so that it can adapt to changing supply and demand pressures.
- The Environment Agency should build on the existing CAMS process and undertake water resources modelling, showing how individual abstractions could be affected in different future scenarios. This work should be shared with abstractors via catchment committees, both to help them understand the risks they face without reform, and to facilitate discussions about how to share resources and manage risk.

¹⁰⁰ EA (2011) The case for change – current and future water availability, Page 32

¹⁰¹ Barker (2014) Water supply security published in Utility Week, 31st October edition, Page 15



What can we learn from the Australian water industry's experience of the Millennium Drought?

What lessons has the Australian water industry drawn from the experience of drought?

Despite the use of supply-demand planning, the Australian water industry was unprepared for the severity of the Millennium Drought. This resulted in a crisis for the sector: severe restrictions were imposed upon customers and planning decisions were made without independent scrutiny resulting in inefficient investments and large price increases.

The experience of the drought has underscored the risks associated with planning, managing and investing on the basis of historic climatic records. The Australian water industry needs to think differently about how it plans for an uncertain future and how it makes investment decisions to balance supply and demand, when the historic record no longer provides a good indication of the levels of climatic variability that could be experienced in the future.

In addition, the assessment of options on the basis of least-cost criteria does not adequately consider other benefits such as reliability, or how that option contributes to the existing portfolio of supplies.

Least-cost planning performs well in the short to medium term where risks are well understood and there is a broad consensus about the options for maintaining the supply-demand balance. It performs less well, however, where there is substantial future uncertainty because it is difficult to show that the investment is justified, particularly when options for managing uncertainty are expensive or controversial.

It is now widely accepted that balancing supply and demand efficiently requires consideration of a diverse range of sources, including traditional sources (reservoirs) as well as sources that are not rainfall dependent, such as recycled water. For example, Melbourne hopes to become a world leader in the capture and reuse of stormwater runoff.

There have already been a few schemes successfully commissioned, such as the first stormwater third-pipe residential development, Avenview, in eastern Melbourne.

Despite the feasibility for many towns and cities to buy additional water from the market, this option has been given limited consideration, and the potential benefits of intersectoral trading have yet to be fully realised. This is placing unnecessary costs on water customers. Although this has been criticised,¹⁰² the example of Melbourne's North-South pipeline suggests it is not likely to change soon. Instead, Melbourne is making significant investment in stormwater harvesting. While there are cost effective opportunities to harvest and store some storm water, the development of these options on a large scale would be more expensive than buying water entitlements on the market.

What can the water industry in England and Wales learn from Australia's experience of drought?

While abstraction reform in Australia has played an important role in achieving secure, sustainable and resilient water resources, the experience of the Millennium Drought illustrates that abstraction reform also needs to be accompanied by effective strategic planning.

Currently, water companies in England and Wales plan for the long term and make investment decisions via a process which is defined by statutory regulation. Every five years, companies are required to produce a Water Resources Management Plan (WRMP) which sets out how the company will balance supply and demand over the next 25 years.

The methodology for supply-demand planning in Australia is broadly similar to that in England and Wales. It involves forecasting demand and supply to identify when and where there may be a risk of a future deficit. Traditionally, supply forecasts have been developed using historic in-flow data. Where a deficit has been identified, a list of options is prepared, which can include both demand management and supply augmentation. Generally, options are assessed using least-cost methodology.



Although the WRMP is a sophisticated and complex process, it is not an exact science. There is significant uncertainty about future population growth and climate change impacts. Managing this uncertainty is challenging, and involves balancing the risks of making investment in assets that are later underutilised (because the perceived threats do not materialise), with the risk that investing too late could impact on service to customers and result in significant environmental damage.

The Australian experience suggests that the WRMP process, that is deterministic, reliant on historic climate data, and has a narrow focus on least-cost, does not allow the water industry to best manage future uncertainty. It also demonstrates that failure is possible, and that the cost of failure is high. The water industry in England and Wales is alive to these risks, and is actively thinking about how it can build upon the WRMP process to better manage future uncertainty and prepare for droughts that are more severe than those experienced in the historic record (such as three consecutive dry winters). For example, Anglian Water is developing the use of Robust Decision Making (RDM), an innovative stochastic modelling approach that can assess options over hundreds of possible future scenarios, as opposed to a possible few. RDM also allows the performance of options to be tested against multiple success criteria as opposed to a narrow focus on least-cost.

In addition, the water industry is working to improve strategic planning through initiatives such as Water Resources East Anglia (WREA) and Water Resources in the South East. The WREA project aims to develop an affordable, reliable and sustainable system of supply for East Anglia which is resilient to the long-term effects of population growth and climate change. This includes extended periods of severe drought. WREA will work all the water companies in the region, and representatives of other abstractors, to create the UK's first regional multi-sector WRMP. It will also draw on the outputs of RDM modelling.

Recommendations

- Abstraction reform also needs to be accompanied by effective strategic planning to ensure that public water supplies are secure, sustainable and resilient.
- Through the development of abstraction reform proposals, Defra has the opportunity to encourage and support innovative approaches to supply-demand planning, such as strategic multi-sector planning, and stochastic modelling approaches including Robust Decision Making.

How were public water supply licences transitioned into the reformed system?

Reducing over-allocation prior to reform

There is a clear body of evidence from Australia showing that, if possible, any over-allocation should be resolved prior to the introduction of markets. Failure to do so can result in previously unused licences becoming activated, increasing aggregate water use and exacerbating problems with over-abstraction.¹⁰³ However, the Australian experience also demonstrates that dealing with over-allocation is difficult and contentious. In most cases, Australian governments have chosen to grandfather unused volumes into reformed systems, and to deal with over-abstraction by buying back water for the environment.

Defra has been clear that existing powers will be used to resolve any over-abstraction prior to, and alongside, implementing reform. In addition, in order to ensure compliance with the Water Framework Directive 'no deterioration' obligation, Defra is proposing to remove 'unused' volumes from licences during the transition so abstractors will only be able to take what they have actually been using into the new system.

¹⁰³ See for example NWC (2011) Water markets in Australia: A short history, Page 43; Quiggin (2008) Uncertainty, Risk and Water Management in Australia, Page 70; Crase & Dollery (2008) The institutional setting, Page 79



A key advantage of the catchment-based committee approach to transition is that it allows abstractors to understand each others' particular circumstances, and to agree an approach to transition that is perceived to be fair and legitimate.

Difficulty of a catchment-based committee approach

This approach to transition, however, is challenging, as demonstrated by the experience of New South Wales, where reform was conducted too quickly and in too many catchments at the same time. In order to avoid similar problems it is recommended that reform is tested in a small number of catchments before being implemented more widely. Defra is proposing to implement reform to different extents in different catchments, depending on need. 'Enhanced' catchments will have the full package of reform, whereas only limited reforms will be made in 'Basic' catchments. It would be possible to trial the reform, and approach to transition, in a small number of Enhanced catchments.

Recommendations

- Any problems with over-abstraction or over-allocation need to be resolved prior to the introduction of water markets. It is positive that this has been recognised by Defra and the Environment Agency.
- In catchments that require full reform, Defra and the Environment Agency should engage with abstractors and other stakeholders extensively via catchment-based committees. Instead of using a formula to calculate recent use, the catchment-based committee should be responsible for agreeing the volume of water abstractors are allowed to transition into the reformed system. In addition, catchment-based committees should be used to resolve any difficulties that arise as a result of catchment-specific circumstances.
- Recognising that a catchment-based committee approach to transition is challenging, Defra should seek to transition a small number of catchments initially.



Summary of recommendations

Designing reform options	Given that there is likely to be a permanent decline in the availability of water resources in the future, it will be necessary to reform the current abstraction regime proactively. Reform should seek to provide certainty to abstractors about what would happen if the aggregate availability of water resources decreases, and build flexibility into the system so that it can adapt to changing supply and demand pressures.
	Defra should explore the possibility of introducing carryover arrangements as part of the reform options.
	Reform in England and Wales should seek to introduce water markets, and reform options should be designed to facilitate trading in order to maximise the potential benefits. Features of reform that can promote trading include the separation of water and land rights and the introduction of water shares, because they reduce transaction costs and facilitate temporary trading.
	Water for essential domestic use should continue to be prioritised during a drought situation, but water companies need to continue to encourage and support their customers to use water efficiently, and may need to occasionally impose restrictions on use.
	Public water supply should not be prioritised in normal conditions.
	In order to allow water companies to meet their statutory duties in the reformed system, the processes that determine how much water is available need to be transparent and predictable.
	Abstraction reform needs to be accompanied by effective strategic planning to ensure that public water supplies are secure, sustainable and resilient. Through the development of abstraction reform proposals, Defra has the opportunity to encourage and support innovative approaches to supply-demand planning, such as strategic multi-sector planning, and stochastic modelling approaches including Robust Decision Making.
Implementing reform	Any problems with over-abstraction or over-allocation need to be resolved prior to the introduction of water markets. It is positive that this has been recognised by Defra and the Environment Agency.
	Given its innovative nature, Water Shares should be carefully trialled in selected catchments to understand the impacts on all abstractors before being implemented more widely.
	An incremental approach to water market development is probably appropriate given stakeholder concerns around trading (although potential benefits will be forgone if suboptimal arrangements are left in place too long).
	In catchments that require full reform, Defra and the Environment Agency should engage with abstractors and other stakeholders extensively via catchment-based committees. Instead of using a formula to calculate recent use, the catchment-based committee should be responsible for agreeing the volume of water abstractors are allowed to transition into the reformed system. In addition, catchment-based committees should be used to resolve any difficulties that arise as a result of catchment-specific circumstances.
	The Environment Agency should build on the existing CAMS process and undertake water resources modelling, showing how individual abstractions could be affected in different future scenarios. This work should be shared with abstractors via catchment committees, both to help them understand the risks they face without reform, and to facilitate discussions about how to share resources and manage risk.
	Recognising that a catchment-based committee approach to transition is challenging, Defra should seek to transition a small number of catchments initially.
	The Environment Agency needs to ensure that there is sufficient catchment monitoring and metering of abstractions in place prior to implementing reform.

Annex 1:

The mechanics of water shares

Victoria

Regulated surface water systems

In Victorian regulated systems, there are two types of water shares:

- High reliability water shares (HRWS)
- Low reliability water shares (LRWS)

Resource managers, such as Goulburn Murray Water, are responsible for the storage and management of raw water resources in regulated catchments, which include assessing how much water is available and then allocating that water to abstractors.

There is an annual allocation period that runs from July to June (the water year). Depending on reservoir levels, entitlement holders generally start the year with a low allocation. Once allocated, water will be credited to the abstractor's allocation bank account. The resource manager will then make fortnightly determinations which continue to allocate water to abstractors as the reservoir refills over the winter months (July – October).

The resource manager assesses how much water is available for allocation by adding the water in storage to expected reservoir inflows. Water is then allocated according to the following hierarchy:

1. Water is set aside to meet upfront commitments during the current allocation period, including losses (seepage and evaporation), environmental flows¹⁰⁵ and carryover (see below).
2. Once these demands have been satisfied, water is allocated to HRWS until they receive a full allocation (100% of their entitlement).
3. If HRWS receive a full allocation, enough water will then be set aside to meet upfront commitments and HRWS in the following year.
4. Any additional water is then allocated to LRWS in the current period.

In 2007, arrangements were put in place for holders of both HRWS and LRWS to 'carryover' unused allocation from one year to the next. Carryover arrangements vary slightly between different systems depending on the size of the storage.

On the Murray, Goulburn and Campaspe systems (where the largest storages are located), abstractors can carryover up to 100% of their allocation. If an abstractor has 30% of their allocation left at the end of the year, this water will be rolled over into the following year. If they then start the next water year with a 20% allocation, they will have 50% in their allocation bank account. The result of these arrangements is that, as long as there are sufficient inflows, abstractors could use up to 200% of their entitlement in any year.

In wet years it is possible that the reservoir could overflow or 'spill', and there are arrangements in place to define whose water is lost first. Once an abstractor has 100% allocation in their allocation bank account, any additional water that is allocated to them will be transferred into a 'spillable water account'. If the reservoir were to overflow, then the water held in spillable accounts would be lost proportionally. Water held in a spillable account cannot be used or traded until the resource manager makes a low-risk-of-spill declaration, at which point the water will be transferred into the abstractor's allocation bank account.

Unregulated surface water and groundwater systems

As already noted, the unbundling of water rights and water shares have only been introduced in regulated surface water systems.

New South Wales

In contrast to Victoria, water shares have been introduced in both regulated and unregulated surface water and groundwater, although the management rules applying to these licences differ between systems.

The storage of raw water is the responsibility of the Sydney Catchment Authority for the Sydney metropolitan area, Hunter Water Corporation for the Newcastle urban area and State Water and local councils in regional areas. However, the NSW Office of Water is responsible for issuing licences, allocating water and making periodic 'available water determinations' (AWD).

As in Victoria, there is an annual allocation period that runs from July to June, and each abstractor has a water allocation account.

Regulated surface water systems

There are several types of water access licences that apply to regulated surface water systems:

- 'Highest priority', which include local water utility, domestic and stock and aboriginal cultural licences. The share component of these licences is expressed as a number of megalitres per year. These licences are not permanently tradable without ministerial consent.

The share components of all other water access licences are expressed as a number of unit shares.

- High security
- General security
- Supplementary water – this is additional water that is available in very wet periods when flows cannot be captured by regulating works, eg when reservoirs are full and actually overflowing.

Water is allocated to each category of licence according to the rules specified in the relevant water sharing plan when water is available. In general, the process is similar to that used in Victoria. The NSW Office of Water determines the available water by adding the water in storage to expected inflows (based on the lowest recorded inflow sequence).

Water is then allocated according to the following hierarchy:

1. Water is set aside to meet upfront commitments during the current allocation period, including losses (seepage and evaporation), environmental flows and carryover.
2. Water is set aside to meet local water utility and domestic and stock requirements.
3. Once these demands have been satisfied, water is allocated to high security licences until they receive a full allocation (100% of their entitlement).

The approach to allocating water to general security shares varies between catchments. In the Murrumbidgee and Murray, inflows from the Snowy Scheme are adequate to ensure there will always be sufficient water available to provide full allocations to high security licences in future years, unless a drought worse than any on record is experienced. In these systems it is only necessary to set aside sufficient water to supply high security licence holders during the current year. Any additional water that is available can then be allocated to general security licences.

In all other regulated systems, there is no large volume of assured inflow each year. In these systems water is set aside in the dam to provide full allocations to high security licence holders in future years (generally two) before any allocation is made to general security licences. The volume set aside also includes an allowance for the water losses involved in delivering the allocations.

As in Victoria, abstractors have the facility to carryover unused allocation into the next year, and carryover rules are catchment specific. Generally, carryover rules are more restrictive in NSW than in Victoria. The level of permitted carryover is a function of the amount of total licence entitlements (shares) and dam capacity.

Unregulated surface water systems

There are several types of water access licences that apply to unregulated surface water systems:

- ‘Specific purpose licences’, which include local water utility, domestic and stock and aboriginal cultural licences. The share components of these licences are expressed as a number of megalitres per year, and are not permanently tradable without ministerial consent.
- Unregulated river licences apply to all other abstractions. The share components on these licences are expressed as a number of unit shares, and are tradable.

‘Available water determinations’ (AWD) are generally made at the start of the water year. AWDs for specific purpose licences are expressed as a percentage of the share component, whereas for unregulated river licences they are expressed as volume per unit share (normally 1 ML). Specific purpose licences receive 100% of their share component.

In unregulated catchments, limits are fixed on the total annual abstraction (Long Term Average Annual Extraction Limit, LTAAEL) and the total daily abstractions (Total Daily Extraction Limit, TDEL). These are set out in the respective Water Sharing Plan.

For each unregulated catchment there is a single LTAAEL assessed at a catchment level. This is either based on the Murray-Darling Basin Cap (where catchments are located within the Basin) or is effectively the sum of all the water access entitlements (where catchments are located outside the Basin). The NSW Office of Water monitors total annual abstractions over a rolling three year average period. If total abstraction is assessed as exceeding the LTAAEL, then it will be brought back in line with the LTAAEL by reducing future available water determinations made at the start of each water year for unregulated river licences.

TDELs are set independently of the LTAAEL, and they establish the basis for flow sharing on a daily basis. Firstly, historic river flow records are used to divide the river flows into classes, which cover the full range of flows that can occur on the river on a daily basis. The TDELs establish the maximum amount of water that can be taken from each flow class; hence, there

can be several TDELs within a single catchment. This effectively sets aside a proportion of each flow class to the environment. The TDELs can then be disaggregated into Individual Daily Extraction Limits (IDELs) which are applied to each licence holder.

In addition, there are daily access rules that govern when licence holders are permitted to extract water. ‘Cease to Pump’ rules (Hands off Flows) apply to the majority of unregulated river access licences (irrigation, farming, industrial and recreational uses). Limited access is available below the Cease to Pump threshold for some categories of licence, e.g. for towns or domestic and stock licences.

Abstractors can carryover 100% of their annual allocation into the next year, allowing licence holders to use up to twice their entitlement in a year, provided that over a consecutive three year period they do not exceed the sum of their water entitlement for those three years. TDELs and Cease to Pump rules remain in place at all times, which means that the environment is protected.

For example, if a licence holder has a share component of 50 shares and the AWD is 1 ML per share, 50 ML is credited to the account at the start of the water year. If only 30 ML is abstracted, 20 ML can be carried over to the following water year. If the available water determination remains at 1 ML per share, then up to 70 ML is available for abstraction in the following water year. Licence holders cannot abstract more water than is held in their account.

However, in practice water shares LTAAELs and TDELs have not been implemented in unregulated catchments because of low levels of abstractor metering.

Bibliography

AUSTRALIAN COMPETITION AND CONSUMER COMMISSION (2014)

Australian Competition & Consumer Commission:
Submission to the Review of the Water Act 2007.

[Online] ACCC July 2014. Available at: <https://www.accc.gov.au/about-us/consultations-submissions/accc-submissions>

AUSTRALIAN GOVERNMENT DEPARTMENT OF THE ENVIRONMENT (2012)

Environmental Water Recovery Strategy for the Murray-Darling Basin.

[Online] Australian Government, Canberra, November 2012.

Available at: <http://www.environment.gov.au/water/publications/water-recovery-strategy-murray-darling-basin>

ANGLIAN WATER & FRONTIER ECONOMICS (2011)

A right to water? Meeting the challenge of sustainable water allocation.

[Online] February 2011. Available at: <http://www.anglianwater.co.uk/about-us/statutory-reports/a-right-to-water.aspx>

BYRNES ET. AL. (2009)

The relative economic efficiency of urban water utilities in regional New South Wales and Victoria. *Resource and Energy Economics*. 32 (2010) 439-455

BARKER, I. (2014)

Water supply security. *Utility Week*. 31st October edition, ages 14-15

COLLINS (2008)

Threats to effective environmental policy in Australia.

In: *Promoting better environmental outcomes, roundtable proceedings*. Melbourne, Australian Government Productivity Commission.

Available at: <http://www.pc.gov.au/research/conference-proceedings/environmental-outcomes>

CRASE & DOLLERY (2008)

The institutional setting. In: Crase, L (ed.) *Water policy in Australia: The impact of change and uncertainty*. Washington: Earthscan

CRASE, L. (2008)

An introduction to Australian water policy. In: Crase, L (ed.)

Water policy in Australia: The impact of change and uncertainty.

Washington: Earthscan

CRASE, L. (2008)

Lessons from Australian water reform.

In: Crase, L (ed.) *Water policy in Australia:*

The impact of change and uncertainty. Washington: Earthscan

CSIRO (2010)

Climate variability and change in south-eastern Australia.

A synthesis of findings from Phase 1 of the South Eastern Australian Climate Initiative

(SEACI). [Online] CSIRO 2010. Available at: <http://www.nccarf.edu.au/localgov/resources/climate-variability-and-change-south-eastern-australia-synthesis-findings-phase-1-south>

DEFRA (2013)

Making the most of every drop:

Consultation on reforming the water abstraction management system.

[Online] Defra, December 2013.

Available at: <https://consult.defra.gov.uk/water/abstraction-reform>

DEFRA (2013)

Impact assessment: Future water resources management:
Reform of the water abstraction regulation system.
[Online] Defra, December 2013.
Available at: <https://consult.defra.gov.uk/water/abstraction-reform>

DEFRA (2014)

Making the most of every drop consultation on reforming the water abstraction management system: Summary of consultation responses.
[Online] Defra, July 2014. Available at: <https://www.gov.uk/government/consultations/reforming-the-water-abstraction-management-system-making-the-most-of-every-drop>

EA (2011)

The case for change – current and future water availability.
[Online] December 2013.
Available at: <http://cdn.environment-agency.gov.uk/geho1111bvpe-e-e.pdf>

EA & OFWAT (2011)

The case for change – reforming water abstraction management in England.
[Online] December 2013.
Available at: <http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho1111bveq-e-e.pdf>

GARDNER & BOWMER (2007)

Environmental water allocations and their governance.
In: Hussey & Dovers (eds.) Managing Water for Australia:
The Social and Institutional Challenges.

GOULBURN-MURRAY WATER (2009)

Annual report 2008-09.
[Online] Goulburn-Murray Water, 2009.
Available at: <http://www.g-mwater.com.au/about/reports-and-publications/annualreports>

GRANT ET. AL. (2013)

Adapting Urban Water Systems to a Changing Climate:
Lessons from the Millennium Drought in Southeast Australia.
Environmental Science & Technology. 47, 10727-10734

HERBERGER (2012)

Australia's Millennium Drought: Impacts and Responses. In: Gliet (ed.)
The world's water: The biennial report on freshwater resources.
Volume 7. Washington: Island Press

MCKENZIE (2009)

Water Rights in NSW: Properly Property? Sydney Law Review. Vol 31: 443

MURRAY WATER ENTITLEMENT COMMITTEE (1997)

Sharing the Murray: Proposal for defining people's entitlements to Victoria's water from the Murray. Unpublished.

MUSGRAVE (2008)

Historical development of water resources in Australia:
Irrigation policy in the Murray-Darling Basin.
In: Crase, L (ed.) Water policy in Australia:
The impact of change and uncertainty. Washington: Earthscan

NATIONAL WATER COMMISSION (2010)

The impacts of water trading in the southern Murray-Darling Basin:
An economic, social and environmental assessment.

[Online] June 2010. Available at: <http://archive.nwc.gov.au/library/topic/rural/impacts-of-water-trading-in-the-southern-murray-darling-basin>

NATIONAL WATER COMMISSION (2011)

Water markets in Australia: A short history.

[Online] NWC, Canberra, December 2011. Available at: http://www.nwc.gov.au/__data/assets/pdf_file/0004/18958/Water-markets-in-Australia-a-short-history.pdf

NATIONAL WATER COMMISSION (2011)

Strengthening Australia's water markets.

[Online] NWC, Canberra, June 2011.

Available at: <http://archive.nwc.gov.au/library/topic/markets/strengthening-australias-water-markets>

NATIONAL WATER COMMISSION (2011)

Urban water in Australia: Future directions.

[Online] NWC, Canberra, April 2011.

Available at: <http://archive.nwc.gov.au/library/topic/urban/future-directions>

NATIONAL WATER COMMISSION (2013)

Australian water markets report 2012-13.

[Online] NWC, Canberra, December 2013. Available at: <http://www.nwc.gov.au/publications/topic/water-industry/australian-water-markets-report-2012-13>

NORTH EAST WATER (2009)

Annual report 2008-09 Adapting to drought: Securing our communities.

[Online] State of Victoria, North East Water, 2009.

Available at: <http://www.newater.com.au/about-us/all-publications/annual-report/Downloads.asp?whichcategory=11&AreaID=70&sortorder=Date>

QUIGGIN (2006)

Urban water supply in Australia: the option of diverting water from irrigation.
Infrastructure 11 1-9

QUIGGIN (2008)

Uncertainty, Risk and Water Management in Australia. In: Crase, L (ed.)

Water policy in Australia: The impact of change and uncertainty. Washington: Earthscan

WATER UK (2014)

Water UK response to the abstraction licence reform consultation. Unpublished.

YOUNG, M (2012)

Towards a generic framework for the abstraction and utilisation of water in England and Wales.

[Online] November 2012. Available at: http://www.ucl.ac.uk/environment-institute/research/ei_fellowship_report

YOUNG, M & ESAU, C (2013)

Detailed case study of the costs and benefits of abstraction reform in a catchment in Australia with relevant conditions to England and Wales.

[Online] Defra, April 2013. Available at: <http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18626>

