Australian Government

MURRAY–DARLING BASIN AUTHORITY

Murray–Darling Basin Authority

Submission to the Select Committee on the Murray–Darling Basin Plan

25th September 2015

Table of contents

List of Figures

List of Tables

Executive summary

The Murray–Darling Basin Plan (Basin Plan) aims to ensure the water resources of the Murray–Darling Basin (the basin) are shared between all water users in a sustainable way. It is about striking a balance that delivers a healthy system that underpins productive industries and resilient communities.

The *Water Act 2007* (Cwth) (Water Act) builds on the lessons of over two decades of water reform, and the Basin Plan is the key instrument that implements it. The Water Act and the Basin Plan have enjoyed unprecedented and ongoing bipartisan support – a strong recognition of the seriousness of the issues at stake, and the importance to Australia of getting this right.

The Basin Plan builds on the state governments' long standing water management arrangements and introduces two key new requirements:

1. sustainable limits on water extraction for all water resources in the basin
2. whole-of-basin management to ensure a basin-wide approach is taken to managing the connected river system across jurisdictional borders

The 2012 Basin Plan was shaped by significant input from state governments, communities, interest groups and individuals, many with diametrically opposed views of what was needed. As a result of community input and state requests, the 2012 Basin Plan water reform package was adjusted to include:

- a seven-year transition period to reach the new settings in the plan, giving communities and industries time to adjust
- opportunities built into the Basin Plan for adjustment and review, to improve the triple bottom line benefits, notably:
  - the 'SDL adjustment process': to look at potential projects that can reduce the amount of water needing to be recovered provided equivalent environmental outcomes can be achieved and social and economic outcomes are maintained or improved
  - the Constraints Management Strategy: to investigate improvements to the effectiveness of environmental water use, which is supported by $200 million Commonwealth funding to mitigate impacts
  - the Northern Basin Review: to revisit some of the settings in the north once more robust science and a better understanding of the potential social and economic effects on some more vulnerable communities is available
  - three groundwater reviews to assess the potential to increase sustainable groundwater extraction in three areas
- Commonwealth government commitment to prioritise infrastructure investment over purchasing water on the market, to achieve the new sustainable limit

The Basin Plan that was endorsed by Parliament (95 votes to 5) balances the competing interests and provides a clearly defined timetable for implementation to create certainty for communities and for investment.

The new extraction limit for the basin as a whole means that 2750 gigalitres per year has to be recovered from consumptive use for the environment. This recovery volume was determined based on an assessment of the potential to improve the condition and resilience of the environment, with the least amount of socioeconomic impact, which inevitably comes with any such adjustment. This volume represents moving about 8.5 per cent of the basin's long-term average inflows from consumptive use to the environment.

It is almost three years since the Basin Plan was passed into law, and implementation by Commonwealth and state agencies is on track. The Basin Plan Implementation Agreement was agreed in 2013 between the Murray–Darling Basin Authority (MDBA) and each state and the Commonwealth Environmental Water Holder. The foundations for implementation have been established and milestones have been met.

There has been good progress on a number of fronts:

- The first ever long-term environmental watering strategy for the whole basin was finalised in 2014, which included quantified outcomes against which to measure progress
- There has been good progress on the SDL adjustment mechanism – the assessment method was trialled, with independent reviewers confirming that the method is scientifically robust and fit for purpose, and an independent stocktake of SDL projects showing that a reduction in the water recovery target of 500 gigalitres was plausible
- The Constraints Management Strategy was developed in collaboration with states and the community at the end of 2013, setting out a 10 year pathway with states now leading investigation of the constraints projects in the key areas of the basin
- The first Basin Plan annual report (2013–14) showed early benefits from environmental watering by state and Commonwealth water holders, and showed the benefits emerging from the large Commonwealth investment in irrigation infrastructure over the past few years
- The monitoring and evaluation framework has been developed and the social, economic and environmental monitoring program is well underway
- Over 2013–14, more than 2000 gigalitres was delivered to priority sites by state and Commonwealth water holders – this water was re-used as it flowed from site to site and benefitted fish spawning, bird breeding, and improvements in vegetation condition throughout the system.

The Commonwealth's multi-billion dollar program to improve infrastructure and irrigation efficiency is well underway. $8 billion has already been contracted and in the coming years will provide unprecedented levels of government funding to modernise irrigation across the basin so that productivity can be sustained – using less water more efficiently. At the same time, investment will start to flow to the SDL adjustment projects that are designed to improve how the river is run, including how environmental water is used.

More than 70 per cent of the water recovery volume has already been acquired. Furthermore, early indications are that SDL adjustment projects being developed by states could reduce the amount of water that must be recovered by around 500 gigalitres. Together with the 1500 gigalitre cap on buybacks, this means that the remaining recovery effort will come mainly from water savings achieved through modernising irrigation infrastructure, rather than water buybacks.

Given the current priority focus on investment and that the opportunities for review and adjustment are on track and will come to fruition in 2016, the MDBA considers it would be premature to delay Basin Plan implementation and investment now. To do so would set back one the best opportunities we have to transform Australia's irrigation sector into a more efficient and competitive industry in the face of an increasingly challenging future. It would set back the best chance to achieving a healthy working basin for all who depend on it.

The Basin Plan and the associated reform package constitute one of the largest structural adjustment packages in Australia's history. Together they will improve the long-term health and sustainability of the river system, to help build sustainable rural industries.

The importance of the Basin Plan

The Basin Plan will achieve a healthy, working Murray–Darling Basin. The Basin Plan was made in November 2012 and at its heart is the need to ensure water is shared between all users in an equitable and sustainable way.

Why the Basin Plan is needed

The Basin Plan is about placing the water resources of the Murray–Darling Basin on a sustainable footing. The overarching aim is to ensure that there is the right balance between the different economic, social and environmental demands on the water resources of the basin.

This will ensure enough water is available to achieve an equitable balance between the Basin Plan's triple bottom line outcomes; to support productive industries, farmers and towns into the future, while leaving sufficient water in the basin's river system to ensure a healthy environment for the benefit of basin communities.

Water in the basin is an important national resource underpinning half of Australia's irrigated agricultural production along with other important industries including tourism, fishing and floodplain grazing, as well as providing water to towns and farms. The basin's rivers and floodplain wetlands contain myriad natural values of both national and international significance, and underpin the long term sustainability of water dependent industries.

However, the water resource development over the past century has been recognised as having had unintended consequences. Changes to the flow regime of the basin's rivers have affected flood- and flow-dependent species and ecosystems. The ecological condition of the basin has been assessed as being predominantly poor, with the trend being one of decline. It is probable that, without management change, there would have been ongoing and increasing degradation of water-dependent ecosystems in the basin.

The Millennium drought exposed the limits and weaknesses of how water is currently used in the basin. However, declines in the basin's environmental health have not been restricted to drought years.

Rivers in the southern basin once flowed more strongly in winter and spring; now their flows peak in summer and autumn to match the demands of irrigators. Changes to seasonal peaks can affect breeding and feeding opportunities for most of the water-dependent native animals in the basin, and seasonality of flooding is important for most flood-dependent vegetation. While very large floods can still occur, small to medium floods are commonly constrained, typically by in-stream dams in the more regulated south, or captured in large on-farm storages in the less regulated north. The reduction in smaller flood events adversely affects the basin environment, as these smaller floods are important in ensuring that the basin's environment is resilient and able to survive through drought years.

Changes to the quantity and quality of the basin's water resources also have social and economic implications. Overallocation of water, compounded by drought, has led to lower reliability of water allocations, with many irrigators receiving little or no water in some years, and a reduction in floodplain grazing. During the Millennium drought, towns and cities experienced harsh water restrictions. Changes to basin river systems have also eroded its capacity to meet the needs of Aboriginal people.

There is a long history of collective management and government involvement to address environmental degradation in the basin. Through the 1980s to 2000s, strategies have been put in place to manage salinity and water quality in the basin. In 1995, a cap was placed on water diversions, in an effort to halt the growing overuse of basin water resources. The 2004 National Water Initiative has provided a strategic framework for reform, and through the Living Murray Agreement almost 500 gigalitres of water has been recovered, and environmental works commissioned, as a first step towards improving the health of the River Murray.

While these interventions have made considerable progress in the sustainable management of basin water resources, successive biennial assessments by the National Water Commission found that the states remained reluctant to explicitly identify over-allocated and overused systems and to fully implement measures to move them to sustainable levels of extraction. It noted in its 2009 assessment that some state water plans were unable to respond effectively to the recent drought. It also stated that accountability for environmental outcomes remained weak. In particular, monitoring capacity was often inadequate and there was a lack of transparent reporting of outcomes.

The MDBA considers that to maintain both the ecological health and productive capacity of the basin, a rebalancing of the basin's water resources is required.

Building a resilient water sector

The Basin Plan builds on a long history of river management and more recent water reform. Governments have long recognised that cooperation is vital if all states are to enjoy the benefits of the system. The need to manage the rivers of the basin collectively has been recognised for 100 years – the first agreement being the *1914 River Murray Waters Agreement* between the Commonwealth, New South Wales, Victoria and South Australia.

More recently, recognising that existing practice was not sustainable, national agreement was reached to move to a more efficient and resilient water sector in the basin – firstly through the *1994 COAG Water Reform Framework* and later expanded in the *2004 Intergovernmental Agreement on a National Water Initiative*. The *Water Act 2007* (Cwth) was the crucial next step in ensuring that the reforms could be achieved, through both the Basin Plan and the substantial multi-billion dollar investment that sits alongside it.

It is widely recognised that water reform is not an easy or short-term issue. The long-term commitment from all governments required to bring about sustainable water management is the reason many other countries have not progressed as far as Australia has. This is to the detriment of their environment, communities and production in the long run.

The unprecedented bipartisan support for water reform across more than 20 years reflects not only its importance, but also the compelling evidence base behind the need for change.

What the Basin Plan will do

The Basin Plan will achieve a healthy working basin. It builds on the experience of two decades of reform, which has been implemented during extremes of wet and dry. The Basin Plan fundamentally changes the way basin water resources are managed, including:

- managing the basin as one system – this means managing water across state borders, in the national interest rather than on jurisdictional or sectoral based views

- sustainable and legally enforceable limits on surface and groundwater extraction across the basin (known as the sustainable diversion limits, or SDLs) established through a triple bottom line approach
- coordinated basin-wide environmental watering arrangements and water quality targets to optimise the outcomes achieved
- increased certainty for water users and entitlement holders through improved and more transparent water resource planning
- reforms for achieving a more effective water market that can deliver more flexibility
- a one-off adjustment process to improve economic and environmental outcomes (through the SDL adjustment mechanism and the northern basin review)

Manage the basin as one system

Water resources in the basin run through five states and territories, connecting across the entire landscape—water runs off catchments; along rivers; into billabongs, lakes and wetlands; across floodplains and ultimately to the ocean.

The Basin Plan introduces a whole-of-basin approach to managing water sustainably across borders, namely managing the basin as one system. This approach can be seen through all elements of the Basin Plan, and is further detailed throughout this document.

The Basin Plan can ensure all those who rely on the basin can be more resilient going into the next drought.

Returning balance to the system – sustainable limits on extraction

The Basin Plan aims to provide for the integrated management of basin water resources, including by ensuring that the use and management of these water resources occurs in a way that optimises economic, social and environmental benefits.

The Basin Plan sets a long term average annual limit on surface water extraction of 10,873 gigalitres that comes into effect on 1 July 2019. This is called the Sustainable Diversion Limit, or SDL. This is 2750 gigalitres (the water recovery amount) less than the 13,623 gigalitre level of extraction at 2009 levels (baseline).

Table 1 – Basin Plan long term average Sustainable Diversion Limits for surface water

	Northern basin	Southern basin	**Total basin**
Baseline level of extraction at 2009 (GL)	3858	9765	**13623**
Amount extraction is to be reduced (GL)	390	2360	**2750**
Basin Plan limit on extraction (GL)	3468	7405	**10873**

The Basin Plan also sets an annual limit on groundwater extraction of 3,334 gigalitres.

These limits will achieve a balance between water users in the basin so that there is a healthy system to sustain production and communities into the future. The Basin Plan provides investment certainty for all water users, including towns and irrigated agriculture.

In developing the Basin Plan, and in particular the new SDLs, the MDBA considered the water needs of communities, industries and the environment. The Water Act requires that these new limits are determined for the water resources of each water resource plan area, as well as for the basin water

resources as a whole. Each SDL must reflect an Environmentally Sustainable Level of Take (ESLT) for the relevant water resource.

Estimating an ESLT at the basin-wide scale, and for individual resources, in a basin as large and diverse as the Murray–Darling is a complex task with many uncertainties.

In recognition that there is no simple mechanism to estimate an ESLT, the MDBA undertook an extensive work program that harnessed relevant knowledge, including environmental, social and economic information, to inform its judgement of an appropriate Basin Plan that met the requirements and objectives of the Water Act. This included ecological, hydrologic and social assessments informed by an extensive array of previous studies, modelling, new research and management plans. Critically, the development of the sustainable limit was informed by the views and evidence from communities and industry. How this limit was derived is detailed at **Appendix 1**.

Expected environmental improvements from the Basin Plan

The Basin Plan includes an Environment Watering Strategy, which was published in 2014, that clearly sets out measurable environmental outcomes that are expected to be achieved. The strategy takes a whole-of-basin perspective and highlights that improvements are sought down the entire length of the river systems - from the top of the system to the end, and across valleys and state borders.

Improving the health of the basin's water dependent ecosystems will provide multiple benefits for individuals and communities in the basin. For example, a healthy environment will provide improved amenity and recreational benefits for local residents, tourists and businesses and water quality suitable for irrigation, domestic and urban water supplies.

The strategy outlines MDBA's best assessment of how the basin's water dependent ecosystems are expected to respond over the next decade, given current operating rules and procedures.

The key components; river flows and connectivity; native vegetation; waterbirds; and native fish, are well understood and have all declined appreciably because of the way we capture, divert and manage water. They are also good indicators of the health of river systems, and respond to environmental watering.

The strategy highlights that river regulation and diversions have reduced the volume of water flowing downstream by up to 50 per cent in the most developed catchments of the basin (e.g. Murrumbidgee, Goulburn Broken, Murray, Gwydir and Condamine-Balonne). This in turn has impacted the habitat available and the populations of water dependent animals and plants. For example, over the 30 years of record there has been a 72 per cent decline in the total population of water birds in the basin and the populations of silver perch in the middle reaches of the River Murray have fallen by 95 per cent during the 1990's.

In summary, the water recovered for the environment should be able to improve the flows along rivers, by 10 per cent in the Barwon-Darling and 30 per cent in the River Murray, and the connection of rivers to their floodplains across the basin will improve. This will:

- maintain the extent and improve the condition of native vegetation on the managed floodplain including 360,000 ha of river red gums, 409,000 ha of black box and 310,000 ha of coolabahs
- maintain current diversity of waterbirds and improve breeding success and numbers by 20-25 per cent by 2024, and

- Maintain the current species of fish, extend their distributions and improve breeding success and their numbers, for example 10-15% more mature Murray Cod and golden perch by 2024.

Monitoring over time will determine how effective the watering is at achieving the environmental outcomes. It will take some time for the full benefits of the environmental watering strategy to be realised, because of the biological lags and also because the Basin Plan and the associated water recovery will not be implemented in full until 2019.

For the period up to 2019, the aim is to arrest the decline in environmental condition, and after 2019 it is expected that the benefits will be reflected more in improved ecological condition.

Further details on these outcomes are provided in **Appendix 2** and the strategy itself.

To achieve these outcomes it will be necessary to make the best use of all water—including held and planned environmental water and consumptive water en-route.

Future certainty through water resource plans

The Basin Plan cannot drought proof the basin. Extended droughts will always be a feature of the Australian landscape and water allocations will fluctuate in response to this.

The aim of the Basin Plan is to increase certainty about how water is shared between all users under different water availability conditions, to increase confidence for investment and enable industries to plan for the future. Water resource plans developed by the states are the mechanism under the Basin Plan for setting out these sharing arrangements.

Water resource plans have a fundamental role in ensuring the limits on the quantities of water that can be taken from the basin will operate from 2019 and beyond. They cover all water resources in the basin, including regulated and unregulated surface water (including interception) and groundwater. These plans will align water management arrangements across the basin and be in place for ten years before review, providing certainty for water users.

Water resource plans are key to implementing the outcomes of the Basin Plan at both a local and basin wide level. They set out arrangements to share water for consumptive use. They also establish rules to meet environmental and water quality objectives and they will take account of potential and emerging risks to water resources.

The states already undertake water resource planning for most parts of the basin and the MDBA is cooperating with states to develop water resource plans that include Basin Plan requirements.

The expected outcome is for use of water across the basin to be more effective and efficient, so that triple bottom line outcomes are optimised from whatever water is available at the time.

Structural adjustment

This latest reform has now been supported by around $13 billion of Commonwealth government funding, most of which goes to improving irrigation infrastructure and efficiency. Essentially, the Basin Plan and its associated reform programs represent the largest single structural adjustment package for industry in Australia’s history.

Pausing or changing the Basin Plan now would create uncertainty and dismantle the achievements of water reforms to date, and jeopardise one of the biggest opportunities we have to transform our irrigation sector into an efficient future-ready industry for the 21st century.

Rather than create further uncertainty for water users of the basin, it is the MDBA's view that implementation should continue, including those aspects of the Basin Plan designed to improve the social and economic outcomes for basin communities.

How communities and industries shaped the Basin Plan

The MDBA developed and finalised the Basin Plan in close consultation with governments, communities and industry, exposing its contents at each step of the way for everyone to feed into the process, well before the draft plan was published for formal public feedback. On the published draft alone, the MDBA made 300 changes as a result of further feedback. All key issues raised and how the feedback was addressed was documented in a 113-page consultation report.

An important feature of the Basin Plan is its flexibility, with opportunities for adjustments to be made along the way. These opportunities were added at the request of communities, to provide for smoother transition to new extraction limits.

This flexibility was designed to help communities adapt to the changed balance and to provide opportunities for innovation for the future. It enables better outcomes for communities, industries and the environment by allowing improvements to be made during implementation.

Communities and industries played a big part in shaping the Basin Plan, and the following were included in response to concerns raised during the extended consultation over 2011 and 2012:

- An extended seven-year transition period to full implementation in 2019 – to give time for people to adjust to any changes, for government investment to be delivered to communities, for further scientific work to be carried out, and for efficiencies for environmental and irrigation water to be investigated
- A mechanism to allow a one-off adjustment to the extraction limits of the Basin Plan – more water may be retained for irrigation through smarter ways of managing rivers that enable equivalent environmental outcomes to be achieved
- Over $8 billion for investment in irrigation efficiencies for water recovery with equivalent social and economic outcomes
- A $200 million strategy to address constraints to environmental water requested by states, which aims to improve the outcomes from the available environmental water and can also reduce the need for buybacks
- A review of northern basin SDLs after a more detailed social and economic assessment of the effects of water recovery in the north, and fresh judgements informed by better science on how much water needs to be recovered in the Condamine-Balonne and Barwon-Darling systems
- A review of the groundwater SDLs in three areas in the basin
- Investment for efficiencies was prioritised over Commonwealth buybacks to assist irrigators to modernise their farms for the future
- Monitoring and evaluation to enable reporting on triple bottom line outcomes of the Basin Plan

How communities are involved in implementation

The Basin Plan sets out a clear pathway of implementation of the extraction limits and whole of basin coordination.

Within this legislative framework, the MDBA's work program is driven by input and feedback from basin governments, communities and industries, and great effort has been made to show stakeholders how their feedback has been addressed.

There are many examples and plenty of supporting evidence to show how the MDBA has consulted across all stakeholder groups and given proper consideration to feedback.

The Constraints Management Strategy was developed in 2013 through extensive consultation with both communities and technical experts. The final 10 year strategy was accompanied by a 30-page feedback report outlining the issues raised during the public comment period and how the issues were addressed in the final strategy. The more detailed local 'river reach reports' developed under the strategy contain extensive local consultation with landholders and affected communities and contain logs of how feedback on the drafts has been addressed (**Appendix 3** outlines the approach to the Constraints Management Strategy and **Appendix 3(a)** includes an example of issues in the Yarrawonga to Wakool Junction reach area and how they were dealt with).

The draft Basin-wide Environmental Watering Strategy was developed in consultation with basin government agencies, water practitioners and technical experts and scientists. During the public comment period, additional briefings and presentations were given to conservation, farming, irrigation and Aboriginal organisations, as well as public meetings in regional communities. A 10-page report was published summarising the feedback received and how it was addressed.

The social and economic work program was, and continues to be, based on detailed and extensive discussions with local people, as well as local councils and researchers. This ground level input has helped to give a better understanding of the long-term social and economic trends that influence communities in the basin.

The Basin Plan is on track

The Basin Plan has an in-built transitional period, providing seven years to achieve full implementation in 2019.

The Basin Plan is currently only three years in to implementation. A large volume of the work done to date has involved setting good foundations to complete the remaining work required under the Basin Plan. Many elements are yet to take effect which means it is too soon to assess all the effects of the Basin Plan and related reforms. Nevertheless, considerable progress has been made. Commonwealth and state agencies who all have responsibilities for the Basin Plan's roll out have met all milestones.

Roles and responsibilities for basin-wide reforms

Water management in Australia is a complex space with Commonwealth and state agencies having different responsibilities but still requiring collaboration and cooperation.

This can lead to confusion about who is responsible for different activities and can sometimes be used to stall or shift blame.

There are many Commonwealth and state agencies who have responsibilities under the Basin Plan. The various roles are summarised at **Appendix 4**. The current arrangements provide an appropriate balance of continued collaboration underpinned by the strength of Commonwealth governance to confront difficult issues and help deliver cross-jurisdictional outcomes.

The MDBA has an important role to play in implementing the Basin Plan, but other Commonwealth agencies play key roles and the states have responsibility for implementation on the ground in their jurisdictions.

The MDBA plays a key role in providing good governance to water management for the basin and facilitating decision making between states. In broad terms, the roles and responsibilities for water reforms in the basin are as follows:

The **Department of Agriculture and Water Resources** is responsible for policy advice and program implementation, in particular investing in the Commonwealth's water recovery strategy and National Partnership Agreement on Implementing the Murray–Darling Basin Plan.

The **MDBA** plays a dual role in the basin through two very clear and distinct functions. The MDBA oversees implementation of the Basin Plan at a basin scale in accordance with the Water Act and as per the approach agreed in the *2013 Intergovernmental agreement on implementing water reform in the Murray–Darling Basin Plan.*

Separate to Basin Plan oversight, the MDBA carries out river operation functions in the River Murray and natural resource management programs, particularly in the southern Basin, on behalf of state governments in accordance with the *2008 Murray–Darling Basin Agreement.*

The **Commonwealth Environmental Water Holder** manages the use of environmental water held by the Commonwealth Government (in collaboration with the MDBA, Basin States and local water managers). It does not purchase water to bridge the gap to the new SDLs.

Basin States own water and are responsible for allocating it to entitlement holders consistent with their water management frameworks. They also hold and deliver environmental water. Basin States are responsible for implementing the Basin Plan on-ground in their own jurisdictions, including proposing and implementing successful projects under the SDL adjustment mechanism and the Constraints Management Strategy.

The **Australian Competition and Consumer Commission** provides advice to the Minister for Water on water market rules and water charge rules, which are intended to free up trade and regulate costs of monopoly infrastructure (e.g. access to irrigation schemes) and to monitor and enforce these rules.

The **Productivity Commission** conducts 5 yearly inquiries into the effectiveness of the implementation of the Basin Plan and water resource plans - the first review is due in 2017.

The **Bureau of Meteorology** has responsibility for compiling and making available water information for all of Australia. This includes producing a National Water Account and collecting and publishing water information.

Effects of the Basin Plan

Each year the MDBA reports on the progress of environmental, social and economic outcomes arising from the Basin Plan. This is based on information collected by the MDBA as well as information provided by the Commonwealth Department of Agriculture and Water Resources, Commonwealth Environmental Water Holder and states.

In the first full year report, 2013-14, the MDBA found that all governments had undertaken their implementation responsibilities and that some significant things had been achieved in the short time

since the Basin Plan was put in place. Over half a billion dollars had been spent in local communities in that time, and over 10,000 irrigators had participated in infrastructure projects across the basin. Even with the limited amount of additional environmental water, there were good signs of a positive ecological response to environmental watering. Priority areas collectively received around 2000 gigalitres as water flowed from one site to another.

About 70 percent of the water recovery target has already been achieved. Additionally, the Commonwealth government has capped the recovery of water from Commonwealth purchases on the market to 1500 gigalitres. Since 2012-13, investment in infrastructure has greatly exceeded that for water purchases. From here on in, the majority of the remaining recovery volumes are earmarked to be recovered through infrastructure projects.

The foundational work was being bedded down, including the first basin-scale environmental watering strategy and annual watering priorities, the Constraints Management Strategy and the Monitoring and Evaluation Strategy.

There has been solid progress on the reviews and adjustment options, with the development of projects to make environmental watering more effective and efficient. The review of groundwater has also been completed. This provides the basis for adjusting the Basin Plan's extraction limits in mid-2016.

Summary of water recovery

Of the total 2750 gigalitre recovery amount due in 2019, a total of 1950.5 gigalitres had been recovered or contracted for the environment by Commonwealth and state governments as at 30 June 2015. This means about 70 per cent of the required water recovery has already been achieved.

This water recovery is made up from progress with the following components (as at 30 June 2015):

- 1162.3 gigalitres Commonwealth recovery purchased by tender program
- 577.3 gigalitres Commonwealth recovery from infrastructure projects
- 49 gigalitres other Commonwealth recovery
- 161.9 gigalitres total recovery by state projects
- 1950.5 gigalitres total estimated contracted water recovery

Social and economic effects so far

The MDBA is monitoring the effects of the Basin Plan water reforms on basin communities and industries. Many communities have undergone big changes over the past few decades due to a range of economic, climatic and policy changes.

Many of these changes are still playing out. Against this background, it is difficult to attribute specific changes to the Basin Plan, or draw any definitive conclusions about what the direct effects are of water reform activities on communities and industries. More detail on the social and economic story is included at **Appendix 5**.

The MDBA's monitoring is helping build a picture of what has driven past changes in basin communities, so we are better placed to separately identify the effects of the basin water reforms.

Some early observations indicate that the effects of the Basin Plan water reforms are determined by the economic and social conditions of industries and communities at the time of the water recovery and the nature of the water recovery itself (e.g. buyback versus infrastructure).

However, there are also positive signs of investment confidence in many parts of the basin (for example, investment in nut production). Many irrigators are also reaping the benefits of the Commonwealth irrigation efficiency programs.

The Commonwealth government recognised the potential flow on effects of water recovery for communities and so provided $100 million to state governments to distribute where they saw fit to help their communities adapt to any changes.

Observed environmental outcomes

It will take some time for the Basin Plan to be implemented in full. It will also take some time for our native flora and fauna to respond to the additional environmental watering made possible by the Basin Plan. It is expected that only a muted ecosystem response will be seen over the next few years, and that a strong basin-wide response won't be seen until around 2024. Outcomes observed will also be influenced by general climatic conditions, as they will vary from wet to dry years.

Despite this, some positive short term outcomes are already being observed, including for waterbirds, fish, flora and fauna and water quality. For example,

- Environmental flows over the last few years into the Gwydir wetlands, Macquarie Marshes, Lower Lachlan and Hattah-Kulkyne Lakes have maintained core areas of wetland habitat supporting thousands of waterbirds (over 20 different species)
- Monitoring has shown that trees at wetland sites that received environmental water during the drought along the River Murray are in better condition than the surrounding areas, including:
    - at Mulcra Island there has been a significant improvement in the condition of River Red Gums between 2006 and 2015
    - the strongest growth and flowering response of Moira grass in the Barmah-Millewa forest for seven years was seen in 2013-14
- Careful management of environmental flows in Gunbower Creek between July 2013 and June 2014 led to multiple spawning events in Murray Cod (recreationally valuable, listed as vulnerable under the EPBC Act) and prompted a bumper breeding season for golden perch and boosted breeding of silver perch (listed as critically endangered under the EPBC Act)

Further detail of observed immediate environmental responses are included at **Appendix 2**.

Water market and prices

Over the past few years the dynamics of the water market have been changing.

Water prices are determined by the market. They are affected by a range of factors including climatic conditions, state water allocations, carryover rules demand from new producers, and new production/ business models (e.g. an increasing number of farmers relying more extensively on temporary water). These have contributed to the changing dynamics of the water market over the past four years. Another contributing factor is the transfer of some water licences from productive use to the environment.

Water prices are also closely linked to state water allocations. When allocations are low, water prices rise and when allocations are high, prices fall. Farmers will make decisions based on those allocations and people adjust their buying and selling, as well as their business activities, to minimise the risks of not having sufficient water to meet their crop demands or paying high prices in summer. The allocation prices in the last few summers has not been out of the ordinary given the allocation levels for those years.

Progress with MDBA responsibilities under the Basin Plan

The Basin Plan sits alongside broader water reforms and programs managed by the Commonwealth government, and provides whole-of-basin scale guidance to inform state activities for water management.

Social and economic analysis

Communities and industries are constantly changing, and so understanding what is causing the change is complex. One of the most important aspects of the MDBA's work is gaining a comprehensive view of the social make-up and economic activity across the basin.

The MDBA's approach to evaluating the social and economic outcomes is based on understanding and differentiating the long term changes occurring in basin communities, and the drivers of those changes. This involves looking at the whole picture of what is happening and identifying trends over many years. This includes the effects of the Basin Plan and local investment in water infrastructure.

This foundational work has included collecting information from a range of different sources. The MDBA has spent the past couple of years talking with local people who live and work in the basin, including Aboriginal communities, sitting down with local councils and industries, and collaborating with researchers to get a better understanding of the long-term social and economic trends that influence communities and set the foundations for understanding the different changes.

The MDBA's social and economic work program has now been established, and will continue over a number of years and there will be annual reporting on what is being seen. This is so the short and longer term changes due to the Basin Plan can be understood. The MDBA must also produce a five-year report to governments in 2017. Progress so far is captured in the first Basin Plan Annual Report.

Environmental planning and monitoring

Basin stakeholders understandably hold a strong view that environmental water should be managed as efficiently as irrigators manage theirs. The Basin Plan provides a strong foundational framework for basin scale environmental water planning, management, and monitoring and evaluation.

The MDBA's main responsibilities are to:

- prepare a basin-wide environmental watering strategy
- publish basin annual environmental watering priorities annually
- facilitate coordination of environmental watering
- monitor and evaluate the environmental outcomes at a basin-scale

The MDBA has completed the basin's first ever Basin-wide Environmental Watering Strategy in November 2014. This strategy takes a whole-of-basin perspective and highlights the improvements sought from the water recovered for the environment, and how governments and communities can work together to achieve it.

The strategy is based on the most up to date science and it draws upon decades of knowledge and experience of managing environmental watering in the basin by many people. It is the best assessment of how four important components of the basin's water-dependent ecosystems are expected to respond over the next decade, given current operating rules and procedures.

The MDBA has also completed three sets of basin annual environmental watering priorities, published in June 2013, 2014 and 2015. The priorities guide the planning of environmental watering across the basin each year. They aim to achieve the most effective use of environmental water,

promote better environmental outcomes across the basin and coordinate watering between environmental water holders and water managers. This planning complements the more detailed annual catchment planning done by the states.

In addition to these activities, the MDBA manages the Southern Connected Basin Environmental Water Committee to coordinate environmental water holders and river operators to maximise environmental outcomes achieved in the southern connected basin.

The MDBA has also established a basin scale monitoring program to measure basin scale changes in environmental condition, consistent with the Basin Plan Evaluation Framework published in 2014. It focuses on waterbirds, fish, vegetation and hydrology, and will help to measure progress towards the expected outcomes established in the Basin-wide Environmental Watering Strategy.

The MDBA has worked with other Commonwealth and state agencies to establish a coordinated and integrated program to monitor the local, asset and basin outcomes.

Water trading rules

New water trading rules began operating in 2014. The rules are designed to improve the operation and transparency of the water market by removing barriers to trade and giving traders better access to market information, regardless of which state they operate in.

The water market in the southern Murray–Darling Basin continues to be the largest and most active water market in the world. Its success has attracted significant international interest in how it operates as an effective tool for water management.

An independent review of Australian water markets by the National Water Commission found that water trade in the southern basin was the key instrument for irrigators managing water scarcity, in particular the severe and prolonged reduction in water availability during the Millennium drought.

There is a continuing trend of an increasing number of people participating in the water market. This suggests more irrigators are adapting to the changing volumes of water in the market, rethinking planting decisions and being able to take a more informed approach to managing their business risks.

SDL adjustment mechanism

At the request of state governments, the Sustainable Diversion Limit Adjustment Mechanism was included in the Basin Plan so that there would be an opportunity to increase the water extraction limits in the Basin Plan if states could develop projects that can achieve equivalent environmental outcomes to the Basin Plan with less water (these projects are called supply measures). This would mean less water would need to be recovered and would benefit irrigation industries and basin communities.

The mechanism also provides an opportunity for the Commonwealth to invest more in irrigation infrastructure (called efficiency measures) to increase the volume of water for the environment if that could be done without any further social or economic impact.

The MDBA's has almost completed an assessment method and framework to determine the volume by which the SDL should be adjusted. The framework has been trialled, and the environmental equivalence test has been thoroughly reviewed and tested, and found to be scientifically robust and fit for the purpose of the SDL adjustment mechanism.

The attention has now turned to the development of the supply measure projects by states. The business cases need to be completed by early 2016 to give states time to select the final package of

supply measure projects by mid-2016. The package will also need to include any agreed efficiency measures and the projects which address constraints.

The MDBA will determine the final adjustment to recommend to the Minister based on the agreed package in mid-2016 and the Basin Plan would be amended thereafter. In 2024, a final reconciliation of the adjustment amount will be made, accommodating any implementation outcomes that differ from that envisaged in 2016. A snapshot of the SDL adjustment mechanism is included at **Appendix 6**.

A recent independent stocktake of supply measure projects being developed by the states found that the Basin Plan SDLs could plausibly be increased by as much as 500 gigalitres through the operation of the SDL adjustment mechanism. The stocktake findings were based on the expectation that all of the projects under development would be finalised and supported by all basin governments.

An adjustment of the Basin Plan extraction limit by 500 gigalitres would mean the recovery target would fall by an equal amount.

The stocktake report also supported the MDBA's methodology for assessing projects put forward by states and was confident the MDBA's work on SDL adjustments and constraints is progressing well.

Constraints Management Strategy

The Basin Plan can be delivered without addressing any constraints.

Constraints are river rules, practices and structures that govern the volume and/or timing of regulated water delivery through the river system.

Governments requested a constraints management strategy be included in the Basin Plan – reflecting community concern about the importance of environmental water and being able to deliver it without adversely affecting landholders and communities.

The Commonwealth has provided $200 million to support the states with this work.

The MDBA developed a 10-year strategy to guide governments in this work in November 2013. An overview of this work is at **Appendix 3**.

The MDBA agreed to undertake the early investigation work required under the strategy on behalf of the state governments, including the consultation with communities and investigation of the target flows set by the states. This involved gathering local information through input from landholders about concerns and effects on their riverside land, as well as technical work on water flows and inundation, and identification of the mitigation options and their likely cost.

The MDBA has been asked to prepare business cases, on behalf of state governments, for the three River Murray constraint areas. These areas are: Hume to Yarrawonga, Yarrawonga to Wakool junction and the SA River Murray.

States are leading the development of business cases for the Goulburn, Murrumbidgee, Lower Darling and Gwydir constraint areas.

The state governments will be the final decision makers on which constraints to address in their own jurisdiction.

The constraints work is an opportunity to get better outcomes from environmental water by addressing some of the things that prevent flows from reaching certain riverside areas as a result of changes made over the past century. An example of constraints work in the Goulburn area is at **Appendix 3(b)**.

The types of flows being investigated in each reach will not flood houses or towns.

Northern basin review

When the Basin Plan was finalised, the MDBA agreed to carry out a review of some of the extraction limits in the northern basin, with a particular focus on the Condamine-Balonne and Barwon-Darling systems. This review is on track and progressing well. A summary of this review is at **Appendix 7**.

The MDBA's scientific work, including hydrological modelling and social and economic analysis is due to be completed by the end of 2015. Based on the results, the MDBA may recommend to the Minister for Water to amend the extraction limits. Any changes would require further community consultation.

The MDBA has been working closely with the Department of Agriculture and Water Resources (formerly the Department of the Environment), the Commonwealth Environmental Water Office, and Queensland and New South Wales governments on this review. The MDBA is also seeking feedback and advice from the Northern Basin Advisory Committee, made up of community members who provide insight into local issues that need to be considered in this work.

Groundwater reviews

State governments requested the Basin Plan include a review of the sustainable extraction limits of three groundwater areas—two in NSW and one in Victoria.

Expert panels were engaged to undertake the reviews and provided recommendations on the sustainable limits of extraction for each area and additional management conditions.

The reviews recommended an increase to the extraction limit in each area would be acceptable, on the condition that more stringent local management conditions are embedded in the relevant water resource plans. It is expected these will form the basis of an amendment to the Basin Plan in 2016. Any such amendment will include public consultation, involving relevant state governments.

Water resource plans

The states are responsible for developing 36 water resource plans by 2019 to ensure the settings of the Basin Plan are reflected in their day-to-day management of water on-ground.

States already do water planning in line with their own state water management frameworks. The Basin Plan was developed so that existing planning will give effect to the Basin Plan without requiring wholesale changes in state approaches.

The MDBA is working closely with all basin states to make sure the final plans are suitable for accreditation by the Commonwealth water minister.

Once in place, the state plans will provide a stable setting for water management across the basin, and will provide certainty for water sharing in the basin through to 2029.

Lower Lakes, Coorong and Murray Mouth management

History is important to understanding management of the Murray Mouth

Water at Murray Bridge would be too saline to use if barrages were removed

Understanding the history of the barrages

The last time a "natural" estuary existed for the Murray–Darling Basin would have been in the late 1800s before irrigation development started. By 1902, during a major drought, there were already signs that the estuary was being affected by reduced freshwater flows.

Up to the early 1930s, South Australia continued to lobby the other three governments for financial support to build the Murray Mouth barrages in recognition of the increase in salt water coming into the lakes as a result of less fresh river flows coming down the system. At that time, irrigation use in the basin was only about a quarter of what it grew to by the mid-1990s.

In 1938, shortly before the barrages were finished being built, the salinity at Milang on the western shore of Lake Alexandrina peaked at more than 60,000 EC, which is saltier than the ocean. Governments were faced with a choice of either building the barrages to create a freshwater lake system or allowing the lakes to experience increasing periods of hyper-salinity.

The only way that a natural estuary could have been reinstated would have been to stop all irrigation in the basin. That was not an option considered in the 1930s, nor is it an option today.

When flows don't reach the end of the river system

During the Millennium drought, flow virtually ceased somewhere upstream of Lake Alexandrina. The level in the Lower Lakes fell to more than one metre below mean sea level. Salinity levels increased and the exposed lake bed turned acidic. At the time, the governments contemplated letting the sea in to hold lake levels higher to prevent acidification. Fortunately, modelling was done before any sea water was let in. That modelling showed that salinity would rapidly rise to well above sea salinity and put at risk Adelaide's water quality at the major extraction point at Murray Bridge.

Governments also contemplated an extra weir near Wellington, but did not build it as there was just enough water to pass into the Lower Lakes to protect Adelaide's water supply, at least until the drought broke.

It is true that the construction of the barrages has significantly changed the ecology of the Coorong, Lower Lakes and Murray Mouth; particularly in times of drought. However, simply removing the barrages would not reinstate the original ecosystems.

A healthy river is not one that stops flowing 60 to 100km before it reaches the sea. The salt collected as water travels through the system has been picked up on the way from the top of the system in Queensland and carried all the way through each state to be exported at the end of the system.

One would have to ask why upstream states can benefit from allowing their section of the river to have good flows to export salt from their area, yet presume it is ok to stop the river flowing short of its final destination so that the water quality there becomes increasingly poor and that section of the river slowly deteriorates.

There are environmental water needs across the whole basin

One of the reasons why some people continue to focus on the Lower Lakes is that they mistakenly believe that large volumes of water are being delivered just to the end of the river system. This is incorrect.

The way the Basin Plan was developed was to determine the environmental water needs of important sites and functions over the length of the river system (from the top to the bottom states). If all those sites and functions receive sufficient flows, then there will be enough water travelling through to the end of the system. In other words, if you meet all upstream environmental water needs then you will also look after the Lower Lakes.

Related matters

Science and peer review

The MDBA routinely seeks all available information for its technical work and often commissions new work to improve understanding of the hydrology, environment and economics of the basin's water resources.

Environmental, social and economic modelling

The science underpinning the Basin Plan is peer reviewed by Australian and international leaders in this field. CSIRO reviewed the method for determining the sustainable extraction limits of the Basin Plan in 2011 and concluded that:

- there was sufficient knowledge to make an informed decision on an ecologically sustainable level of extraction
- the scientific methods for determining extraction levels were fit-for-purpose
- the body of work undertaken was substantial and sufficient to progress management at the extraction limits set in the Basin Plan

The social and economic modelling for the Basin Plan was independently reviewed by KPMG in 2011. This review found that the approaches used to model socio-economic impacts are considered to be appropriate.

The MDBA's method for assessing the amount of SDL adjustment possible from states' supply measure proposals was reviewed by a consortium, led by CSIRO, who also made contributions to the assessment process. This was followed by consultation with the states and further review by an independent review panel. The method has been trialled and both the CSIRO-led team and the independent review panel were re-engaged to assess its performance. The assessment method was deemed fit-for-purpose.

Further, state Minister's commissioned a stocktake of the progress of supply, efficiency and constraint measure proposals, completed in August 2015, which concluded that MDBA's work on the SDL adjustment was progressing well.

The social and economic studies for the northern basin review are currently underway. Before these are completed in early 2016 they will be independently assessed.

Hydrologic modelling

Hydrologic modelling is an important tool for water resource management, and in fact underpins the entitlement system used by irrigators. However it is not the only tool used by water managers, and judgement and ground-truthing always have an important role to play.

All hydrological models are calibrated carefully against actual measured data including 114 years of historic flow data. Hydrologic models to assess the extent of floodplain inundation are calibrated against recorded flows and satellite imagery of actual flow events.

Models these days are very reliable and accurate.

Accessibility and transparency

The MDBA has continuously shared its scientific reports and the peer reviews underpinning the Basin Plan and made them publicly available. Independent reports are also published as soon as they are released.

There is a range of products on various subjects that go to different levels of detail and complexity.

Menindee Lakes

The levels in the Menindee Lakes have been very low as they have received little inflow from upstream since May 2013 as a result of very dry conditions in the northern basin.

The lakes are very shallow and are in a hot, windy and dry area, which means evaporation is very high, losing on average about 400 gigalitres of water to evaporation every year, and anywhere up to 560 gigalitres in a year. Even with only minimum releases from the lakes to meet downstream requirements, unless there are flows coming in from upstream, the lakes run out of water within three years.

The Menindee Lakes water storage is owned by the NSW government and operated by Water NSW, at all times.

NSW has a longstanding agreement with Victoria, South Australia and the Australian Government to share some of the water in the lakes when they are above certain “trigger” levels. When the lakes volume rises above 640 gigalitres and until it drops below 480 gigalitres, the water can be shared to support the River Murray system.

The MDBA, which operates the River Murray on behalf of the basin governments, is allowed to place orders for NSW to release water when trigger levels are exceeded. During those periods, NSW also releases water from the lakes to meet its own local needs.

It is the responsibility of NSW, as the owner and operator of the storage, to decide which of the lakes to store water in, direct all flood operations from the storages and to make the releases from the Cawndilla outlet.

Any decision to change the current arrangements, including the trigger levels would need to be made by NSW in agreement with the other basin states.

State water allocations

Annual water allocations always have been and will continue to be the responsibility of the states.

The levels of water allocations are not prescribed by the Basin Plan. The Basin Plan requires states only to set out their process for determining the levels of allocation in their water resource plans, to provide transparency and certainty to water users.

Each year, state governments decide how much water can be extracted from their rivers based on their state water plans and the amount of water likely to be in the system.

These assessments take into account how much is in storages, water coming into the system or inflows, how much water is used and moved around the system, and expected evaporation and losses.

Water allocations have been in the news after NSW announced low allocations for certain classes of water entitlements in some valleys. NSW and other states announce water allocations at the start of each water year on 1 July. Allocations are then updated throughout the year if and when conditions change.

Each allocation announcement tells water entitlement holders how much of their entitlement they're allowed to take from the system over the course of the year. Where such a provision is available, irrigators can choose to carryover their allocations, as can state and Commonwealth environmental water holders.

Supporting information

Appendix 1 – Development of the SDL for the basin

The approach considered the ecological needs of the basin's water-dependent ecosystems and incorporated an assessment of social and economic costs and benefits of varying water regimes to optimise triple bottom line outcomes

The approach to determining the sustainable diversion limits in the Basin Plan was based on peer reviewed science and used the best contemporary hydrologic modelling available

The Basin Plan aims to provide for the integrated management of basin water resources in a way that promotes the objects of the Water Act, including by ensuring that the use and management of the Basin water resources occurs in a way that optimises economic, social and environmental outcomes.

In developing the Basin Plan, and in particular the new long-term average limits on extraction, the MDBA considered the water needs of communities, industries and the environment. The method used by MDBA to determining an Environmentally Sustainable Level of Take, or ESLT is described below.

Surface water

The Basin Plan proposes an SDL for the basin surface water resources as a whole of 10873 GL/y—representing the recovery of 2750 GL/y of water for the environment from the 2009 baseline.

To determine the ESLT on which this SDL is based, the MDBA developed a methodology explicitly designed to meet the task set out in the Water Act. This method, termed the indicator site method, describes the environmental water requirements of key locations (indicator sites) along the basin's rivers, with these water requirements aimed to meet the requirements and objectives of the Water Act and the purposes of the Basin Plan. The indicator sites and the flows described at those sites represent the broader environmental flow needs of river valleys or reaches. The assessment of environmental flow needs at each location utilises the best available science and considers local water management arrangements, opportunities and constraints, coupled with the shared zone SDL reduction amounts where appropriate.

The MDBA is confident that the basin-wide ESLT translates well to the SDLs for each of the 23 SDL resource units. In the view of the MDBA this is the most robust method available for the task and represents the best available science and is an effective overall framework for harnessing existing and new knowledge to the task set for the Basin Plan under the Water Act.

The MDBA's approach to the ESLT analysis to determine surface water SDLs in the Basin Plan included the following elements:

- Determine Basin-wide environmental objectives consistent with the requirements of the Water Act.
- Identify key environmental assets and ecosystem functions across the Basin. This work was done with particular reference to declared Ramsar sites in the basin, and also included consideration of other obligations under the Water Act.

- Determine environmental water requirements of indicator sites by setting local environmental objectives and associated targets to determine site-specific flow indicators. This work is further described in:
    - MDBA 2012, The assessments of environmental water requirements, available at: http://www.mdba.gov.au/what-we-do/basin-plan/development/bp-science/assessing-environmental-water-requirements
- Select SDL options for assessment against these environmental water requirements, corresponding to different levels of water recovery relative to a June 2009 baseline (this is the date used to determine the baseline diversion limits and is the baseline against which the extent of additional recovery of environmental water is assessed).
- Assess the environmental benefits of the SDL options, as set out in MDBA 2011, The proposed 'environmentally sustainable level of take' for surface water of the Murray–Darling Basin: Method and outcomes, available at:
    - MDBA 2011, The proposed "environmentally sustainable level of take" for surface water of the Murray–Darling Basin: Method and outcomes, available at: http://www.mdba.gov.au/what-we-do/basin-plan/development/eslt
- Assess the socio-economic implications (including benefits and costs) of the SDL options. This work was a significant component of the development of the Basin Plan and is further described in:
    - MDBA 2012, The Socio-economic implications of the proposed Basin Plan, available at: http://www.mdba.gov.au/what-we-do/basin-plan/development/socio-economic-reports
    - MDBA 2012, Socio-economic analysis and the draft Basin Plan: Part A – Overview and analysis , available at: http://www.mdba.gov.au/sites/default/files/archived/proposed/social_economic_analysis_part_a.pdf
    - MDBA 2012, Socio-economic analysis and the draft Basin Plan: Part B – Commissioned and non-commissioned reports which informed MDBA's socio-economic analysis, available at: http://www.mdba.gov.au/sites/default/files/archived/proposed/social_economic_analysis_part_b.pdf
    - KPMG 2011, Review of the MDBA's Socio-Economic Impact Modelling, available at: http://www.mdba.gov.au/sites/default/files/archived/proposed/KPMG_Econtech_Report.pdf
    - MDBA 2012, Social and Economic Analysis – key reports, available at: http://www.mdba.gov.au/what-we-do/basin-plan/development/socio-economic-reports
- Select an ESLT, and associated SDL for the basin water resources and for each surface water SDL resource unit coupled with the shared zone SDL reduction amounts where appropriate, informed by modelling and assessment of outcomes.
    - MDBA 2011, The proposed "environmentally sustainable level of take" for surface water of the Murray–Darling Basin: Method and outcomes, available at: http://www.mdba.gov.au/what-we-do/basin-plan/development/eslt
    - MDBA 2012, Hydrologic modelling to inform the proposed Basin Plan: Methods and results, available at: http://www.mdba.gov.au/sites/default/files/archived/proposed/Hydro_Modelling_Report.pdf

The method to set the ESLT underwent a number of peer reviews, including the CSIRO-led scientific review in 2011, which concluded that these methods are robust and are sufficient to provide a suitable starting point for an adaptive management process, see:

- CSIRO 2011, Science review of the estimation of an environmentally sustainable level of take for the Murray–Darling Basin, available at: http://www.mdba.gov.au/sites/default/files/archived/proposed/CSIRO_ESLT_Science_Review.pdf

An initial ESLT option of a basin-wide reduction for surface water of 3,000 GL/y, with a distribution of the reduction amount of 650 GL/y from the northern connected basin, 2,350 GL/y from the southern connected basin and 45 GL/y from the disconnected rivers, was used as the basis for further detailed analysis through the hydrologic indicator site method. This option was chosen after consideration of previous assessments of basin scale water needs including those undertaken for The Living Murray, by the Wentworth Group, the Victorian Government, and the MDBA's end-of-system flow analysis. Feedback from communities, the potential costs for irrigation dependent communities and the need to optimise economic, social and environmental outcomes provided additional input into this judgement.

This initial ESLT option was reduced to 2,800 GL/y overall, with changes in the northern basin made to reflect the nature of the river systems in that part of the basin.

- MDBA 2011, The proposed "environmentally sustainable level of take" for surface water of the Murray–Darling Basin: Method and outcomes, available at: http://www.mdba.gov.au/what-we-do/basin-plan/development/eslt

The MDBA then assessed the level of sensitivity of reaching ecological targets by assessing reductions of 2,400, 2,800 and 3,200 GL/y with current river constraints included. These assessments maintained the same ESLT volume in the northern basin and subsequently focussed on the southern connected system which is more heavily regulated, and environmental outcomes in the lower end of the Murray which are the most difficult to achieve.

The MDBA's modelling and analysis of the benefits of 2,800 GL/y of additional environmental water, compared with higher and lower SDL options identified that:

- At a whole-of-basin scale, positive environmental outcomes would be achieved with water recovery of 2,800 GL/y.
- With the recovery of 2,400 GL/y under current operating arrangements, some important environmental outcomes would be compromised. Further, the ability to manage salinity levels within the Coorong, maintain an open Murray Mouth, and maintain the resilience of lower elevation parts of the lower River Murray floodplain and associated wetlands (i.e., River Murray downstream of the Murrumbidgee junction, including the Coorong, Lower Lakes and Murray Mouth) during dry periods, is likely to be compromised with the 2,400 GL/y option.
- The recovery of 3,200 GL/y showed incremental improvements in some indicators compared to the other options. However, the MDBA's overall assessment was that 3,200 GL/y delivered few additional environmental benefits relative to the 2,800 GL/y option whereas there were greater social and economic impacts. A significant contributing factor to not meeting the few additional environmental benefits is a result of a range of constraints that increasingly inhibit the delivery of environmental water as environmental flows increase. These constraints include limits to river heights to prevent the flooding of private property, roads and bridges.

The basin-wide recovery amount changed from 2,800 to 2,750 GL/y as a result of changing the SDL of the Condamine-Balonne catchment. There is less certainty about the hydrology and impact of growth in water use on the environmental needs of the Culgoa floodplain in the Condamine-Balonne catchment and the Barwon-Darling because development is more recent in these areas compared to southern parts of the basin.

An SDL of 150 gigalitres (GL) was initially proposed for the Condamine-Balonne catchment, however, new scientific assessment and analysis commissioned by the Queensland Government, and subsequent remodelling by the MDBA (see MDBA 2012, Hydrologic modelling to inform the proposed Basin Plan: Methods and results) indicated that an SDL of 100GL/y would water the catchment's key environmental assets, such as the Narran Lakes. Some uncertainty remains about the impact of this SDL on the Culgoa floodplain and the Barwon-Darling, and therefore, the MDBA has established the Northern Basin Advisory Committee to advise on a program of work to gain a better understanding of the environmental needs of the Culgoa Floodplain, Barwon-Darling and the northern basin generally.

Recovery of an average of 2,750 GL/y of water for the environment will achieve significant environmental outcomes (further detailed in *The proposed "environmentally sustainable level of take" for surface water of the Murray–Darling Basin: Method and outcomes report* and Chapter 5 of the *Regulation Impact Statement)*, including the ability to reinstate more frequent and variable flow regimes to provide healthy wetland habitats and support the role that these systems play in the productivity of the river system more broadly, for example providing breeding and feeding habitats for birds and fish, and carbon/nutrient inputs to support instream productivity.

The MDBA's socioeconomic analysis of implications (including benefits and costs) of the SDL options found that:

- The socioeconomic impacts of the Basin Plan include reductions in irrigated agricultural production (partially offset by a small substitution towards dryland agriculture), impacts on agricultural service and supply businesses, and flow-on effects for the non-agricultural sectors of the basin economy.
- Overall, the impacts on the basin economy will be modest. The basin economy is still expected to grow under the Basin Plan, but at a slower rate than would be the case without the Basin Plan.
- The extension of time to 2019 to recover environmental water substantially reduced the impacts and enabled a measured transition to the SDLs.
- Infrastructure investments under Water for the Future substantially reduce the impacts of water recovery.
- While the overall impact of the Basin Plan is expected to be modest, some communities will likely be relatively more vulnerable to impacts from moving to SDLs. The most vulnerable regions include:
    - communities in the cotton growing areas of the Lower Balonne
    - communities in the rice growing areas of the Murrumbidgee and NSW Murray
    - smaller dairying communities in northern Victoria
    - horticultural communities in Sunraysia and the South Australian Riverland.

In 2012, the MDBA undertook further modelling to assess what additional environmental benefits could be achieved with water recovery of 2,800 GL/y and 3,200 GL/y if eight key river operating

constraints in the southern connected system were relaxed. This modelling found that significant additional environmental outcomes could be achieved if constraints were relaxed, particularly with water recovery of 3,200 GL/y. This included the ability to maintain the resilience of mid to higher parts of the lower River Murray floodplain during dry periods. Due to these operational and physical constraints, providing flows to the higher parts of the floodplains is limited. The results referred to here and further consideration of the issues relating to river management, including constraints, is provided at:

- MDBA 2011, River Management and Opportunities, available at: http://www.mdba.gov.au/kid/files/1870-River-mangement-discussion-paper.pdf
- MDBA 2012, Hydrologic modelling of the relaxation of operational constraints in the southern connected system: Methods and results , available at: http://www.mdba.gov.au/what-we-do/basin-plan/development/bp-science/hydrologic-modelling-of-relaxed-constraints

The additional work on the effect of relaxing constraints confirmed for the MDBA the extent to which relaxation of constraints and other factors could change environmental outcomes. Recognising the significance of current system constraints, the Basin Plan requires the MDBA to prepare a constraints management strategy in the first year of the Basin Plan, which will guide future investment in removing or relaxing constraints on the delivery of environmental water.

The Basin Plan also includes an SDL adjustment mechanism. This adjustment mechanism will allow the SDLs in the Basin Plan to be adjusted, based on new initiatives which achieve equivalent environmental outcomes, with neutral or improved social and economic impacts, relative to those considered in setting the SDLs contained in the Basin Plan.

Through the SDL adjustment mechanism:

- SDLs could be adjusted upwards (i.e. less water would need to be recovered to achieve an environmentally sustainable level of take) through the implementation of environmental works and measures (‘supply measures’)
- SDLs could be adjusted downwards (i.e. more water would be recovered for the environment) through the implementation of measures with no adverse social or economic impacts, such as investment in projects that increase the efficiency of water use for irrigation (‘efficiency measures’)

Taking into account the evidence on benefits and costs, the diminishing capacity to achieve additional benefits as water recovery extends beyond 2,800 GL/y in the context of existing system constraints, and further analyses undertaken in the Condamine-Balonne region, the MDBA considers that water recovery of 2,750 GL/y on a long-term average will result in environmentally sustainable levels of take in the surface water resources, returning enough environmental water to the basin to achieve most environmental objectives, while also ensuring that social and economic effects are best managed.

Groundwater

The MDBA has determined a total groundwater SDL of 3,334 GL/y, which reflects an environmentally sustainable level of take for groundwater resources for the 66 groundwater SDL resource units assessed under the Basin Plan. The total groundwater SDL is less than the sum of state groundwater extraction limits of 4,695 GL/y that applied at the time the Basin Plan was made. The total of state extraction limits of 4,695 GL/y is the volume of the extraction limits under the state water plans that were in place when the Basin Plan was made, plus groundwater entitlements where there was no state water plan.

The Basin Plan also specifies a basin-wide baseline diversion limit (BDL) for groundwater, which represents a determination of the limits on groundwater use under pre-existing water management arrangements. The BDL represents the volume of water that could be taken under the existing entitlements in the basin at the time of the making of the Basin Plan, not the amounts that could be taken under the extraction limits in state water plans that were higher in several cases. The baseline diversion limit is 2,386 GL/y.

To meet the ESLT requirements for groundwater, the MDBA determined that a groundwater SDL must: maintain key environmental assets that have any dependence on groundwater; maintain base flow groundwater contributions to rivers and streams; ensure that productive use of the aquifer is sustainable without compromising the hydrogeological integrity of the aquifer; and protect against decreasing groundwater quality, in particular salinisation of the groundwater resource.

The groundwater SDL for each SDL resource unit was informed by numerical groundwater models, or where these were not available, an analytical risk assessment developed for the Basin Plan. Both the numerical groundwater modelling and the analytical risk assessment provide the potential volume of water available for consumptive use. The MDBA then applied a groundwater assessment framework that considers this volume against other information to determine the groundwater SDLs.

In response to submissions on the draft Basin Plan (November 2011) as well as the consultation with Basin States and groundwater experts, the MDBA undertook a review of the methods and assessments that were used to determine the groundwater SDLs. The review determined that a consistent and more precautionary approach to groundwater should be adopted across the Basin and is reflected in the SDLs in the Basin Plan.

In the later part of 2012, a number of minor refinements were made to groundwater SDLs to incorporate updated data made available by states about several groundwater systems. A requirement to review the groundwater BDLs and SDLs in three groundwater systems (two in NSW and one in Victoria) within two years was also added to allow further consideration of the SDLs in relation to aquifers where the relevant states had expressed the view that higher levels were justified, but the MDBA was not, without further work over an appropriate time, prepared to accept a higher level as reflecting an ESLT.

Supporting information can be found in:

- CSIRO and SKM 2010, The groundwater SDL methodology for the Murray–Darling Basin Plan, Murray–Darling Basin Authority, Canberra. Available at http://www.mdba.gov.au/kid/files/1056-MDBA-Groundwater-SDL-Methodology.PDF
- MDBA 2012, The proposed Groundwater Baseline and Sustainable Diversion Limits: methods report, available at: http://www.mdba.gov.au/sites/default/files/Proposed-BP-GW-BDL-SDL.pdf
- MDBA 2012, The addendum to groundwater methods report , available at: http://www.mdba.gov.au/what-we-do/basin-plan/development/addendum-groundwater
- MDBA 2012, The Groundwater Sustainable Diversion Limit Resource Unit Summary Report cards, available at: http://www.mdba.gov.au/what-we-do/basin-plan/development/addendum-groundwater

Appendix 2 – Environmental watering

The Basin Plan builds on a history of managing water for the environment

Long-term commitment is required to deliver improved environmental outcomes

The limited environmental watering that has been conducted so far has had a positive effect

The environmental response to recent environmental watering highlights that a substantial improvement should be possible in the long run

Full achievement of the expected basin-scale environmental outcomes will follow from full implementation of the Basin Plan, and will take some years for monitoring to show

The Basin Plan builds on a history of managing water for the environment

Environmental watering has been happening in parts of the basin (like the Macquarie Marshes) since the 1980s. A lot has been learned from this experience and this has informed the Basin Plan.

There has been cooperation and action by states and the Commonwealth for some time to recover water for the environment through initiatives such as The Living Murray and the Water for Rivers program.

Environmental monitoring has shown that the icon sites have begun to improve in the past four years in response to managed environmental watering. The areas that were watered under The Living Murray during the Millennium drought are also showing faster improvement now that better conditions have returned compared with areas that were not watered.

Through the implementation of the Basin Plan states and the Commonwealth are now working together to manage the basin as a connected system to achieve more sustainable and efficient use of its water resources for the long-term.

One of the outcomes sought from the full implementation of the Basin Plan is "healthy and resilient ecosystems with rivers and creeks regularly connected to their floodplains and, ultimately, the ocean". Achieving this outcome also underpins social and economic outcomes in the basin because they rely on healthy and resilient ecosystems.

The Basin Plan sets out a framework to ensure the efficient and effective management of water, including the water recovered to provide for healthy and resilient ecosystems. This framework includes the *Basin-wide environmental watering strategy*.

Basin-wide environmental watering strategy

The *Basin-wide environmental watering strategy* was published by the MDBA on 24 November 2014, consistent with the requirements of the Basin Plan. This followed extensive collaboration with states and a period of public consultation. It guides achievement of the best possible environmental outcomes using all the environmental water made available by the Basin Plan.

The purpose of this strategy is to assist environmental water holders, state governments and waterway managers to plan and manage environmental watering at a basin scale and over the long term to meet the environmental objectives in the Basin Plan. The strategy describes:

- the important environmental outcomes expected to be achieved in the long term
- strategies for the management and use of water to maximise outcomes
- how various partners will work together to plan and manage environmental water
- the approach to determining the basin annual environmental watering priorities so as to achieve the long-term outcomes

Where possible, outcomes in the *Basin-wide environmental watering strategy* are measurable to assist in evaluating success and to inform adaptive management.

Whole-of-basin approach

Water connects across the landscape—it runs off catchments; along rivers; into billabongs, lakes and wetlands; across floodplains and ultimately to the ocean. Because of this connectivity, actions involving water taken in one place affect other parts of the basin. Similarly, ecosystem functions and food webs are connected across administrative boundaries (such as state borders) and should be managed holistically.

The basin contains water-dependent ecosystems of national significance and several sites are listed in international agreements for migratory waterbirds (i.e. Ramsar and Bonn conventions and bilateral agreements with China [CAMBA], Japan [JAMBA] and the Republic of Korea [ROKAMBA]). It is important that these are managed in the national interest.

A basin-wide approach to environmental watering is particularly required:

- where the water resources of multiple regions are needed to achieve desired outcomes; such as in the lower River Murray or along the Darling River
- where important ecosystems or organisms with a need for coordinated management are broadly distributed across state boundaries—such as fish, migratory waterbirds and large floodplain forests
- for rare, unique or representative species at the basin scale; or habitats such as the estuary and the internationally-significant migratory bird sites

Expected environmental outcomes

The goal of environmental watering is to protect and restore the resilience of the basin's rivers, wetlands, floodplains, lakes and red gum forests, together with the plants and animals that depend on them.

The *Basin-wide environmental watering strategy* sets out the environmental outcomes expected from full implementation of the Basin Plan. Mostly these are expressed as quantified outcomes. Monitoring and evaluation is directly connected to these quantified outcomes.

The MDBA has taken particular care to limit expected improvements to areas where water can be actively managed and where watering would not impact negatively on social and economic assets on the floodplains. Accordingly, the area of expected improvements is small relative to the broader floodplain. These are mapped and described in detail in the *Basin-wide environmental watering strategy*. The table below summarises the expected environmental outcomes.

Table 2 - Summary of quantified environmental expected outcomes that can be achieved from 2019

RIVER FLOWS AND CONNECTIVITY	VEGETATION	WATERBIRDS	FISH
Improve connections along rivers and between rivers and their floodplains	**Maintain the extent and improve the condition**	**Maintain current species diversity, improve breeding success and numbers**	**Maintain current species diversity, extend distributions, improve breeding success and numbers**
Maintained base flows: at least 60% of natural levels Improved overall flow: • 10% more into the Barwon–Darling[1] • 30% more into the River Murray[2] • 30–40% more to the Murray mouth (and it open to the sea 90% of the time) Maintained connectivity in areas where it is relatively unaffected: between rivers and floodplains in the Paroo, Moonie, Nebine, Warrego and Ovens Improved connectivity with bank-full and/or low floodplain flows: • by 30–60% in the Murray, Murrumbidgee, Goulburn and Condamine–Balonne • by 10–20% in remaining catchments3 Maintain the Lower Lakes above sea level	Maintenance of the current extent of: • about 360,000 hectares of river red gum; 409,000 ha of black box; 310,000 ha of coolibah forest and woodlands; and existing large communities of lignum • non-woody communities near or in wetlands, streams and on low-lying floodplains Maintain the current condition of lowland floodplain forests and woodlands of: • river red gum • black box • coolibah Improved condition of: southern river red gum	Maintained current species diversity of: • all current Basin waterbirds • current migratory shorebirds at the Coorong Increased abundance: 20–25% increase in waterbirds by 2024 Improved breeding: • up to 50% more breeding events for colonial nesting waterbird species • a 30–40% increase in nests and broods for other waterbirds	Improved distribution: of key short and long-lived fish species across the Basin Improved breeding success for: • short-lived species (every 1–2 years) • long-lived species in at least 8/10 years at 80% of key sites • mulloway in at least 5/10 years Improved populations of: • short-lived species (numbers at pre-2007 levels) • long-lived species (with a spread of age classes represented) • Murray cod and golden perch (10–15% more mature fish at key sites) Improved movement: more native fish using fish passages

In the short term, improvements in key flows can be measured as surrogates for environmental outcomes. In the medium to long-term, however, measurement of environmental outcomes will form the basis of evaluation. The MDBA has developed and commissioned a carefully planned program of monitoring and evaluation to ensure that basin-scale information on environmental (biological) outcomes is timely and efficient.

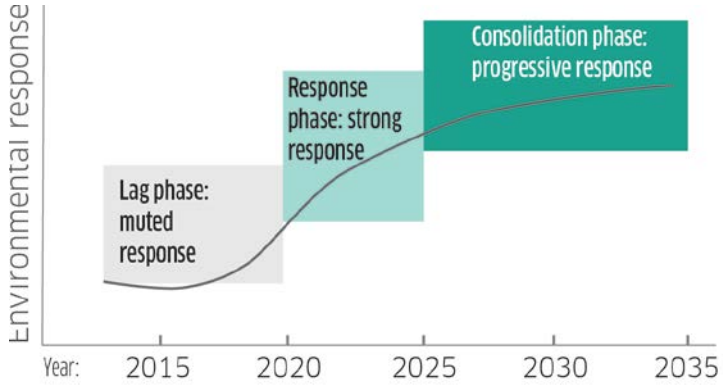
The MDBA expects to see progressive improvements in the condition and resilience of water dependent ecosystems as a result of environmental watering. The extent of improvement in the shorter

[1] Comprising tributary contributions from: Condamine–Balonne, Border Rivers, Gwydir, Namoi and Macquarie–Castlereagh catchments
[2] Comprising tributary contributions from: Murrumbidgee, Goulburn–Broken, Campaspe, Loddon and Lower Darling catchments
[3] Border Rivers, Gwydir, Namoi, Macquarie–Castlereagh, Barwon–Darling, Lachlan, Campaspe, Loddon and Wimmera catchments

term will depend on the rate of implementation of the Basin Plan, particularly progress with environmental water recovery, and the sequence of wet and dry seasons experienced in coming years.

The degradation of the basin's natural assets has occurred progressively over more than one hundred years of water resource development, with many of the serious problems only becoming observable in recent decades. Accordingly, it will also take decades before the full benefits of environmental watering are fully realised. The expected outcomes set out in the *Basin-wide environmental watering strategy* reflect both this lag period and the timetable for full implementation of critical Basin Plan elements such as the extraction limits and new complying water resource plans.

Figure 1 - Illustrative environmental response to Basin Plan implementation



How is it done?

Years of environmental watering experience shows that the best results are achieved by:

- **listening to communities:** local land managers, community groups and Traditional Owners know what conditions are like: where's water needed most? How are the fish doing?
- **mimicking nature:** ecosystems are adapted to natural patterns (like golden perch spawning best after spring/summer rain causes flow pulses). Using environmental water (in the absence of rain) to mimic such natural patterns is most likely to produce desired environmental responses
- **working together:** e.g. being efficient and achieving multiple results with the same delivery of environmental water; or pooling water toward larger-scale outcomes
- **thinking holistically:** e.g. water being delivered for irrigation or other purposes can potentially also contribute to environmental benefit, if the preceding strategies are considered while planning

These techniques are set out in greater detail in the *Basin-wide Environmental Watering Strategy*.

Early each year the MDBA, other water managers and river operators consider environmental water needs across the basin. They take into account the condition of sites; current and forecasted seasonal conditions; history of watering; and the water available to be used. They also talk to other interested groups like Aboriginal and irrigation representatives, local governments and landholders. These deliberations inform the basin annual environmental watering priorities that the MDBA publishes in June each year as another part of the framework for the management of environmental water across the basin.

These priorities guide owners and managers of environmental water. However, specific decisions on what goes ahead and when are made over shorter time-scales by environmental water managers themselves after considering local conditions and needs; and the feasibility of delivering water to a particular site. Local 'on-ground' knowledge is important in determining the amount of water, timing

and likely outcomes. Water is then released and managed through agreed river operations processes. These processes include safeguards that protect infrastructure and property in the course of routine operations.

Regional long-term watering plans

States are currently preparing long-term watering plans at a regional / catchment scale that complement the *Basin-wide environmental watering strategy*. These will inform the development of water resource plans which are to be completed by 2019. The MDBA is helping states prepare their long-term watering plans to ensure they are consistent with the Basin Plan and the *Basin-wide environmental watering strategy*. This will help optimise the outcomes from environmental watering at both the basin and catchment scales.

Environmental outcomes are being seen

Evidence of environmental change resulting from targeted environmental watering is already being seen, providing improved ecosystem health and water quality across the basin, including in unregulated systems.

Local level ecological responses in our native flora and fauna are being seen within the short timeframes since implementation of the Basin Plan began in late 2012. Examples include bird breeding again in the Hattah Lakes and the first fish migration along the entire 2000 km length of the Murray River since the late 1920s. A snapshot of responses is included below.

Improving the health of the environment requires a long-term approach, and will depend not only on targeted management actions but also on factors such as short-term climate variability and good land-management practices. The successes we are seeing today with managing the highly saline areas in the southern basin, and the rejuvenation of iconic wetlands are the result of long-term commitment by Governments to improving the health of those areas.

Hattah-Kulkyne Lakes

The Hattah-Kulkyne Lakes are a Ramsar-listed floodplain and wetland system in north-west Victoria. For decades, river regulation and a drying climate have restricted the volume of water flowing into the lakes system.

Structures to pump environmental water into the lake system were completed in 2013 and environmental watering began in October that year.

The annual basin-wide aerial waterbird survey in November 2014 observed that the lakes were at their fullest for more than five years and were supporting hundreds of waterbirds including pink-eared ducks, hardhead, pelicans, ibis, herons and a large population of great cormorants. The survey also observed that the great cormorants were breeding at the lakes. Breeding in great cormorants is triggered by an abundant food supply, so these survey results indicate that the watering events had created good environmental conditions for the cormorants' preferred prey: fish, crustaceans and aquatic insects.

This was the first time since a natural flood in 2010 that waterbirds have been observed to breed at Hattah-Kulkyne Lakes and is hoped to have helped to arrest the decline in waterbird populations.

Northern basin

Aerial survey observations in the northern basin have shown that environmental flows were providing important refuges for hundreds of waterbirds in the otherwise-dry Macquarie Marshes and Gwydir

Wetlands. Species observed at these sites included herons, egret, grey teal, yellow and royal spoonbills, black duck and even a few brolgas and a jabiru.

Improved fish outcomes

A combination of actions have led to a number of positive changes in fish populations in the Basin over the past eighteen months.

From July 2013 to June 2014, environmental flows in Gunbower Creek were carefully timed to be delivered during the critical spawning period for Murray cod and this resulted in multiple successful spawning. A monitoring program in place since 2005 had shown Murray cod to be in decline, so it is hoped that these spawning events will provide a valuable boost to the population.

Meanwhile, two spring 'freshes' of environmental water delivered in the Goulburn River in 2014 prompted a bumper breeding season for golden perch and boosted breeding in silver perch, another threatened species.

The Sea-to-Hume Fishway was completed in 2014 and will assist native fish to migrate along the entire 2000 km length of the Murray, which has not been possible since the construction of locks and weirs began in the late 1920s. Monitoring shows that millions of native fish are using the fishways, with as many as 10,000 native fish passing through fishway structures per day. In January 2015, a tagged silver perch was recorded as travelling 470 km upstream through the fishway in one month.

Optimising environmental outcomes over multiple years

The Basin Plan promotes targeted and purposeful delivery of environmental water that is coordinated with irrigation supplies and natural events, to ensure that environmental water is used as effectively as possible. Ongoing monitoring will improve the information base and guide future decisions.

Just as irrigators do not always use their allocations annually, environmental water will sometimes be carried over to make the most effective and productive use of the water and manage risks to the environment. Carry over rules apply to all water entitlements, regardless of whether they are held for environmental use or for irrigation. Carry over water is still very much needed and it is an important part of the management strategy for environmental water holders if they are to maximise the environmental dividend from that water.

For example, this year in the Border Rivers and Namoi Rivers, the Commonwealth Environmental Water Holder (CEWH) chose to carry its water over to the next water year because the need was seen to be greater for future years, rather than this year. This is about actively managing the available water to suit the conditions so as to achieve the best outcomes with limited water.

The MDBA works with the CEWH and local water managers to deliver coordinated flows for a range of environmental purposes with water recovered from the system.

The important improvements in salinity and water quality already observed in the southern river reaches are a further demonstration of the success that comes from years of coordinated management by multiple governments. Salinity has been gradually reduced through cooperation between governments, land management and smart engineering, such as salt interception schemes. Increased environmental flows under the Basin Plan give greater flexibility to manage dilution flows and improve water quality for downstream users – lack of dilution flows is one of the major causes of algal blooms, such as those experienced in 2009 and 2010 across almost 1,100km of the Murray River from Lake Hume to Euston.

Appendix 3 - Progress of the Constraints Management Strategy

Environmental outcomes can be improved by changing river rules, practices and structures that govern the volume and/or timing of regulated water delivery through the river system

Constraints work to date has focused on gathering information for decision making by the states

The MDBA's work program was shaped by community feedback and is designed to investigate community concerns by consulting with landholders in the key study areas

This work is about improving options for how we can deliver environmental water in a way that is acceptable to local communities

The purpose of including a study of constraints in the Basin Plan is to identify and describe the physical, operational and management constraints that are affecting environmental water delivery. This is a long-term strategy that looks at smarter ways to manage available environmental water and to maximise its potential benefits. The *Constraints Management Strategy 2013-2024* (CMS) was completed in November 2013.

The development and release of the CMS has improved understanding of the likely impacts of constraints in seven key focus areas, and identified knowledge gaps, community issues and concerns.

The Basin Plan only requires the CMS to be written. Decisions to change river constraints will be collectively decided by the state and Commonwealth governments by 30 June 2016.

Constraints development timeline

2012
- Basin ministers requested the Basin Plan include a Constraints Management Strategy to be prepared by MDBA

2013
- MDBA released the Constraints Management Strategy 2013-2024 in November 2013
- MDBA released a report on feedback from community consultation and how it influenced the final CMS

2014
- MDBA completed a Basin-scale analysis of priority constraints for the prefeasibility phase of the CMS (analysis and prioritisation of constraints in seven key focus areas)
- Basin Ministers agreed that the key focus areas identified in the prefeasibility phase progress to business case development
- MDBA provided the first annual report to Basin ministers about progress with the CMS

2015
- MDBA completed 'Reach reports' for each key focus area (after drafts released in 2014)
- The Commonwealth Government places a cap on water buybacks at 1,500 GL
- Ministers note that Constraints projects offer potential as 'supply measures' to reduce the water recovery target in August 2015
- Relevant Basin States to finalise and submit constraints business cases for consideration by basin governments in late 2015

2016
- Basin ministers to agree a package of constraints and SDL adjustment measures to recommend to MDBA for assessment by 30 June 2016

2024
- Constraint measures enter into operation if agreed

Effectiveness and appropriateness of the CMS

The MDBA is committed to the efficient and effective delivery of environmental water and to devising smarter ways of managing rivers. Addressing system constraints is fundamental to this. Addressing constraints means environmental water holders will be able to use water in the most efficient and effective way possible.

The CMS is built on principles central to work the MDBA is doing for states, to ensure any potential effects of new policies (e.g. changes to flow levels) are explored before final decisions are made:

- solutions to overcome constraints will recognise and respect the property rights of land-holders
- affected communities need to be involved to identify potential impacts and solutions
- solutions will not create new risks to entitlement reliability

In general, the changes being considered by Basin States relate to managed flows on the lowest parts of the floodplain, in areas often designated as floodways or 'flood country'. Usually, this is not where there are buildings or crops, but it is where a range of native species will benefit.

An independent stocktake of the SDL adjustment mechanism has recently been undertaken. The stocktake is confident that the constraints program is progressing satisfactorily given the complexity and extent of the projects. The stocktake also highlighted the importance of ongoing consultation with landholders and communities.

Science underpinning the CMS

Detailed hydrologic modelling work was undertaken in 2012 to explore if it would be appropriate to relax constraints. Three scenarios were modelled with water recovery volumes between 2400 and 3200 GL. The results showed that relaxing constraints would result in improved environmental outcomes at each scenario.

The modelling also showed that there would be additional benefits from recovering a higher volume, particularly for river red gum and black box woodland communities in the mid and lower sections of the River Murray if constraints could be relaxed.

This is why the MDBA recommended a recovery volume of 2,750 GL in the Basin Plan in 2012, and why South Australia campaigned for a program of efficiency measures to recover an additional 450 GL and a strategy to relax constraints.

A diversity of views

There is a diversity of views amongst riverine landholders and river operators about what flows can be achieved and options to mitigate risks.

On one hand, some local people MDBA has met with appreciate the potential benefits of investing in projects to enable efficient delivery of environmental water, reducing the need for future water buyback. Such investment would help communities along the river to better manage natural floods.

On the other hand, many riparian landholders have consistently raised concerns about the effectiveness and appropriateness of the CMS. The main concern relates to the size of some of the flows being considered, the increased risk of uncontrolled flooding, and the way community concerns have been addressed and reported.

The MDBA is progressively reporting on the views of landholders within each study reach that together with the results of further investigations in 2015, will be used to inform decisions by Basin States about whether or not to proceed with different proposals.

Potential flow limit changes under the CMS

There are seven key areas being studied in 2015 for the CMS. The flow limits under investigation were prescribed by Basin States as these were considered the most likely to get the best environmental gains from the use of environmental water by changing constraints.

Table 3 – Constraint flows to be investigated in 2015

Key Focus Area	Flow for investigation	Lead State
Hume to Yarrawonga	40,000 ML/day	Victoria and NSW
Yarrawonga to Wakool Junction	50,000 and 65,000 ML/day	NSW
SA Murray	Up to 80,000 ML/day	South Australia
Goulburn	40,000 ML/day	Victoria
Murrumbidgee	40,000 ML/day	NSW
Gwydir	To be set during 2015	NSW
Lower Darling	To be determined	NSW

The work involved looking at where water goes in the landscape at different flows and what this means for people who live along the river. By checking inundation maps with people in these areas, the MDBA has also been able see if it is possible to overcome the negative effects of overbank flows.

MDBA is continually reporting and responding to community concerns

MDBA staff have been liaising closely with the local communities about potential changes to river flow limits over the past two years.

Where possible, the MDBA and states have committed to sharing material that will be included in business cases so that stakeholders have an opportunity to provide feedback on the information states will use to make decisions around what projects to proceed with. This approach is consistent with the CMS commitment to transparency, a principle that has been upheld through the ongoing publication of reports, along with other relevant information on constraints on the MDBA's website.

For example, a summary of concerns and responses from more than fifty meetings with individuals and groups in the Edward-Wakool region is included at **Appendix 5(b)**. The constraints work program is designed to investigate community concerns and has been shaped by community feedback.

The scope of constraints proposals

During 2015 the MDBA has been assisting states to carefully improve the detail of constraints proposals. The MDBA has been collecting information on the impacts, costs and mitigation of flows that are feasible. In some cases the MDBA is still looking at flows that communities find concerning (such as 20,000 ML/day downstream of Lake Eildon).

The purpose of this work is to help understand the risks and impacts of constraints proposals to provide the best possible advice to Basin States about the flows being investigated. Choosing the final flow targets is the responsibility of Basin States.

A summary of work in the Goulburn River is included at **Appendix 5(a)** as an example of how constraints can be operated and managed in complex systems. This example shows the scope of easing constraints in the Goulburn River that are primarily based around the watering needs of the lower Goulburn River and floodplain, while there are also additional environmental benefits of water flowing to the River Murray.

Appendix 3(a) - Responding to issues at Yarrawonga Weir to Wakool Junction

The Yarrawonga Weir to Wakool Junction reach is one of the key focus areas identified for investigation in the Constraints Management Strategy. This reach incorporates all of the River Murray downstream of Yarrawonga Weir through to Wakool Junction. It also includes the Edward–Wakool system and associated rivers and creeks right through to the Wakool Junction.

The hydrology of the system is complex and large flow or flood events can be highly variable. This reach contains several RAMSAR listed forested wetlands, which provide important breeding habitats for native birds and fish populations, as well as linkages for migratory and nomadic birds and small mammals moving throughout the landscape. The Edward–Wakool system was also critical in helping the post-Millennium drought recovery of numerous species.

MDBA constraints work

Local landholders, local governments and other stakeholders within the Yarrawonga to Wakool Junction reach have been consulted about potential changes to river flows since early 2013. During this time, over 50 stakeholder meetings have been held in the Yarrawonga-Wakool region documenting their views, collating the information, checking back with people on what they said and ensuring that issues raised are properly investigated. The meetings ranged from one-on-one meetings to group workshops.

Preliminary information on the likely social, economic and environmental benefits and impacts of increasing maximum regulated flow limits was gathered throughout 2013 and 2014. This work, along with community feedback, was collated in the Yarrawonga Weir to Wakool Junction reach report, which was published in July 2015. Table 3 shows how the constraints work program in the Yarrawonga weir to Wakool Junction reach has been shaped by community input and tailored to investigate community concerns.

Work in 2015 continues to investigate concerns raised by the community to develop a more detailed understanding of the benefits, impacts and costs of mitigation of the changes to river management practices being considered.

Table 4 – Yarrawonga-Wakool constraints consultation: Stakeholder concerns and how they are being addressed

Stakeholder issue/concern	What work is happening to address this?
Increased risk of uncontrolled flood events	As part of developing Business cases, the MDBA has engaged a consultant to develop a method for assessing exacerbated flood risk. The MDBA intends to engage an independent consultant to apply the method to understand the risk of overbank environmental flows exacerbating current flood risk. To enable the issue to be better quantified, the MDBA and CSIRO are developing an improved hydrodynamic model of the Edward-Wakool system
There is a difference between modelled flows and associated inundation patterns and what happens in reality.	Flow trials and incremental commissioning of higher flows are important in understanding inundation patterns under different flow conditions. Flow trials and incremental commissioning of higher flows will be included in the Implementation Plan as part of the Business Case. MDBA has supported flow trials wherever possible, but needs environmental water holders to participate.

Stakeholder issue/concern	What work is happening to address this?
Competition for channel share	Competition for channel share was investigated through the operational and management constraints process and reported on in the CMS Annual Progress Report 2014. It was found that environmental water is unlikely to increase, and may even decrease competition for channel share.
Private diverter access - changes in water demand patterns (through the Basin Plan) alter river flows, will this affect water access	As part of developing business cases the MDBA is working with River Operators and partner governments to quantify the issue and identify appropriate mitigations strategies.
Interrupted or impeded access to land and water	As part of developing business cases MDBA has engaged consultants to explore possible options to mitigate the effects of increased regulated flows and is costing these options for the Business Case.
Increased flows inundating private land	As part of developing business cases MDBA has engaged consultants to explore possible options to mitigate the effects of increased regulated flows and is costing these options for the business cases
Impacts of increased flows on levees and floodplain management	The current distribution of levees across the floodplains of the Edward-Wakool system is not well understood. MDBA is investing in improved LiDAR. This information will be used to construct a more detailed GIS layer of existing levees. As part of developing business cases MDBA has engaged consultants to identify which levees will be affected by flows being examined and explore potential mitigation options.
Frequency, timing, duration and predictability of proposed flows	Throughout 2015, the MDBA has refined the hydrologic modelling to give a better picture of the likely frequency, timing and duration of flows.
Managing access during emergencies	MDBA has explored mitigation actions to maintain access during flow events. MDBA added the importance of maintaining critical access routes in the principles for determining mitigation options in the business cases for the River Murray.
Potential for increase flows to result in environmental damage	The potential for perverse environmental outcomes (including hypoxic blackwater events) is being considered and reported on in business cases.
Impacts of increased flows on Private infrastructure	The MDBA has engaged consultants to explore possible options to mitigate the effects of increased regulated flows and is costing these options for the business cases.
Tourism - Fishing and water skiing are significant tourist drawcards for towns like Deniliquin and Moulamein. If the beaches and boat ramps are submerged (or flows are too fast) at critical times, tourist numbers drop, with town economies consequently suffering.	MDBA has engaged consultants to explore possible options to mitigate the effects of increased regulated flows and is costing these options for the business cases. Improving the ecological health of the river and riparian areas should have beneficial effects for tourism that outweigh any short term impacts. To check this, MDBA has commissioned CSIRO to study the possible beneficial effects of improving the ecological health of the river and riparian areas, including for tourism.

Stakeholder issue/concern	**What work is happening to address this?**
Adequacy of funding There is a strong view that $200 million to address constraints is inadequate for the Yarrawonga Weir to Wakool Junction reach, let alone six additional reaches across the basin.	Basin States and MDBA are exploring the possibility of constraints measures being proposed as supply measures under the SDL adjustment mechanism, which would make additional funding sources available. MDBA is considering whether and how funding may be made available for independent professional advice for landholders.
Public infrastructure — bridges and roads	MDBA has engaged consultants to explore possible options to mitigate the effects of increased regulated flows, including effects on public land and assets, and is costing these options for the business cases.
Impacts of increased flows on Forestry operators	MDBA has engaged consultants to explore impacts and possible options to mitigate the effects of increased regulated flows, including the effects on forestry operations, and is costing these options for the business cases. MDBA added a forestry case study to the case studies on specialist business in the Yarrawonga-Wakool reach.
Groundwater recharge — increased salinity risk	Management of these risks currently occurs through existing programs. Incremental commissioning of higher flows will enable impacts to be assessed through these programs.
Environmental watering events and benefits — improved communication.	Improving the ecological health of the river and riparian areas should have beneficial effects for tourism that outweigh any short term impacts. To check this, MDBA has commissioned CSIRO to study the possible beneficial effects of improving the ecological health of the river and riparian areas,
Redgum regrowth in channel – restricting flows	If higher managed flows were to be implemented, they would be delivered by slowly increasing flow rates in different events over time i.e. incremental commissioning of higher flows. This allows for changes in channel capacity to be taken into account. As part of developing Business Cases, the MDBA has engaged consultants to explore impacts of increase regulated flows on landholders, including unintended consequences such as red gum regrowth in delivery channels.
Clarify who carries liability for third party impacts	As part of developing Business Cases, the MDBA has engaged consultants to quantify the increased risk of uncontrolled flood events. Through 2015 and beyond the MDBA will continue work with Basin governments, water user groups and landholders to understand these issues and find practical solutions.

Appendix 3(b) - Goulburn River constraints case study

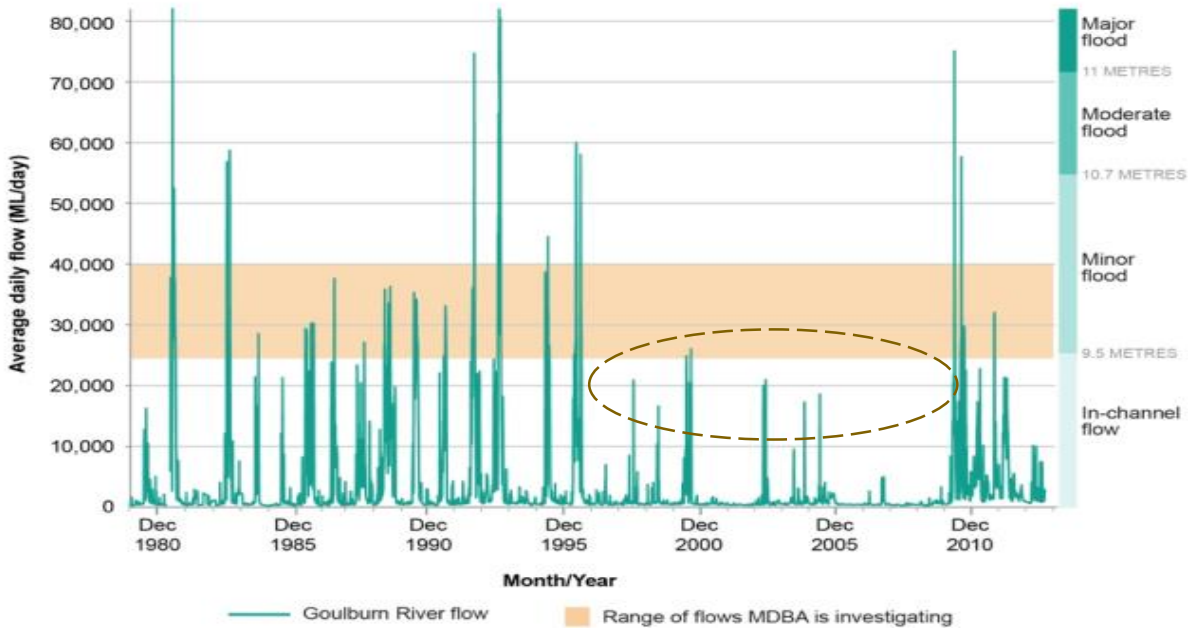
What flows are being looked at for the Goulburn River and why?

Since 2003 a series of Victorian technical studies and policy recommendations have consistently reported that the frequency of overbank flows is less than what is needed to maintain the health of the Goulburn River and floodplain environment.

The constraints work is primarily based around the watering needs of the lower Goulburn River and floodplain, although there are additional environmental benefits of water flowing to the River Murray. Environmental water managers are seeking to water native vegetation inside the levees, and minimise or avoid effects on productive farmland outside of the levees. Flows between 25,000ML/day and 40,000ML/day at the Shepparton gauge would get water to 45% and 89% of the water-dependent vegetation on the floodplain, while staying within the leveed floodway.

Figure 2 – Average daily flows at the Shepparton gauge

(The range of flows being investigated is presented by the shading. The Millennium drought is represented by the dashed circle)



Constraints work is investigating the potential for higher environmental flows between June and November, when rainfall and natural tributary flow events typically happen and when the Goulburn floodplain needs the water most. This timing also minimises competition for channel capacity by avoiding peak irrigation demands in late spring and summer. Based on initial overbank flow recommendations for the lower Goulburn the flows would occur at least once every three years. Given that these flows sometimes happen naturally (Figure 4), this means an extra one to two managed minor overbank flows every ten years on average.

What are the constraints?

To achieve higher environmental flows in the lower Goulburn means relying on a combination of unregulated tributary flows, topped up with some modest releases from Lake Eildon or Goulburn Weir. However, regulated flows are currently constrained by possible effects on private land, especially around Molesworth in the mid-Goulburn. The intent of constraints work is to find out if it

is possible to allow more water to pass downstream to reach the creek and floodplain network of the Lower Goulburn while also understanding how changes to river flows would affect people, businesses and communities all the way downstream of lake Eildon.

There are a large number wetlands between Lake Eildon and Goulburn Weir. However there is no specific environmental watering objective to deliver overbank flows upstream of the Goulburn weir. Managed flows need to be higher upstream to achieve flows of 25,000 to 40,000ML/day downstream of Goulburn Weir. There are many different potential combinations of tributary flows plus managed flows that could achieve these flows.

Overbank flows upstream of Goulburn Weir would impact on infrastructure and private land. In 2015 the Victorian government is investigating a range of flow footprints along the river, with flows ranging from below minor flood level to minor flood level. Flow footprints are being used to identify when and how riparian landholders, councils and businesses are affected.

The flow footprints being investigated are assumed to include the flow contributions of unregulated tributaries. The flow footprints are providing constraints work with a detailed understanding of how impacts, risk and benefits change for different flows along different parts of the river. This helps to build more comprehensive information to better advise Basin governments about which flows should or should not be considered.

Approach to community involvement

In 2013 three community advisory groups were formed to assist with the Goulburn constraints work. The advisory groups include landholders and representatives from local businesses and councils many of whom have decades of first-hand experience on the Goulburn River. Goulburn-Murray Water and Goulburn Broken Catchment Management Authority (GBCMA) staff have attended all advisory group meetings as observers. The GBCMA is leading this work in 2015. The local information has been incredibly valuable and these people have been extremely generous with their time and input.

A range of other regional meetings have been held in order to provide input to information collection for the constraints work. The ongoing involvement of a dedicated officer has provided continuity to community engagement, while respecting the time and input the community has provided.

- 680 people have been involved in constraints discussions over three years in the Goulburn Valley
- Over 200 hours of meetings from 2013–2015
- 72 meetings held regionally, and 2 in Canberra. This includes 20 advisory group meetings, 18 landholder meetings on farm, 18 public meetings, 7 briefings to local councils, 4 regional authority briefings, 4 presentations to broader interest community organisations and a communications and engagement workshop with Victorian regional officials.

How are community concerns being addressed?

Many of the submissions received on the draft report for the Goulburn River raised concerns about higher flows in the mid-Goulburn region between Lake Eildon and Yea. Revisions to the Goulburn Reach report were made on the basis of this feedback that included:

- Developing a Molesworth landholder case study to better describe potential impacts and risks to businesses and communities
- Strengthening the wording around which flows are a significant community concern in the mid-Goulburn reach

Currently, the scope of constraints flows under investigation is being narrowed. The main focus is to reduce the main uncertainties and cost the flow impacts. The table below shows how community input is influencing constraints work in the Goulburn River.

The GBCMA, on behalf of the Victorian government, will prepare a constraints business case for the Goulburn River by 30 November 2015. This will include an analysis of all flow options, importantly including which are recommended as feasible and why, and which are recommended to not be pursued any further, and why. This is the stage when the scope of constraints flows under investigation will be narrowed, although many in the community are impatient with the process, preferring some of the higher flow footprints of concern to stop being investigated as soon as possible.

Table 5 –Goulburn River constraints consultation: Stakeholder concerns and how they are being addressed

Stakeholder issue/concern	**What work is happening to address this?**
Catchment unpredictability and adequacy of the gauging network	Analysing past flow events to better understand tributary behaviour over a wide range of conditions Test the value of additional gauging information in order to be able to better predict tributary flows
How would specific flow footprints be created and managed under a range of catchment conditions and tributary flow scenarios, including worst case? (e.g. unexpected rainfall event after a release from storage has been made)	Define target flows at different points along the River Scoping how to add managed environmental water to tributary flows, i.e. develop and test potential operating strategies (which events to target, what part of the event, potential triggers for release, etc.). Scoping what it would cost to develop and test real-time catchment and river models to provide water managers, river operators and community with the confidence to water within a target flow range. Develop risk mitigation strategies to reduce targeting errors.
Flow footprint mapping accuracy concerns, particularly in the mid-Goulburn. Also concerns that there could be backing up issues for tributary landholders.	Undertaking new hydraulic mapping work incorporating additional flow/height data to help improve model accuracy. Look at the extent and impact of tributary backup for two sample tributaries – the Acheron and Yea Rivers Look at the extent and impact of River Murray and Goulburn River back up.
Adequacy of MDBA's pre-feasibility cost estimates	Refine mapping of asset locations (roads, bridges, buildings, specialist businesses) to better reflect what assets could be affected MDBA independent consultants working directly with local government and specialist businesses to refine cost estimates for roads and bridges and to develop costs for specialist business impact mitigation.
Poor condition of the lower Goulburn levees and relying on their condition to keep higher environmental flows inside the levees	Work to improve pre-feasibility costing for upgrades to the lower Goulburn levees to bring them up to a minimum standard of protection, including levee outlet structures to limit the amount of nuisance flooding along creeks on the north side of the river.

Appendix 4 - Roles and responsibilities

The MDBA has an important role to play in implementing the Basin Plan, but other Commonwealth and state agencies are actively involved and also play an important part

The roles and responsibilities for water reforms in the basin are shared across different agencies.

The MDBA plays a key role in providing good governance to water management for the basin and facilitating decision making between states.

In short, the MDBA is responsible for coordinating the implementation of the Basin Plan for the Commonwealth. The states have responsibility for day-to day water management such as setting allocation levels. The Department of Agriculture and Water Resources is responsible for administering the water recovery programs including the buyback and infrastructure programs. The Commonwealth Environmental Water Holder is responsible for using the environmental water portfolio to meet environmental objectives.

The roles and responsibilities for basin water reforms are set out in the **table below**:

Roles and responsibilities for Murray–Darling Basin water reforms

In broad terms, the roles and responsibilities for water reform in the Murray–Darling Basin are as follows:

- The **Minister for Water** approves the Basin Plan (and any amendments), approves the use of program funding (water recovery, SDL adjustment measures etc.), considers evaluations of overall progress, and chairs the MDB Ministerial Council.
- **Department of Agriculture and Water Resources** is responsible for policy advice and program implementation, in particular investing in water recovery and SDL adjustment measures. The Department also chairs the Basin Officials Committee.
- **Murray–Darling Basin Authority** oversees implementation of the Basin Plan, including the Sustainable Diversion Limits, reporting direct to the Minister.
- **Commonwealth Environmental Water Holder** manages the use of Commonwealth-held environmental water consistent with the Basin Plan, to achieve best possible environmental outcomes.
- **Basin States** own water and are responsible for allocating it to licence holders consistent with their water resource plans. They also hold and deliver environmental water, and are responsible for implementing the Basin Plan in their own jurisdictions.
- **Australian Competition and Consumer Commission** provides advice to the Minister on water market rules and water charge rules which are intended to free up trade and regulate costs of monopoly infrastructure (e.g. access to irrigation schemes), and to monitor and enforce these rules.
- **Productivity Commission** conducts 5 yearly audits of Basin Plan implementation.

Table 6 – Roles and responsibilities for Murray–Darling Basin water reforms

		Minister for Water	Department of Agriculture and Water Resources	Murray–Darling Basin Authority	Commonwealth Environmental Water Holder	Basin States
REVIEWS	SDL Adjustment Process	Support SDL adjustment package through Ministerial Council. Adopt amendments to Basin Plan giving effect to the proposed SDL adjustment.	As Chair of BOC, facilitate agreed package of SDL adjustment measures (see State role). Implement efficiency measures program and part-fund states to implement supply measures.	Develop method for assessing 'supply' measures based on Basin Plan (done). Apply method and modelling to determine amount of adjustment. Advise Minister on proposed SDL adjustment to Basin Plan.		Develop proposed supply measures. Agree on package of SDL adjustment measures by 30 June 2016.
	Constraints	Support constraints measures as part of SDL adjustment package. Note that some constraints projects are also likely to be SDL adjustment projects.	Manage $200 million to address constraints.	Develop Constraints Management Strategy. Provide technical advice to states on measures to best implement the strategy, where requested.	Input as required.	Develop proposals to address constraints by mid-2016. Implement agreed measures.
	Northern Basin Review (mid 2016)	Adopt any proposed amendments to Basin Plan and revisions to water recovery strategy in light of northern basin review.	Participate in the review. Consider changes to water recovery strategy in light of the review.	Conduct 'triple bottom line' review to test if there is a case to change SDLs or pattern of water recovery in the northern basin. Advise Minister on amendments to Basin Plan and changes to water recovery strategy based on the review.	Participate in the review.	Qld and NSW are participating in the review. They will need to advise on their preferred apportionment of the 'downstream' component before the review is finalised. Provide views on any proposed amendments to Basin Plan.
WATER RECOVERY	Buybacks & Infrastructure	Decide on water recovery strategy.	Implement the Commonwealth's water recovery strategy including cap on buybacks, and recovery of water for enhanced environmental outcomes (efficiency measures) under the SDL adjustment mechanism.	Monitor and report progress with water recovery ('Bridging the Gap').	Input as required.	Work with Commonwealth to identify ways to maximise water savings made through existing and proposed infrastructure projects (IGA).
BASIN PLAN	Prepare & implement Basin Plan	Adopt Basin Plan (done). Consider regular reports on Basin Plan implementation, including those to Ministerial Council.	Input to draft Plan (done). As BOC Chair, facilitate development of agreed state comments (done).	Develop Basin Plan including consultation with states and stakeholders (done). Enforce Basin Plan including through annual assessment of state SDL compliance.		Advise state views on draft Basin Plan (done). States report on SDL compliance post 2019.
	State Water Resource Plan (WRP) Accreditation	Decision to accredit each state WRP based on MDBA advice. There are 36 plans required by 2019.		Assess state water resource plans and advise Minister on their accreditation.		Prepare WRPs suitable for C'wealth accreditation.
	Environmental water planning and delivery	Considers reports on use of environmental water.		Set long term outcomes for environmental watering across Basin (done) and set annual priorities. Coordinate environmental watering at a basin scale.	Manage Commonwealth environmental water holdings consistent with the Basin Plan.	Prepare valley-based long term environmental watering plans and annual priorities. Have regard to MDBA published priorities when conducting environmental watering.
	Water Trade	Makes Water Market and Charge Rules on advice of ACCC (done).	Participate in water market as per water recovery strategy.	Ensure compliance with Basin Plan water trading rules.	Manage Commonwealth water portfolio – including trading – in accordance with Water Act (under review).	Implement state trade rules consistent with Basin Plan trade rules and processing trades.
	Monitoring and evaluation	Consider 5 yearly evaluations and PC audits.	Annual and five yearly reports on water recovery and investment to MDBA.	Monitor and evaluate economic and social outcomes across Basin with input from Dept on investment. Monitor and evaluate environmental outcomes with input from CEWO and States. PC to audit each 5 years.	Monitoring and evaluation of CEWO watering activities. Annual and five yearly reports to MDBA.	Monitoring and evaluation of environmental outcomes at valley/local scale. Annual and five yearly reports to MDBA.

Appendix 5 - Understanding the social and economic effects of the Basin Plan and water recovery

It is difficult to single out the impacts on communities from the Basin Plan from other factors – it will take time for any changes as a result of the Basin Plan to be known

There are signs of both positive and negative social and economic circumstances in basin communities – it is impossible to generalise

One of the emerging elements of how well a community might to adapt to the Basin Plan water reforms is the condition of the community at the time of water recovery as well as the nature of the water recovery process itself

There are likely positive impacts yet to come from the significant investment in on-farm infrastructure over the next few years

Many drivers of change

The Basin Plan water reforms are happening in a constantly changing environment. So the task of MDBA's social and economic monitoring and evaluation program is to understand and differentiate the long term changes and drivers of those changes occurring in Basin Communities from the effects of water reform. It is not possible to consider the effects of the Basin Plan water reforms in isolation from all of the other changes that have occurred or are occurring.

Changes in Basin communities are likely to be a consequence of multiple economic, climatic and policy changes affecting each community in different ways and over differing periods of time. Innovation, economic factors, climatic variability, past and present water reforms, and other policy changes affect investment, production and employment over relatively long periods of time.

The MDBA recognises the need to acknowledge potential impacts where they exist, but it is also important to understand that changes are occurring in a complex context with multiple drivers of change. It will take time for the effects to emerge, in most cases, as farmers adjust their cropping and water management decisions.

It is not yet possible to provide definitive evidence of the extent to which the Basin Plan water reforms have affected Basin industries or communities. However, it is possible to make some early observations about the changes we are seeing and where there might be a higher likelihood of impacts that are worth investigating further. In particular, those areas of significant water recovery and where underlying social and economic conditions are quite challenging, such as Dirranbandi, Warren, Collarenebri, Deniliquin-Wakool and Kerang-Cohuna.

Early observations

Major shocks such as the severe drought in 2002-03, increasing farm mechanization, rises in farm debt and the consolidation of farming enterprises appear to have had a significant influence on employment, production and investment in Basin communities. Economic shocks such as the Global Financial Crisis in 2007-08 and the severe drought of 2006-09 also contributed to the social and economic conditions of rural communities. The changes in Australia's farm jobs are consistent with changes we have observed in individual rural communities inside the Basin. There are also changes to

seasonal work opportunities. For example, technological improvements and mechanisation have significantly reduced the seasonal work opportunities in the cotton industry over the past 15 years.

Shifts in the foreign exchange rate and commodity prices plus an array of non-water policy changes are some of the other factors influencing changes in communities, including their wellbeing. These factors are outside the influence of the Basin Plan water reforms but they contribute to changes in the social and economic conditions of communities. It is this broad and complex set of matters which intersect with the Basin Plan water reforms, and how individual communities respond to the reforms, which will influence their future development pathways.

There are some common changes affecting all rural areas inside and outside the basin, however it is becoming clear that it is not possible to generalise about the reasons for the changes. While there are signs of difficult and challenging social and economic circumstances in some communities, other communities are prospering. One of the emerging elements of how well a community might to adapt to the Basin Plan water reforms, is the condition of the community at the time of water recovery as well as the nature of the water recovery process itself. That condition is influenced by a range of past and more recent changes. The indicators which describe community condition include rates of population change and migration of people into or out of communities, the role played by different regional centres, employment (in the form of the total number of jobs, male and female employment, full-time and part-time work, changes in the age, industry and occupations profiles of the workforce), and specific measures of social and economic condition and well-being.

While water purchases have often had beneficial effects on the individuals selling the water, these benefits do not necessarily flow on to communities. Water recovery through infrastructure investment, which essentially recovers water by reducing losses, can lead to direct benefits to the farmers and to their respective communities. Those benefits may include increased activity for non-farm businesses associated with installing the new infrastructure.

From the infrastructure investment, farmers report they are able to better plan their cropping programs with lower allocations, spend less time watering and have increased flexibility within their farming enterprises.

Wellbeing survey

The University of Canberra's Regional Wellbeing Survey has so far measured Community Wellbeing in 2013 and 2014. The majority of areas in the basin that participated in the survey recorded little change in their overall wellbeing.

The survey identified Deniliquin and Conargo (together with Mildura, Greater Shepparton, Moira, Campaspe shires) as having recorded a significant increase in Community Wellbeing from 2013 to 2014. This is likely to coincide with recent investment in the re-opening of the Deniliquin abattoir on top of the rice mill activity and high levels of agricultural production.

However, Wakool shire (plus Wentworth and Balranald) recorded a significant decrease in Community Wellbeing between 2013 and 2014.

It is not yet possible to separate what, if any, part of these changes in wellbeing may be due to the Basin Plan.

Aboriginal communities

The MDBA is ensuring connections are built with Aboriginal people in the basin as part of implementing the requirements of the Basin Plan. The MDBA has developed the Aboriginal Submissions Database (ASD), based on the 480 Aboriginal people's submissions to the draft Basin Plan. The MDBA also undertook a small socio economic survey of Aboriginal water related issues in the basin, which was completed by 280 respondents.

Aboriginal peoples in the basin have a strong interest in environmental watering. To ascertain the nature and extent of their interest in environmental watering and long held views about irrigation, a review of the Aboriginal Submissions Database and the socio-economic survey were undertaken. In summary this review found:

1. Most Aboriginal respondents were of the view that more water for the environment and less for irrigation would be good for Country
2. Environmental watering directly provides Aboriginal environmental, cultural, social and economic benefits
3. Common views on irrigation included; there was over extraction of water by the irrigation industry at the expense of the environment and Aboriginal people's interests and that opportunities for Aboriginal people to participate in water management and the water economy have been limited

Aboriginal people are generally supportive of the role of the MDBA and the intent of the Basin Plan.

On-ground works and measures undertaken by water management agencies in association with environmental watering will often have impacts on Aboriginal cultural heritage. Those impacts vary depending on the individual project. Aboriginal communities would rather not do them, but where they are necessary, work with MDBA to manage the impact.

The MDBA is developing methods to help empower Aboriginal communities to articulate and agree on cultural priorities in their local area and communicate these to states for their water resource planning (one method is called the Aboriginal Waterways Assessment).

Trials have been conducted in Walgett, Deniliquin and the Victorian Alps along the Ovens River. These trials allowed Aboriginal people to participate in developing the methodology and to endorse its use more widely. The Alps trial provided learning opportunities for younger generations and helped communities to re-establish links with their Country.

Changes in the water market

Water markets, especially the temporary water market, play a critical role in assisting irrigators adjust to climatic, economic and policy changes. They provide an increased level of flexibility in the decision-making of farmers, provide a means for better managing the risks farmers face, and contribute to the increasing diversity of farming enterprises observed within the Basin. These risks may include changes in non-water input costs, commodity prices or seasonal conditions across the growing season.

One area of concern raised with the MDBA is the extent to which the Basin Plan may have affected water prices, particularly the prices during the peak periods between November and January. These concerns arise from peoples' views about how the recent changes in the temporary water market may lead to social and economic changes in Basin communities.

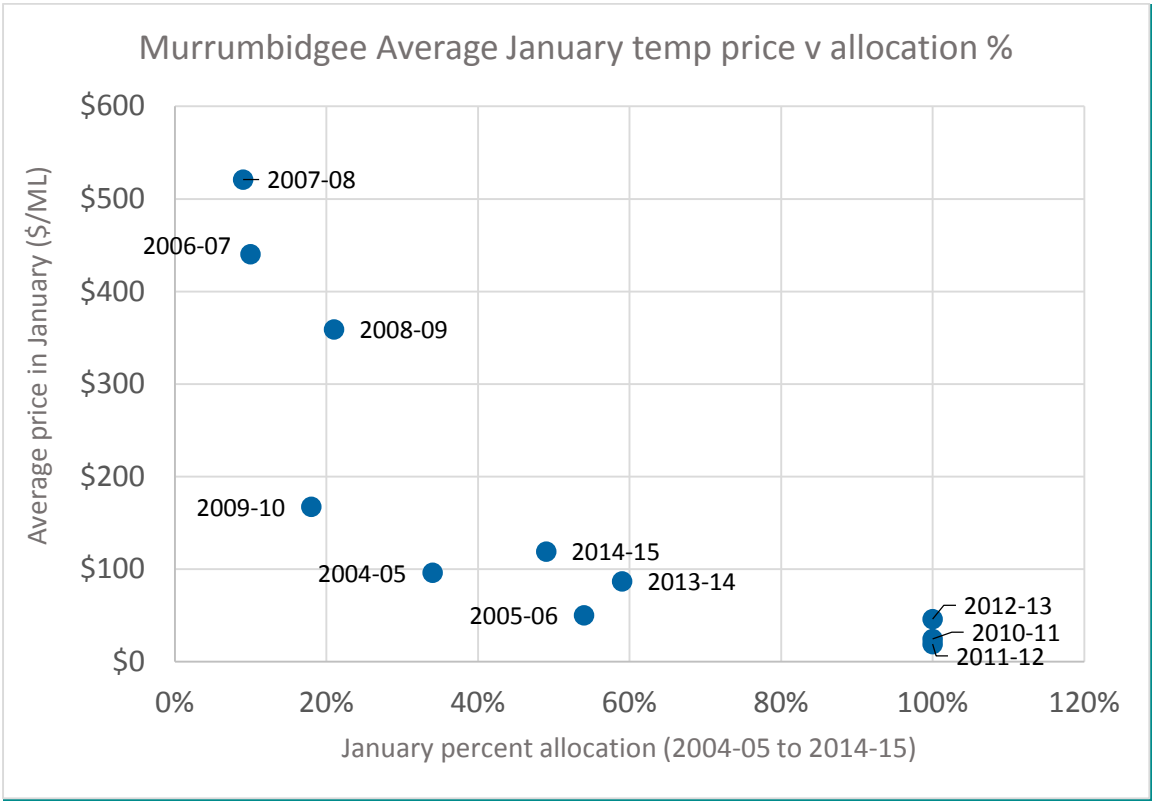
Are temporary water prices consistent with past levels?

There is a strong relationship between allocations and temporary water prices. For example, the MDBA has plotted NSW water allocations in the Murrumbidgee for the month of January across the past 11 years alongside the average temporary water prices in January (see Figure 3).

The graph shows a very strong relationship between the temporary price and the percentage of allocation set by the state.

Interestingly, the graph also shows that prices over the past few years are generally consistent with the historic relationship between prices and allocation levels. This indicates that the recent temporary water prices are not unusual, given the recent state allocations.

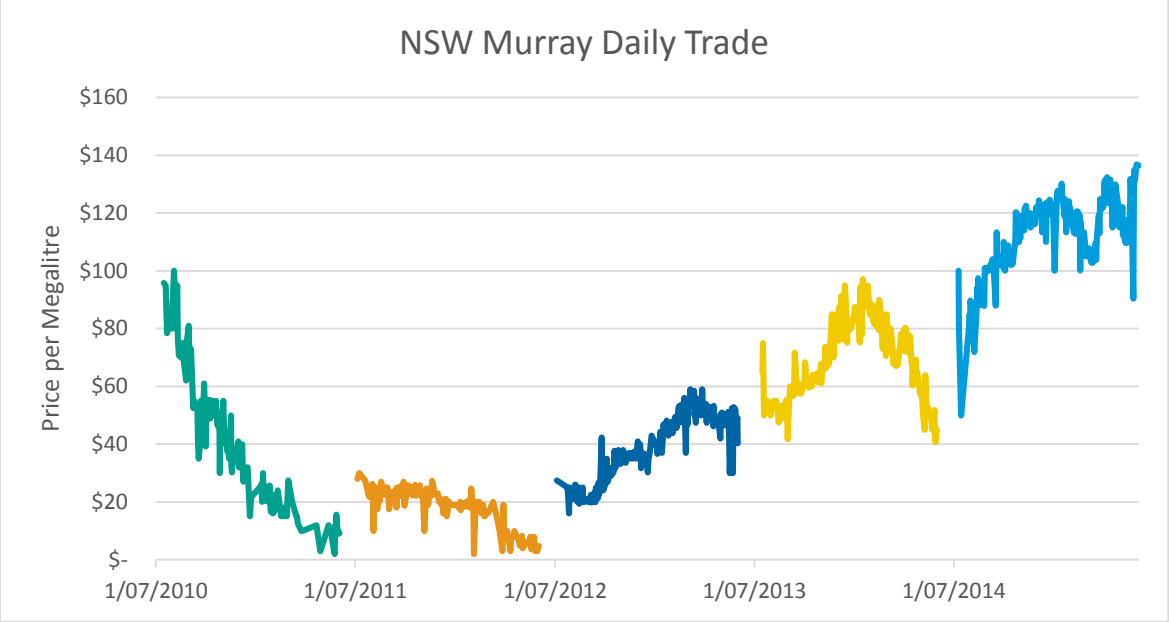
Figure 3 – Murrumbidgee average January temporary water price versus allocation per cent



Changes in trends

Up until and including 2011-12, prices in the temporary water market displayed a fairly consistent trend across the water year. Essentially water prices would start at a particular point that was dependent on early season allocations then generally fall across the water year. However, this pattern changed in 2012-13. Across the last three water years, the temporary water price has started higher early in the season, in accordance with the relatively lower water allocations in the southern connected system and increasing demand for temporary water. The price has remained high during November to January and fallen towards the end of summer. See Figure 4 below.

Figure 4 – NSW Murray daily trade



Source: New South Wales Department of Primary Industries – Water, Water Register

The reason for this change appears to be driven by changes on both the supply and demand sides of the market, as well as risk management approaches of the market participants.

On the supply side, water held in storages and initial allocation announcements influence prices. There has also been a reduction in the potential supply of water to the temporary market following the recovery of water for the environment between 2008 and 2015.

On the demand side there appears to be increased demand from farmers who sold some or all of their water and who are seeking to secure their water needs early in the season. There are new growers in the market, such as expanding nut farms, and farmers seeking to avoid high prices in summer. This is a consequence of the relatively high prices experienced during the very hot, dry spell in early 2013.

With the hot, dry spell in early 2013 leading to a sharp increase in demand for temporary water given the area of annual crops planted at that time (and possibly higher than expected water demands for perennial plants), farmers made choices around the best way(s) of protecting their crops. Those choices included buying additional water, letting their crops suffer (leading to impacts on prices received or yields) and using up the carryover water they were hoping to transfer into the next water year. In late 2012-13, after the hot dry spell passed, the temporary water prices fell only marginally.

In 2013-14, learnings from the previous water year and even greater demand for temporary water early in the growing season saw starting prices rising above those in 2012-13. This was in part due to the lower allocations in 2013-14 than in 2012-13, and would have been contributed to by the risk management approaches being developed by irrigators. That was to minimise the risks of paying very high prices for temporary water in the middle of summer. Towards the end of the 2013-14 water year, temporary water prices fell rapidly in response to good autumn rainfall, in the southern Basin.

A similar pattern of water market behaviour was observed across the first eight months of the 2014-15 water year. Temporary water prices started higher than in 2013-14 and increased again up until early November. They remained fairly consistent through November to January before falling in February

and March. They then rose again with dry conditions in early autumn followed by an announcement of increased likelihood of a severe El Nino event.

How have people adapted

People in irrigated agriculture are adapting to the complexity of sharing a limited resource, and are changing their water use efficiency, adopting different water trading strategies, and changing farm level decisions in response to reforms. We are not yet seeing a major change in the rate of farmer exits but the MDBA is aware of the changing farming practices and impacts on profit during the adaptation stages.

The MDBA qualitative analysis for the dairy industry and the mid-Murrumbidgee demonstrate how the combined effects of the Millennium drought, economic and policy pressures, and the Basin Plan water recovery have changed farmers' perceptions about the value of water. This has driven them to change their farming practices and to introduce a wide array of adaptation strategies.

As a consequence of the multiple influences of farmers, there is now a much greater degree of diversity in farming practices. For example, in the dairy industry this is indicated by the variability in area operated, herd size, calving patterns, water owned and fodder purchases. This contrasts with largely homogeneous farming practices observed across the industry ten or fifteen years ago. Back then, most farms in the northern Victoria dairy industry had similar production systems in terms of the water owned, how it was used and with a single calving period in the year. Since the Millennium drought dairy farmers have found ways to reduce the amount of water they use per kilogram of milk solids produced, which generally requires an increase in the non-water inputs. Similar changes have occurred with cropping enterprises.

The recovery of water for the environment through buyback and infrastructure investment has also contributed to the adaptation of farming enterprises. Dairy farmers who participated in the buy-back program reported they largely reinvested funds to reduce debt, improve the sustainability of their enterprise or to expand their businesses. The Government's on-farm infrastructure programs has helped dairy enterprises to expand and reduce the amount of time spent watering. Program participants believe this investment will provide positive flow-on effects to their local communities.

Appendix 6 – SDL adjustment mechanism

States are putting together a package of projects which, if implemented, could enable the SDL to be changed. These measures are essentially about being more efficient - doing more with less water – both on farms and in how we run the river and deliver environmental water

While the states are responsible for developing these projects, the MDBA will determine how much the SDL can change as a result of the projects – when calculating this, the MDBA must ensure that the environmental, social and economic outcomes of the Basin Plan are maintained or improved

Early indications are that the SDL adjustment projects could deliver an increase in the SDLs of up to 500 gigalitres, which would be a substantial reduction in the amount of water that must be recovered

To optimise the outcomes achieved by the Basin Plan, state and Commonwealth governments sought an opportunity in the Basin Plan for a one-off adjustment to the extraction limit in 2016. A key reason for the potential adjustment was that state governments wanted to explore ways to make environmental watering more efficient, and thereby leave more water available for irrigation. In response, the SDL adjustment mechanism was included in the Basin Plan, and provided the environmental, social and economic outcomes could be maintained or improved, the SDLs could be adjusted.

If the Basin Plan's environmental outcomes can be achieved with less water (actions known as supply measures) the volume of water recovery needed to deliver the environmental outcomes from the Basin Plan could be reduced. Similarly, if further investment increases irrigation efficiency (actions known as efficiency measures) more water could be recovered for the environment. The third type of investment is for constraints measures, to make environmental water delivery more effective in the future.

States are responsible for developing supply, constraint and efficiency measure projects and consult with communities in their development. While the MDBA does not develop projects or determine their inclusion in the final adjustment package, it provides technical support to governments.

The volume by which water recovery can reduce is known as the supply contribution. Governments agreed that the MDBA would calculate this contribution using the SDL adjustment method outlined in the Basin Plan. The method provides a model-based assessment framework to calculate the new water recovery target and includes an independently-developed, science-based and peer-reviewed test for environmental equivalence. The assessment framework includes a number of safeguards including the protection of a number of environmental outcomes which were considered especially important, ensuring there would be no detrimental impacts on reliability of entitlements. The scale of the net adjustment is also limited to 5 per cent of the SDLs.

The MDBA has run an early test of the method it will use to calculate the supply contribution, using some of the known projects that states are currently considering. Whilst this was just a test run, results were encouraging. An independent assessment of the states' projects under consideration found that it was plausible that the SDLs could be increased by around 500 GL.

To implement the Basin Plan in 2019, the supply contribution needs to be determined before the projects are fully implemented. A package of supply and efficiency measures will be submitted to the MDBA for assessment before 30 June 2016 and the MDBA will then determine the amount by which the SDLs can be adjusted within the limits agreed by governments. A final reconciliation will take place come 2024 to ensure the intended outcomes of the projects were delivered.

Before proposing any SDL adjustment to the Commonwealth Water Minister, the MDBA will have a public consultation period. This will be a further opportunity to help people understand the assessment approach and the SDL adjustment.

Appendix 7 – Northern basin review

Further research is being undertaken in the northern basin to determine if the setting for the sustainable diversion limits in this region could be changed

The MDBA is undertaking the review because the knowledge base for determining SDLs was not as strong as that for the southern basin when the Basin Plan was being made

This review is being undertaken in close consultation with the Queensland and New South Wales governments and the Northern Basin Advisory Committee

The northern basin comprises the catchment area of the Barwon-Darling River and its tributaries upstream of Menindee lakes. The northern basin river systems, their management, and the industries and communities around them are different to those in the southern basin.

In 2012, the MDBA agreed to undertake a review of certain aspects of the Basin Plan in the northern basin as there was less information available in the north compared to the south.

The northern basin review is aimed at answering two key questions:

- Should any of the SDLs change (with a focus on the Condamine-Balonne system and the northern zone shared reduction)?
- Should the apportionment of the northern zone shared reduction change from the default specified in the Basin Plan?

The outcomes of the northern basin review will also inform the water recovery program being managed by the Department of Agriculture and Water Resources. For example, the type and location of entitlements to be recovered in the north.

The MDBA is planning to make a decision on whether or not to recommend changes to SDLs in around April 2016. If amendments to the Basin Plan are required a formal Basin Plan statutory amendment process will begin which would take up to a further 12 months.

The Basin Plan sets limits on extraction for the northern basin equal to a reduction of 390 GL average use. This is made up of “local reductions” (e.g. for the Condamine-Balonne valley this is set at 100 GL) to meet the environmental needs of each valley and a “shared reduction amount” (143 GL) which could be sourced from any of the northern valleys. This shared reduction is to achieve environmental outcomes in the Barwon-Darling system.

When drafting the Basin Plan a local reduction of 150 GL was initially proposed for the Condamine-Balonne catchment. However, additional scientific assessment and analysis commissioned by the Queensland government together with remodelling by the MDBA showed that a local reduction of 100 GL would still be likely to water the catchment’s key environmental assets such as Narran Lakes.

Who is involved in the review?

The MDBA established the Northern Basin Advisory Committee to provide advice on the review. The Lower Balonne Working Group was also formed to provide specific advice on the work in the Condamine-Balonne catchment. In addition, the Northern Basin Intergovernmental Working Group was formed with representatives from the NSW and Queensland governments, the Commonwealth

Department of Agriculture and Water Resources and the Commonwealth Environmental Water Office. Together these groups are providing guidance on the review, which will result in advice going to the MDBA on the case for changing the Basin Plan settings for the north.

Key elements

The MDBA has commissioned a range of projects within three themes of work:

- Socio-economic assessment to assess the likely impacts of alternative SDLs and options for water recovery across the whole northern basin. This work is much more detailed than previous social and economic assessments undertaken by the MDBA. The work has a more local focus with significantly more stakeholder input.
- Environmental science projects to improve base data and knowledge of environmental water requirements in the Condamine-Balonne and Barwon-Darling. The focus of the science projects is on these two regions as they are driving the need for the greatest volume of water recovery still to occur and are where the science was most uncertain. The MDBA is also drawing on any new science completed since the Basin Plan was finalised.
- Hydrologic modelling work to explore potential flow and environmental outcomes from alternative SDLs and options for water recovery using the improved knowledge of environmental needs.

All of this work will be synthesised for a selected range of SDL options over the next few months to early 2016.

Environmental science

The table below shows a summary of the environmental science projects and their potential use in revising flow targets for the Condamine-Balonne and Barwon-Darling systems.

Table 7 – Environmental science projects in the Condamine-Balonne and Barwon-Darling systems

Project	Potential influence on flow indicators
Floodplain inundation mapping across the Lower Balonne and Barwon-Darling systems.	Potential to change flow indicator requirements to inundate key floodplains.
Floodplain and wetland vegetation mapping within the Darling river system.	When combined with other datasets, flows needed for wetland and floodplain vegetation inundation can be determined.
Waterhole mapping and analysis of persistence in the Lower Balonne and Barwon-Darling systems.	Review the existing in-channel Lower Balonne Floodplain flow indicator and determine if additional flow indicators are required.
Water requirements for floodplain vegetation in the Lower Balonne and Barwon-Darling systems.	Potential changes to existing flow indicators to better represent the environmental water requirements of floodplain vegetation.
Review of waterbird breeding response to flow at Narran Lakes.	Potential changes to the environmental water requirements of colonial nesting waterbirds in the Narran Lakes system.
Response of fish to changes in flow	In combination with the waterholes project will be used to identify the environmental water requirements for fish communities and to consider ways to minimize opportunities for carp breeding when developing environmental water requirements.

Hydrological Modelling

There are a number of different options being explored with the hydrologic modelling work. This work will identify the potential flow and environmental outcomes from alternative SDLs and options for water recovery. Some examples include:

- Exploring recovering some water upstream of Beardmore Dam
- Targeting recovery on specific entitlement flow windows
- Exploring recovery of different entitlement types (e.g. overland flow licences versus water harvesting entitlements)
- Exploring the recovery of water from different locations

Social and economic assessments

Two social and economic projects are being undertaken to inform the northern basin review.

The first project is developing an integrated model for describing the social and economic effects of water recovery across 21 communities of the northern basin. It will use the same data from the hydrology models as will be employed in the assessment of environmental outcomes.

The integrated socioeconomic modelling tool will estimate the effects of water recovery through changes in irrigated agricultural production, regional economic activity, and wages, jobs and population. There are three modules to this project:

- Landuse module - this module will show the direct effects on irrigated agriculture production associated with different water recovery scenarios (e.g. changes to area irrigated, total production etc.
- Regional economy module - this module will show the broader impact of water recovery scenarios at the regional economy level. There are six regions that will make up the economy of the northern basin. The regions are the Condamine–Balonne, Border Rivers, Gwydir, Namoi, Macquarie–Castlereagh and the rest of the northern basin.
- Community module - the community module will represent the effects of the water recovery scenarios through changes in wages, employment and the population in each of 21 communities. These communities differ in their size and dependence on irrigated agriculture. An important output for this module will be a short write-up of the consultation findings for each of these communities. The consultations have helped identify the relative dependency between the town businesses and farming in each community. This information will be considered together with the levels of disadvantage and economic resources in each community to estimate the potential adjustment pathway for wages, jobs and people in response to the recovery of water for the environment.

The approach to assessing potential social and economic change largely relies on describing outcomes for irrigated agriculture and communities. The emphasis of the work is on how changes in water availability impact on irrigated production around each of 21 towns in the northern basin. Estimating the effects of water recovery will take into account the scale of water recovery, whether it is through buyback or infrastructure investment, the time period for acquiring the water and the relative dependence of the individual towns on irrigated agriculture. Determining the effects of water recovery and how communities might adjust to the change will take into account the economic and social conditions of the community at the time of the water recovery and the proportion of funds from the buyback or infrastructure investment remain in the respective towns. It does not assume that all individuals in a community receive an equal share of the water recovery amount.

The second project is seeking to understand the benefits of water recovery for floodplain graziers and the community in the Lower Balonne. The main component of this project is the development of a model of agricultural production for floodplain grazing systems in the Lower Balonne to assess improvements in the volume and value of production under various water recovery scenarios.

Consultation and engagement

The MDBA will need further input and advice of northern basin community members, as well as technical experts, to help it complete the northern basin review successfully. Engagement with the Northern Basin Advisory Committee and the Northern Basin Intergovernmental Working Group will be the primary source of this advice but there are also opportunities for broader community involvement.

Two main rounds of further consultation with stakeholders are proposed. The first will begin shortly and will outline the findings to date and the possible SDL scenarios that are under consideration. The second round will occur in early 2016 and will be to discuss draft results for the final selected scenarios and should provide an indication on the possible recommendations that the MDBA will make.