Australian Government

MURRAY–DARLING BASIN AUTHORITY

Since the Millennium Drought

— the River Murray System

Lessons learnt and changes made

December 2016

Published by the Murray–Darling Basin Authority

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MDBA publication no: 42/16
ISBN (online): 978–1–925599–03–9

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Acknowledgement of the Traditional Owners of the Murray–Darling Basin

The Murray–Darling Basin Authority acknowledges and pays respect to the Traditional Owners, and their Nations, of the Murray–Darling Basin, who have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. The MDBA understands the need for recognition of Traditional Owner knowledge and cultural values in natural resource management associated with the basin.

The approach of Traditional Owners to caring for the natural landscape, including water, can be expressed in the words of the Northern Basin Aboriginal Nations Board:

> *…As the First Nations peoples (Traditional Owners) we are the knowledge holders, connected to Country and with the cultural authority to share our knowledge. We offer perspectives to balance and challenge other voices and viewpoints. We aspire to owning and managing water to protect our totemic obligations, to carry out our way of life, and to teach our younger generations to maintain our connections and heritage through our law and customs. When Country is happy, our spirits are happy.*

The use of terms ‘Aboriginal’ and ‘Indigenous’ reflects usage in different communities within the Murray–Darling Basin.

Cover image: Dartmouth Dam

Contents

Introduction

This report summarises the key lessons learnt from operating the River Murray System during the Millennium Drought. The report also documents the changes made since the drought to improve water resource management in extreme dry conditions and identifies potential issues looking to the future.

The Millennium Drought lasted for over a decade, from the late 1990s through to the summer of 2010–11, and led to widespread social, financial and environmental impacts. The most severe impacts on water availability and management in the River Murray System were from 2006–07 to 2009–10. Inflows to the River Murray System during this period were half the previous recorded minimum and created significant uncertainty as to whether even the most basic water needs could be met. This extreme water shortage tested the long-standing arrangements for sharing the water of the River Murray between states as set out in the Murray–Darling Basin Agreement 2008 (the Agreement). The extreme dry conditions became highly political and required temporary changes to the water sharing arrangements and the implementation of a range of water saving initiatives.

During the drought, a broad range of mechanisms were made available for individuals through to the national scale to help adapt to low water availability, including: water trading, access to groundwater, altered farm management practices, off-farm sources of income and government assistance. As a result of these mechanisms, the impacts of the drought for Australia as a nation were lessened, even though there were still significant social, economic and ecological impacts at the local and individual scale.

The Millennium Drought triggered major reform in water management across Australia. It led to Australian governments investing $12.9 billion[1] into 10 years of water reform funding through the Water for the Future Program. Outcomes included the introduction of the Commonwealth *Water Act 2007*, the *Basin Plan 2012*, and a series of changes to the Agreement specifically focussed on being better prepared for the next big dry.

What was learnt?

This section outlines the key lessons learnt during the Millennium Drought, to inform future decision-making and operation of the River Murray System. In retrospect, many of these lessons seem obvious, however they are still important to reflect on. A brief summary of the changes made in response to these lessons is included, with further details in the following section.

Records can be broken

Lesson 1: Historic inflow records were broken in the Millennium Drought, and can no longer be relied upon as the best guide to what the future might hold.

The Millennium Drought led to record water shortages. Reductions in inflows and increases in water losses, such as evaporation and seepage, were significantly beyond those previously experienced. Even the most secure inflows to the River Murray System, such as those from the

[1] Commonwealth of Australia, Water Amendment Bill 2008 Explanatory Memorandum

Snowy Mountains Hydro-electric Scheme, were severely affected, and broke records for the lowest recorded inflows.

Season conditions were unlike those ever experienced before and processes based on the historic record became unreliable. For example, the water resource assessment uses the worst conditions on record to determine the volume of water guaranteed to be available, when this record was broken new worst case scenarios had to be estimated and the guaranteed volume of water reduced. The breakdown of the historical record affected operational planning and decision-making, making it harder to answer questions such as 'should the available water and contingency measures be used now or save them in case things get even worse?'

Further, unforeseen problems in existing water sharing and system operating rules and arrangements, which had been designed around wetter conditions, were also exposed by record-breaking water shortages.

In response to these unforeseen problems, tiered water sharing arrangements were introduced, and the previous minimum inflow scenarios were reviewed and reduced (see page 7 for further detail). These measures help to better assess and manage risks associated with inflow prediction and are designed to provide a framework to manage extreme dry conditions in the future, ensuring better preparedness when they next occur.

Urban water security can be threatened

Lesson 2: Unprecedented drought threatened the supply of critical human water needs.

Up until 2006, it was assumed that even under what was considered a worst case inflow scenario, inflows would still be high enough to cover losses and meet, not only urban demands, but also high security entitlements. During 2006–07 inflows reduced to half previous recorded minimum levels. Inflows were so low that without drawing on large amounts of water from the major upstream dams critical needs may have not been met.

In response, the changes made to system operating rules and arrangements formalised the concept of 'critical human water needs' and assessed and specified the volume of water required to meet critical human water needs for communities dependent on the River Murray System. The new arrangements also formally established how much water was needed to be set aside to help deliver critical human water needs. This water is known as the 'conveyance water' and allows for evaporation and other losses along the system to make sure water delivered for critical human water needs — the highest priority water in the River Murray System — makes it to where it is needed.

Impacts increase exponentially as water availability decreases

Lesson 3: As water availability declined, impacts on communities and the environment increased exponentially.

Impacts on communities and the environment increase as water availability decreases. Although this was not unexpected, what was unexpected was the rate at which impacts mounted in relation to decreasing water availability. Impacts were greater for a relatively smaller decrease in water availability the longer the drought lasted.

For example, if permanent plantings or industries are lost, the flow on effect in towns or regions could take decades to recover. For the environment, the loss of key areas of refuge such as deep pools or access to a wetland, may result in the loss of threatened species.

In response, new rules and arrangements were put in place to include a 'conveyance reserve' to provide greater security for meeting and delivering critical needs.

The long-lasting and wide-ranging effects of drought

Lesson 4: The Millennium Drought had dire effects on individuals and communities over an extended period of time, both during and after the drought.

Extreme droughts have long-lasting and wide-ranging impacts on the wellbeing and livelihoods of many, at the individual, family and community level. Impacts are diverse, for example, loss of livelihoods, strain on relationships, reduced recreational opportunities and the loss of environmental amenity. Governments provided a range of assistance to farm families and primary producers, including in the form of exceptional circumstances[2] arrangements and social and wellbeing support. Broader support was also provided by non-profit organisations.

It is also worth noting how extreme droughts impact on all levels of government decision makers and water managers, both in terms of increased workloads, but more significantly, knowing how their decisions and actions will impact others.

Some impacts of drought are irreversible, and many impacts continue long after the drought breaks; even for decades in some instances.

In response, the new arrangements provide greater drought protection for critical human needs, by prioritising it over other water uses. The matured water market and introduction of private carryover gave individuals and urban water providers greater power to best manage their own circumstances. At a broader level, the former exceptional circumstances arrangements have been replaced by an Intergovernmental Agreement on National Drought Program Reform which seeks to improve the capacity of primary producers to manage business risks, and support farm families in times of hardship.

Drought impacts states differently

Lesson 5: The drought impacted each state differently, causing some interstate inconsistencies with water supplies.

States have different processes and priorities for allocating water. These processes have evolved over time in response to the needs of the different types of production that predominate in each state, such as annual crops in New South Wales compared to permanent plantings in Victoria. These different processes and priorities meant that the impacts varied significantly across the three states. This challenged the collective state and federal decision-making processes around interstate water sharing, but was resolved at the time by negotiating temporary loans of water between states.

In response, the Australian Government and River Murray state governments agreed new water sharing arrangements to recognise these inconsistencies, and to recognise that every drought

[2] For more information see www.agriculture.gov.au/ag-farm-food/drought

will be different, presenting different issues which may vary across states. The new tiered water sharing arrangements provide flexibility for water to be advanced between states, and remedial actions to be implemented, to appropriately cater for those differences.

Private carryover and the water market play a valuable role

Lesson 6: The Millennium Drought emphasised the valuable role played by private carryover and the importance of an effective water market (including compatible water registers).

The use of private carryover expanded considerably during the Millennium Drought. Private carryover is a valuable tool that provides holders of water access rights the ability to manage their own circumstances and risks by allowing them to decide to use water now or carry it over to the next water year. Private use of carryover worked particularly well in conjunction with the water market, which allowed water to move to the highest value uses. Accordingly, a key focus of governments at the time was to ensure initial allocations were available to allow the market to operate. Analysis by the Productivity Commission[3] concluded that the impact of the drought on the economy was halved through the wide use of water trade.

In response, new arrangements were made to enable South Australia to carry over some of its entitlement to help meet its future critical human water needs, as well as for private carryover purposes. States have also individually strengthened their private carryover arrangements.

The environment bears a disproportionate impact

Lesson 7: The environment was disproportionately impacted by the Millennium Drought.

During periods of reduced water availability, water is prioritised to meet the requirements for critical human water needs, as further water becomes available it will usually be allocated to high reliability/security licences.

The Millennium Drought resulted in extremely low water availability. To reduce losses and conserve water, emergency system management measures had to be taken. Environmental impacts arose as wetlands and tributaries were disconnected from the river to save water for towns and irrigation, and water levels and river flows reduced. These impacts were perceived to be worse downstream, and included river bank slumping, soil acidification, and extremely high salinities in the Lower Lakes. Impacts, such as significant blackwater[4] events, also arose as the drought ended and floods re-wet areas of floodplains that had been dry for extended periods of time.

Environmental impacts were often difficult to predict, for example, the nature and extent of the soil acidification, and which species would be most impacted or threatened. At the time, only small volumes of entitlements had been bought for the environmental, so environmental water managers were allocated only very small volumes of water. As such, they focused on providing water to localised areas where small local outcomes could be achieved, rather than taking a system-wide approach.

In response to the significant environmental impact of the Millennium Drought, the Water Act and Basin Plan were introduced to help improve the Murray–Darling Basin's natural resources, and

[3] Productivity Commission (2010) Market mechanisms for recovering water in the Murray–Darling Basin
[4] the resulting low dissolved oxygen levels led to (for example) the death of native fish and Murray crayfish

enhance its resilience to drought. This reduces the risk to the environment but does not eliminate it.

Environmental water holders are working towards prioritising and explaining critical environmental watering needs under various dry scenarios, to allow the trade-offs to be considered in a more open and transparent manner.

Contingency measures must be carefully managed

Lesson 8: Contingency measures undertaken in the Millennium Drought created some water savings, however some involved a trade-off between local impacts for state or system-wide benefits. Several measures had significant impacts and required detailed consideration to the advantages and disadvantages of implementing them.

In response to the extremely low water availability in the Millennium Drought the Murray–Darling Basin Commission, which became the Murray–Darling Basin Authority, and River Murray states implemented a wide range of contingency measures to reduce system losses (and therefore increase water available for other purposes), increase volumes available in upstream storages to improve the likelihood of improving water availability, mitigate water quality risks and find alternative water sources for use. Contingency measures included actions such as:

- disconnecting and drying out wetlands permanently connected to the river
- reducing releases from storage below the normal minimum levels
- turning off anabranches, such as the Wakool River
- maintaining residual pools for pumping or managing acid sulphate soils
- lowering pump access points
- more flexible operation of weir pool levels
- early pumping to Adelaide storages
- use of groundwater resources
- loaning water between states.

Based on the physical nature of the River Murray System, the opportunities for implementing water saving measures varied significantly across the states.

Many of the measures had considerable social, economic and environmental impacts, and are unlikely to be repeated in the same way again. Some were able to provide water savings for a prolonged period of time, others could only be used once. Some were very expensive or required extensive planning approvals. In addition it was very difficult to accurately measure the water saved from some of the measures, making it hard to determine if the benefits were worth the costs, and how water savings should be 'repaid' when conditions improved.

Many of the proposed contingency measures had the potential for significant negative impacts. Decisions were informed by the risk management concept that you should not necessarily implement a certain severe outcome to prevent a catastrophic, but highly unlikely outcome. Decisions with the potential for significant impacts were delayed for as long as possible, so that as much information as possible was available to inform the decision. It was recognised that the costs of delaying an action could be outweighed by the benefits of waiting for more information.

Given these trade-offs, decision-makers spent considerable time weighing up the likelihood and consequence of various risks associated with each contingency measure. The immediate costs

and impacts associated with various measures and understanding the critical timeframes in making these decisions were also considered. Significant questions were considered at length, for example, would the high immediate impact of setting aside water in the current year be worth it, if it helped to offset even greater costs and impacts next year, if the next year turned out just as dry?

In response, new River Murray System management arrangements were put in place to provide for 'remedial actions'. Remedial actions have the same concept as 'contingency measures', however, the Millennium Drought showed that only small volumes of water can be made available through remedial actions. Some of the actions implemented during the Millennium Drought have now become permanent measures in some areas, such as improved on and off farm efficiencies, reducing the number of options available to create future savings. The measures used in the Millennium Drought have been reviewed, so that lessons can be incorporated next time they are required.

Clear communication is vital

Lesson 9: The Millennium Drought emphasised the value of clear information to water users and the water market.

There was significant uncertainty for water rights holders during the Millennium Drought, they were assisted by clear and regular information updates, including outlooks showing the chances of improvement in water availability, and information about water management actions being undertaken. These helped water rights holders to plan and adjust to the changing conditions and assisted the water market to function despite some significant 'shocks', such as reductions in allocations.

In response, governments and water management authorities have normalised some of the improved communication processes and practices established during the Millennium Drought, and will adapt these over time as required. Consideration is also being given as to how new technologies might be used to enhance future communication approaches.

Effectiveness of arrangements between partner governments

Lesson 10: The Millennium Drought emphasised the value of water management agencies and decision makers working together.

The Murray–Darling Basin Agreement relies on cooperative arrangements between the basin states and the Australian Government, these arrangements were fully tested by the Millennium Drought. The Murray–Darling Basin Agreement provided a robust but flexible framework for decision making, which allowed decision makers to vary historic practice in order to respond to the unprecedented conditions. In addition, the cooperation that is fundamental to the operation of the Agreement went to new levels. Ministers and senior state officials showed extraordinary cooperation, at times making decisions that benefitted the whole River Murray System, when the provisions of the Agreement would have otherwise provided a more favourable outcome for their state.

What changes have been made?

The Millennium Drought triggered major reform in water management across Australia. Major reforms included the National Plan for Water Security, the Water Act, significant investment in water related infrastructure and the replacement of the Murray–Darling Basin Commission with the Murray–Darling Basin Authority.

The signing of the Intergovernmental Agreement on Murray–Darling Basin Water Reform on 3 July 2008, led to further reforms, including arrangements for critical human water needs. The intergovernmental agreement recognised the record breaking Millennium Drought worsened the environmental stress that the basin's water and other natural resources were already under due to past water management decisions and practices. As such, a key focus of the intergovernmental agreement, particularly the Basin Plan components, was to help improve the basin's natural resources.

The following sections further explore the key changes made to managing extreme dry conditions in the River Murray System in response to the Millennium Drought. The changes provide a robust but flexible framework to plan for and manage extreme dry conditions. States have also made complementary changes within their own water management frameworks.

New governance framework

The new governance framework focuses on requirements to prioritise and better secure water to meet critical human water needs. Critical human water needs was a term applied during the Millennium Drought to include both basic human consumption requirements in urban and rural areas; and other non-human requirements that would cause unacceptably high social, economic or national security costs if water needs were not met. The ability to meet critical human water needs was threatened during the drought and so the new framework prioritised water to be set aside to meet and deliver these needs.

The new arrangements also established a three tier water sharing arrangement between the River Murray states. The tiered system provides a framework for adjusting ‘normal’ water sharing arrangements under extremely dry conditions. The framework is purposefully flexible, allowing for decision-makers to respond to the conditions at the time and new issues as they arise.

The four key parts to the new governance framework are the Water Act, Basin Plan, Murray–Darling Basin Agreement and the Objectives and outcomes for river operations in the River Murray System. The new or changed arrangements are described briefly in Table 1, and in further detail in the following sections.

Table 1: Core elements of the new governance framework

Item	What's new?
Water Act 2007 (Cwlth)	Part 2A establishes the concepts of: • critical human water needs • tiers for water sharing • conveyance water (to deliver) • conveyance reserve
Basin Plan 2012	Chapter 11 sets out: • volumes of critical human water needs • conveyance water and the conveyance reserve • salinity and water quality triggers at which water becomes unsuitable for meeting critical human water needs • processes to assess and manage risks associated with inflow prediction • triggers for changing water sharing tiers
Murray–Darling Basin Agreement	Changes to the Murray–Darling Basin Agreement include: • addition of Schedule G — SA Storage Right • addition of Schedule H — water sharing during Tiers 2 and 3 • supporting amendments
Objectives and outcomes document for operation of the River Murray System	Basin Officials Committee has set Specific Objectives and Outcomes that provide further direction on river operations during periods of Tier 2 and Tier 3 water sharing arrangements.

The Water Act

Provisions for critical human water needs are set out in Part 2A of the Water Act. The Act establishes water for critical human needs as the highest priority water use for communities that are dependent on the Basin's water resources. To give effect to this in the River Murray System, the Water Act provides that the 'conveyance water' (water required to deliver critical human water needs to protect against losses) has the first priority of the available water. The priorities for the available water are shown in Figure 1.

The Water Act also sets out requirements for the Basin Plan to address critical human water needs, including to:

- set the volume of water required to meet critical human water needs for communities dependent on the River Murray System in New South Wales, Victoria and South Australia
- set the volume of conveyance water required to deliver critical human water needs at an adequate water quality as far as Wellington in South Australia. This provides for water to

be extracted for Adelaide, but does not provide for the maintenance of water levels or quality in lakes Alexandrina and Albert
- establish water quality and quantity triggers for changing water sharing tiers
- include a water reserve policy to help meet conveyance water requirements.

The Water Act also requires an emergency response by the MDBA and the Basin Officials Committee if a water quality trigger is reached.

The Basin Plan

Critical human water needs

A key component of the Basin Plan is to state the volumes of water required to meet and deliver critical human water needs (Chapter 11). These volumes are shown in Figure 1, with the highest priority water in the River Murray System being conveyance water. As conditions improve and further water becomes available, critical human water needs, followed by conveyance reserve volumes are set aside. New South Wales, Victoria and South Australia are each responsible for setting aside the water they need for critical human needs, they may use water from outside the River Murray System, for example from tributaries, groundwater or desalination. Once the required volume of water is set aside to meet and deliver critical human water needs, any further water that enters the system is then made available to state allocations.

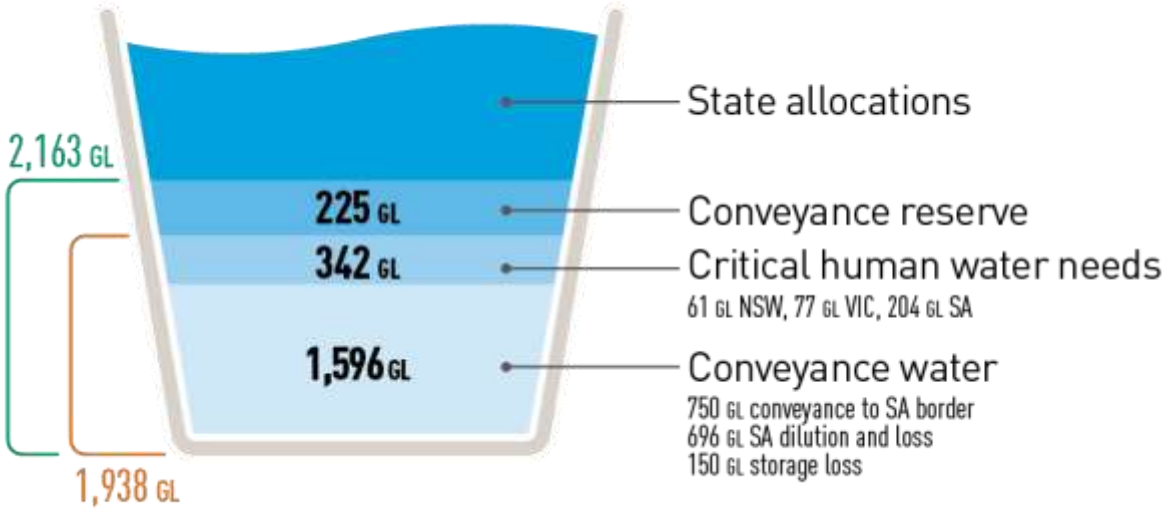

Figure 1: Volumes required to meet and deliver critical human water needs

The conveyance reserve was determined by seeking an appropriate balance between the small risk (but very significant impact) of such low inflows occurring, and the ongoing impact to entitlement holders of reduced water availability at other times.

The Basin Plan also sets out requirements for monitoring, assessment and management of risks with regards to critical human water needs. These new requirements complement the MDBA's existing processes for managing risks to water availability in the River Murray System.

Triggers for changing between water sharing tiers

Another key component of the Basin Plan is setting the triggers that activate moving between water sharing tiers. These triggers are based on the amount of water available, or the quality of the water, in the system.

Water quality based triggers are activated if water is of a quality that cannot be treated for human consumption, or if salinity is greater than 1,400 EC (µS/cm) upstream of Wellington. Activating the water quality trigger establishes Tier 3 water sharing arrangements.

Water availability based triggers are activated if assessments of future water availability show that conveyance water, conveyance reserve or critical human water needs requirements may not be able to be met. Activating the water availability triggers establishes either Tier 2 or Tier 3 water sharing arrangements, depending on the circumstances. The triggers and the provisions of the different water sharing tiers are discussed in the next section and in Appendix 1.

The Basin Plan also sets out how water availability is to be assessed in regards to meeting requirements for critical human water needs. The assessment uses hypothetical inflows to the storages of the River Murray System that are less than the lowest recorded inflow, combined with estimated worst case inflows from the tributaries, such as the Goulburn River and the Murrumbidgee River. Assessing future water availability based on potential inflows lower than previously recorded, helps river managers plan and prepare for conditions ever drier than previously experienced.

The Murray–Darling Basin Agreement

The Murray–Darling Basin Agreement was amended in 2011 to work alongside the critical human water needs provisions in the Water Act, and the provisions required by the Water Act to be included in the Basin Plan. The Water Act defines critical human water needs and establishes conveyance water as the highest priority water in the River Murray System. The Basin Plan establish the volumes and other requirements for critical human water needs. The Agreement gives effect to these requirements by changing water sharing arrangements, for example giving priority to conveyance water.

The most significant changes to the Agreement were the creation of:

- Schedule G — Accounting for the South Australian storage right
- Schedule H — Water sharing during Tiers 2 and 3
- the addition of provisions related to critical human water needs in clauses 102A to 102D (noting there are other consequential amendments).

Schedule G

The inclusion of Schedule G gave South Australia the ability to store water for critical human water needs and private carryover. Previously, South Australia was limited in its ability to manage its use of River Murray resources to plan for dry conditions.

Schedule H

Schedule H created Tier 2 and 3 water sharing arrangements, which were designed to enable special arrangements to be agreed to provide for critical human water needs in extreme circumstances (Figure 2). Tier 1 water sharing arrangements are the long standing ‘normal’

arrangements in the Murray–Darling Basin Agreement for sharing water in the River Murray System between the River Murray states.

Tier 1 arrangements cover very wet, through to dry conditions. Tier 2 arrangements are triggered when critical human water needs volumes can be met, but adjustments to water sharing arrangements are needed to provide conveyance water and/or the conveyance reserve.

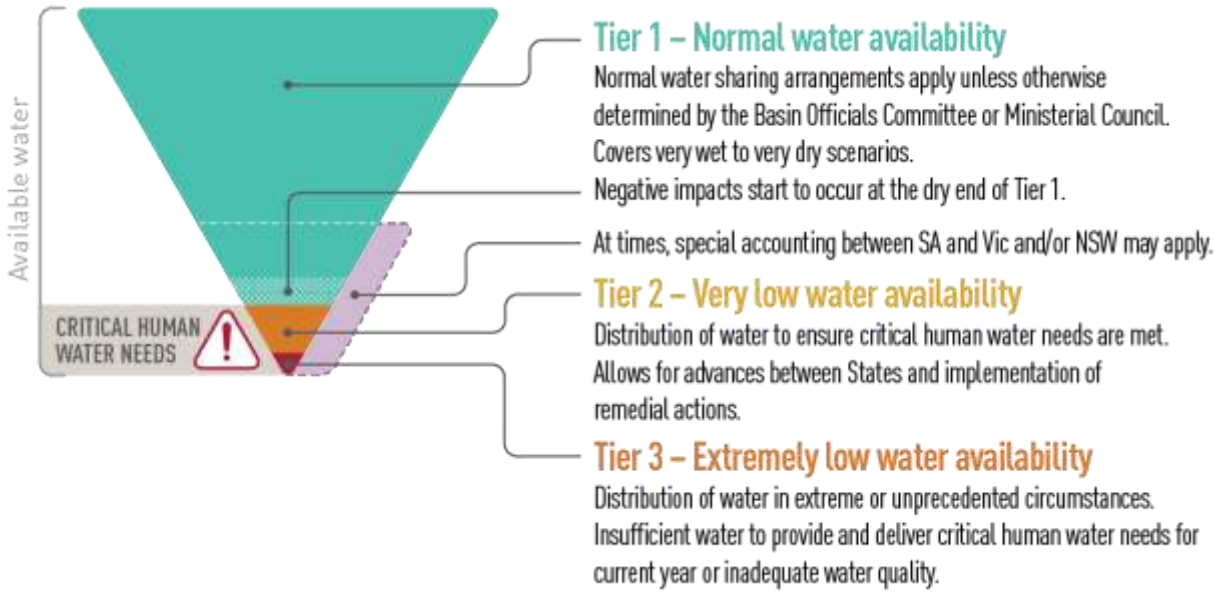

Figure 2: Tiered water sharing arrangements in the River Murray System

Tier 2 provides a framework to vary the normal water sharing arrangements to ensure conveyance water and/or the conveyance reserve are met. This may involve one or more states advancing water from its entitlement to help another state meet their conveyance obligations, or it may involve BOC implementing remedial actions to provide for conveyance water.

Tier 3 arrangements are only triggered in extreme and unprecedented circumstances, where there is insufficient water for critical human water needs to be met and delivered. Tier 3 may also be triggered by poor water quality.

Schedule H also creates additional roles for the MDBA in terms of water accounting and reporting, and obligations for the Basin Officials Committee and Ministerial Council.

Provisions related to critical human water needs

The key changes to the body of the Murray–Darling Basin Agreement in relation to drought management:

- require the MDBA to set aside conveyance water before any water is allocated to the states (cl 102(c)(i))
- require the states to demonstrate that they have set aside sufficient water for critical human water needs (cl 102B)
- establish a mechanism to allow one or more states to advance water to another state to meet critical human water needs (cl 102C)
- describe how the MDBA will determine each state's contribution to the conveyance reserve (cl 102D)

- allow for the conveyance reserve in the calculation of the minimum reserve (cl 103(2)).

Objectives and outcomes

Clause 31 of the Agreement requires the Basin Officials Committee to set objectives and outcomes for river operations in the River Murray System. This is achieved through the Objectives and outcomes for river operations in the River Murray System document, in which the committee provides direction to the MDBA with regards to river operations. The document also improves transparency by setting clear governance arrangements for decision-making in river operations, and an annual review process. The Objectives and outcomes document includes specific objectives and outcomes which allow the committee to provide further direction for particular activities, structures and river reaches.

In 2015, the Basin Officials Committee set specific objectives and outcomes for Tier 2 and 3 water sharing arrangements. These provide further detail around the committee's expectations with respect to:

- how advances of water from one or more states to another are to be made and paid back
- the information to be provided by the MDBA with respect to possible remedial actions, such as:
    - the likely volume of water to be provided
    - the lead time to implement the action
    - potential economic, social, environmental (including water quality) and political impacts
    - how the action is to be accounted for
    - priorities for allocating water when Tier 2 or 3 water sharing arrangements apply
    - how the conveyance reserve is set aside.

Other changes

There were also a wide range of non-governance changes to the management of the River Murray System that arose during, or in response to the millennium drought. A few key examples are provided below:

- States introduced policies that allow water entitlement holders to carryover allocations from one year to the next, giving entitlement holders more flexibility to manage their own water use across years and save water for dry conditions. In some cases, states also introduced reserves to ensure that the water carried over could be delivered.
- The water trade market matured, and entitlement holders are understood to be relying on the market, including temporary trade to help plan for and respond to dry conditions.
- Water delivery and ordering systems have become more efficient.
- Entitlement holders are using water more efficiently on-farm and have adapted to be able to produce more with less.
- Alternative water supplies, such as groundwater and desalination, have been sourced to help reduce pressure on the River Murray System during dry conditions.
- The Basin Officials Committee amended some of the rules for which unforeseen issues arose during the millennium drought, for example the details associated with 'special accounting'.

- Learnings about contingency measures (now referred to as remedial actions under Tier 2) have been documented for future reference.
- Some of the improved processes and practices for communicating with communities and water users, which were established during the millennium drought, have become embedded as 'normal' practices.
- Significantly more environmental water has been acquired under the Basin Plan. Environmental water holders are working towards prioritising and communicating environmental watering needs under extremely dry conditions, to allow the trade-offs to be considered in a more open and transparent manner.
- A national review of drought policy and programs undertaken in 2008 recommended that drought assistance programs be restructured to help farmers better plan and prepare for drought, rather than waiting until they are in crisis before offering assistance. This led to the Intergovernmental Agreement on National Drought Program Reform[5] in 2013, which seeks to improve the capacity of primary producers to manage business risks, and support farm families in times of hardship.

What risks remain? What new issues have arisen?

Governments are preparing for what the future might hold if the dry conditions continue. Despite the many changes that have been made, some risks still remain, and a range of new issues have arisen. These matters are being actively considered and discussed by water managers, both individually and collectively, in relation to the River Murray System. Further, the reforms made since the millennium drought have not yet been tested with another significant dry period.

Tier 2 and 3 water sharing arrangements occur in extreme conditions, similar to, or worse than the millennium drought. However, water users and communities are still likely to experience very difficult times at the drier end of Tier 1 arrangements, and water managers may choose to undertake precautionary actions at the drier end of Tier 1. Precautionary actions would likely focus on assisting water users by keeping the water market operating or to avoid or delay entering Tier 2. However, if conditions continued to deteriorate, the early use of precautionary actions could later reduce the options available to manage extreme conditions. Decision-makers need to carefully balance the risks between helping water users at the dry end of Tier 1, against having more options available if conditions stay dry. Water managers understand this risk and factor it into their decision-making processes.

There is now more reliance on the water market to allow water to move to the highest value uses during such dry times. There is also a greater expectation that entitlement holders will manage their own risks, such as through the use of carry over provisions. However, there is uncertainty as to how, and to what extent, such behaviour will occur during the next dry period, making operational planning difficult.

[5] www.agriculture.gov.au/ag-farm-food/drought/drought-policy/drought-program-reform

The states operate under different risk profiles and as such, have very different approaches to allocating and reserving water and how private carryover and high security entitlements are provided for. As a result, the potential remains for significant differences in water available to each state during very dry conditions. These differences could create pressure for water to be shared more evenly.

The new arrangements have sought to provide a balance between required responses, while still allowing flexibility to respond to the conditions being experienced at the time. Inevitably, it will remain necessary for decisions to be made with a high degree of uncertainty about what the future will hold. Communication within and between governments and with communities will be key at such times.

At the time of publication, it has been little more than five years since the millennium drought was broken by the floods of 2010. Whilst many communities have bounced back, others are still recovering and have strong memories of the difficulties faced last time. Some communities will likely have less resilience to face another drought in the short term.

Some of the actions implemented during the millennium drought have now become permanent measures in some areas, with improved efficiencies both on and off farm. Further on-farm efficiencies have enabled the water savings to be sold to environmental water holders. Permanent improvements in efficiency such as these mean it will be much harder to find further cost-effective savings in future.

There are now substantial volumes of environmental water entitlements held by governments. As conditions become drier, environment water managers and governments are likely to face conflicting pressures from varying interest groups — on the one hand to deliver on the Basin Plan through protecting key environmental assets or maintaining refuges for key threatened species, on the other to sell or 'loan' water to other struggling consumptive users. Environmental water managers are reviewing possible risks to the environment, and considering the best ways to use their water holdings under a range of dry and extremely dry scenarios. They are also working closely with water resource managers to understand and manage the potential risks to the environmental portfolios.

Conclusion

Significant changes have been made to help better plan for and manage extreme dry conditions in the River Murray System and to provide water for critical human water needs. These changes seek to provide a clear and consistent framework for decision-making across all River Murray states, while giving decision-makers the flexibility to respond to the conditions at the time. The Basin Plan should also mean that the environment is better equipped to cope with drought conditions than it was previously during the millennium drought.

Despite the best plans, droughts cannot be prevented. Future droughts will be different and potentially more severe than the millennium drought. Different responses may be required, but the new arrangements provide a solid framework for responding to the conditions at the time.

Glossary

Advance
A general term that refers to water temporarily 'loaned' from one state to another. Unlike ceding of water, it must be repaid. In times of Tier 2 and Tier 3 water sharing the Basin Officials Committee would make decisions on advances and arrangements for repayments.

Agreement
See the Murray–Darling Basin Agreement 2008.

Allocations
The percentage of water to which the holder of an access licence is entitled. Each state makes water allocations to its water entitlement holders that can be used or traded within a water year. Allocations depend on seasonal conditions and state laws.

The basin
See Murray–Darling Basin.

Basin Officials Committee
A committee established under section 201 of the Water Act 2007 (Cwlth) that facilitates cooperation and coordination between the Australian Government, the basin states and the MDBA in funding works and managing the basin water and other natural resources. Membership of the committee comprises one official from each of the basin states (Australian Government, New South Wales, Victoria, South Australia, Queensland and the ACT), and is chaired by the Australian Government committee member.

Basin Plan 2012
The Basin Plan is an Instrument that was made under Part 2 of the *Water Act 2007* (Cwlth) as a strategic plan for the integrated and sustainable management of water resources across the whole basin. The Plan identifies risks to basin water resources and strategies to address/manage these risks, such as critical human water needs (Part 2A) and water trading rules.

Blackwater
A water quality issue when levels of dissolved oxygen in water are low. It occurs during flooding after accumulated organic material is washed into waterways. Bacteria consume the organic material and this depletes the dissolved oxygen in the water. The water takes on a black appearance when dissolved carbon compounds are releases as organic matter decays.

Contingency measure
An historical term for 'extraordinary measures' that supplement water availability under extreme dry conditions. The term has been replaced by ‘remedial actions’.

Conveyance reserve
Water set aside by the Murray–Darling Basin Authority to support the provision of conveyance water for the following water year. See Clause 102D of the Murray–Darling Basin Agreement 2008.

Conveyance water
Has the meaning given by subsection 86A(4) of the *Water Act 2007* (Cwlth) -is water in the River Murray System that is required to deliver water to meet critical human water needs as far

downstream as Wellington in South Australia. Conveyance water is the extra water involved in transferring a parcel of water from an upstream location to a downstream location to allow for losses along the way such as seepage and evaporation.

Critical human water needs
Has the meaning given by subsection 86A(2) *Water Act 2007* (Cwlth). The need for a minimum amount of water that can only reasonably be provided from basin water resources, required to meet core human consumption requirements in urban and rural areas; and those non-human consumption requirements that a failure to meet would cause prohibitively high social, economic or national security costs.

Extreme dry conditions
Periods where inflows to the River Murray System are substantially diminished for sustained periods of time, combined with reduced volumes held in River Murray System.

Forecast
A prediction or estimate.

High security entitlements
Different states have different entitlement classes that may access water from a consumptive pool. High security entitlements are generally seen as having a high reliability of access each year compared to other entitlement classes.

Improvement
The net increase in water resources or water availability determined by the Murray–Darling Basin Authority between one water resource assessment and the next. This term can apply at different scales — for example to specific sources such as tributaries, or to total or state water shares. In undertaking the water resource assessment the Murray–Darling Basin Authority must take into account forecast system losses and inflows which may need to be altered from time to time.

Inflow
Input of water from a source to a specific body of water — for a lake, inflow could be a stream or river. Inflow for a stream or river could be runoff from rainfall.

Inflow prediction
A process for estimating the likely volume of inflow, requirements for inflow prediction are set out in Part 3 of the Basin Plan 2012 for predicting system inflows, this includes identifying risk factors to meeting critical human water needs.

Losses
Water lost from the available pool of consumptive water through processes like evaporation and seepage.

Murray–Darling Basin
The entire tract of land drained by the Murray and Darling rivers. The basin covers over 1 million square kilometres of land in Queensland, New South Wales, the Australian Capital Territory, Victoria and South Australia.

Murray–Darling Basin Agreement 2008
An agreement between partner governments that promotes and coordinates effective planning and management for the equitable, efficient and sustainable use of the water and other natural resources of the Murray–Darling Basin.

Murray–Darling Basin Authority
Established under section 171 of the Water Act 2007 (Cwlth) as in independent expertise based agency whose key roles involve preparing and implementing the Basin Plan, and to operate the River Murray System.

Murray–Darling Basin Commission
Superseded by the Murray–Darling Authority.

Millennium drought
Period when much of southern Australia experienced a prolonged period of dry conditions. It occurred in different areas from 1996 to mid-2010.

Minimum reserve
Clause 103 of the Agreement specifies a minimum reserve – water held in storage to provide additional security in meeting South Australia's entitlement the following year.

Private carryover
Private carryover of allocations describes the policy arrangements that allow water entitlement holders to save a volume of unused allocation made available in a water year, for use subsequent in a water year. It helps water entitlement holders to manage their own risks. Carryover provisions vary between states and carryover rules may change from time to time.

Refuge
An area that a population of organisms inhabit to survive unfavourable conditions such as low water availability.

Remedial action
An action or actions that has been approved by the Basin Officials Committee to give effect to water savings or provide greater water efficiency in times of low water availability. See clause 10 of Schedule H to the Agreement.

River Murray System
The River Murray System includes the main stem of the River Murray and associated dams and weirs, the Coorong, Lower Lakes and Murray Mouth in South Australia, and the Edward–Wakool, Mitta Mitta, Kiewa, and the lower Darling rivers (downstream of Menindee Lakes). The exact meaning is given in Subsection 86A(3) of the *Water Act 2007* (Cwlth).

River operations
Activities under the Murray–Darling Basin Agreement relevant to operating the River Murray System and providing related services to state contracting governments. The exact meaning is given in Clause 2 of the Agreement.

Snowy Mountains Hydro-electric Scheme
The scheme collects water from melting snow and rain in the Snowy Mountains. Historically, most of this water flowed into the Snowy River. Now the water is diverted into the Murray and

Murrumbidgee rivers and stored in dams before being used to create hydro-electricity in power stations. The scheme is jointly owned by the governments of New South Wales, Victoria and Australian Government.

States
Means New South Wales, Victoria and South Australia.

Tier 1 water sharing
Normal River Murray water sharing arrangements as set out in Part XII — Division 1 of the Murray--Darling Basin Agreement.

Tier 2 water sharing
Water sharing arrangements set out in Part XII — Division 2 of the Murray–Darling Basin Agreement and Schedule H to the Agreement. They seeks to ensure critical human water needs are met. Tier 2 will be declared by the Murray–Darling Basin Authority if:

- from 1 June to 31 August — there is insufficient water to provide conveyance water in the current water accounting period and/or
- from 1 September to 31 May — there is insufficient water to set aside a conveyance reserve for the next water accounting period

based on the worst case planning water resource assessment.

Tier 3 water sharing
Water sharing arrangements set out in Part XII — Division 3 of the Murray–Darling Basin Agreement and Schedule H to reflect extreme and unprecedented low levels of water availability in the system. Tier 3 will be declared by the Murray–Darling Basin Authority if:

- there is insufficient water to provide all of the critical human water needs in the current year
- there is insufficient water to provide conveyance water in the current water year, taking into account any advances or remedial actions

based on the worst case planning water resource assessment, or if a specified water quality or salinity trigger is reached.

***Water Act 2007* (Cwlth)**
Legislation that includes the Murray–Darling Basin Agreement (Schedule 1) and provides for the management of the water resources of the Murray–Darling Basin. It also provides for other matters of national interest in relation to water and water information.

Threatened species
Any animal or plant species that are at risk of extinction.

Water for the Future initiative
A long-term Australian Government initiative to better balance the water needs of communities, farmers and the environment which contains a suite of urban and rural policies and programs, including significant funding for irrigation, modernisation, water purchasing and desalination.

Water market
The Australian marketplace for trades of tradeable water rights.

Water resource assessment
The activity of estimating the volume of water available in the River Murray System.

Water resource management
The activity of planning, developing, distributing and managing the use of water.

Water sharing arrangements
Governed by the Murray–Darling Basin Agreement, water sharing arrangements are those arrangements agreed to by the River Murray states in how the water of the River Murray System is to be shared between those states.

Appendix 1

Triggers for changing water sharing tiers

Table 2: Overview of the three tiers of state water sharing

Tier	Information
Tier 1 — normal	Normal water sharing under the Agreement.
Tier 2 — distribution of waters to ensure critical human water needs are met	Tier 2 will be declared by the Authority if: • from 1 June to 31 Aug — there is insufficient water to provide conveyance water in the current water accounting period and/or • from 1 Sep to 31 May — there is insufficient water to set aside a conveyance reserve for the next water accounting period based on the worst case planning water resource assessment.
Tier 3 — extreme and unprecedented low levels of water availability in the system	Tier 3 will be declared by the Authority if: • there is insufficient water to provide all of the critical human water needs in the current year or • there is insufficient water to provide the conveyance water in the current water year, taking into account any advances or remedial actions based on the worst case planning water resource assessment, **or** • a specified water quality trigger or salinity trigger is reached.

It is possible to move from Tier 1 to Tier 2 or Tier 1 to Tier 3.

Additional information of the triggers for moving between tiers is in the Chapter 11 of the Basin Plan and in the Guideline on the triggers and processes for moving between water sharing tiers (available on the MDBA website). As well as low volume triggers there are water quality triggers and salinity triggers.