Australian Government

MURRAY–DARLING BASIN AUTHORITY

Sustainable Diversion Limit Adjustment Mechanism: Draft Determination Report

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Acknowledgement of the Traditional Owners of the Murray–Darling Basin

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

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

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

Cover image: Hattah Lakes TLM project - Messengers Regulator, releases back to the Murray after second watering event. Date: 3 April 2014, taken by: Heather Peachey

Foreword

Through a suite of state-nominated projects, the Murray-Darling Basin Authority (the Authority) is confident that 605 gigalitres of water can remain in the river system, and at the same time ensure that environmental outcomes can also be achieved.

This is a key step in the Basin Plan, and demonstrates the flexibility and adaptability of the Plan. The Authority continues working with all government agencies involved in the Basin to achieve a healthy and productive river system.

These projects will make a real difference in the Basin and achieve environmental results. Some of the projects will improve management of the Basin's rivers to deliver water for the environment more efficiently. Other projects will change river operating rules to enable better delivery of water.

All Basin governments are committed to these projects, and are confident they will get results.

As the Authority, we assess the projects nominated by the States and recommend changes to Sustainable Diversion Limits (SDL) through the SDL Adjustment Mechanism.

This determination report outlines the assessment of the projects as a package. This includes the proposed SDL adjustment at a Basin-wide scale, as well as at a catchment level for the southern Basin.

The Authority's role in the SDL Adjustment Mechanism is clearly defined. The Authority is charged with independently determining the proposed adjustment to the SDL as a result of the package of projects nominated by state governments in the southern Basin, through the SDL Adjustment Mechanism framework.
When the projects are further designed and implemented from 2018 to 2024, the Authority has a role in monitoring the projects and ensuring outcomes are met.

The Authority knows community consultation in the Basin is crucial. Considerable work lies ahead for all governments to further progress the design and implement the nominated projects in the period to 2024. The Authority encourages all governments to actively involve the community in progressing the projects.

The Authority understands and expects that projects will adapt to accommodate new information, innovations, community feedback and regulatory approvals required for technical work. We are optimistic that across the full suite of projects change can be accommodated and that further improvements can be incorporated during the implementation phase. To achieve desired outcomes from the nominated projects, governments will need to collaborate and progress must be monitored independently.

This is just the start of the process, there are years ahead to design and implement these projects. We encourage Basin state governments to continue the conversation, and ensure these projects work on-the-ground with communities.

On behalf of Basin governments, the Authority invites public feedback until 3 November 2017. This is just the start of the process, there are year's ahead to further design and implement these projects and they will contribute to a healthy productive Basin.

Contents

Summary

Purpose of the report

This report provides the **Authority's draft determination** of the proposed adjustment to the sustainable diversion limit (SDL). The determination is **based on 36 projects notified by state governments** through the SDL Adjustment Mechanism in the Basin Plan, which aim to achieve equivalent environmental outcomes using less water.

The Authority **invites public comments** on the draft SDL adjustment determination in the period from Tuesday 3 October 2017 until Friday 3 November 2017.

Draft determination

The **Murray–Darling Basin (the Basin) is a complex, diverse and dynamic system**. It is constantly changing in response to the influences of people, the climate and the way water is used for production, communities and the environment.

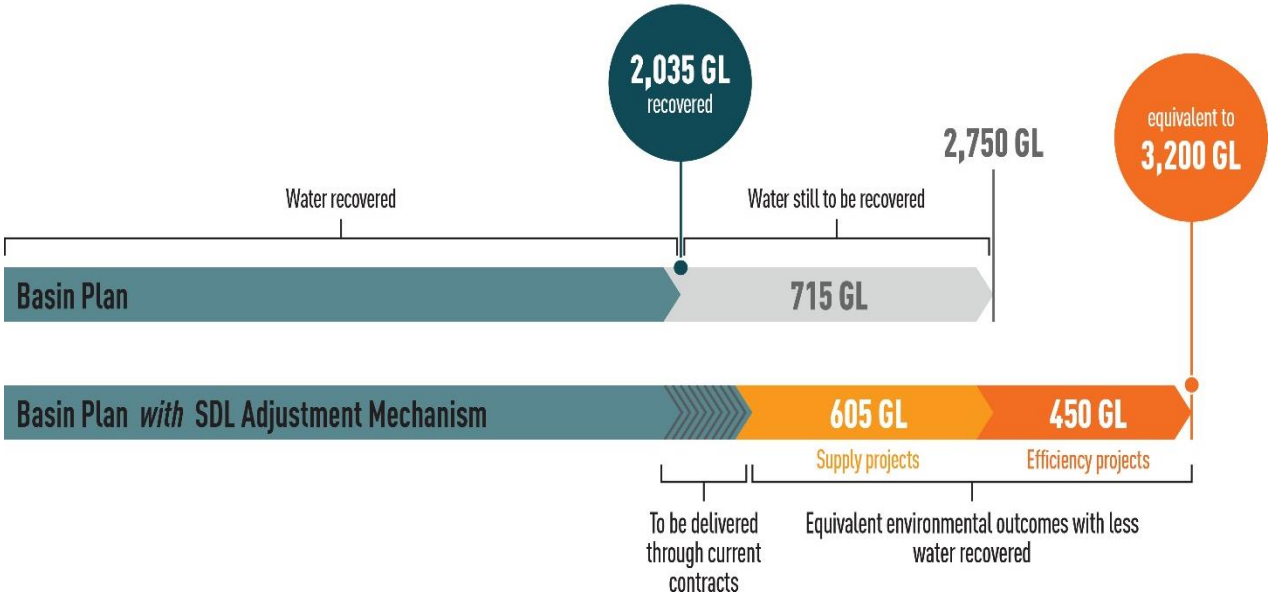
The Basin Plan aims to find a balance between the water needs of all Basin users, to make sure communities, industries and the environment continue to thrive. It does this through setting limits on the amount of surface and ground water that can be taken to ensure sustainable use into the future. These limits, also known as sustainable diversion limits (SDLs), regulate the amount of water that can be used by communities and industries both within catchment areas and across the entire Basin.

The Basin Plan set an **initial water recovery target of 2750 GL** for the whole Basin, an approximately 20 percent reduction in water extractions. In settling the Basin Plan Basin governments agreed that this target could be amended in two ways:

- a review of northern Basin SDLs
- **the SDL Adjustment Mechanism**.

Under the SDL Adjustment Mechanism, state governments can nominate projects which aim to achieve agreed Basin Plan environmental outcomes with less water, leaving this water in the system for consumptive uses. These projects are referred to **as supply measures**.
Governments can also propose projects that provide more water for the environment by making consumptive water use more effective and efficient, providing those water savings to the environment (referred to as **efficiency projects**).

The SDL Adjustment Mechanism **allows an increase in SDLs of up to 650 GL** of water from supply measures, and 450 GL of additional water for the environment from efficiency measure projects. State governments have nominated 36 supply measure and two efficiency measure projects.



The **Authority has undertaken its assessment of the supply measure projects** using the SDL Adjustment Mechanism framework in the Basin Plan, and **determined a proposed SDL adjustment increase of 605 GL**. With current water recovery, including contracted deliveries, this means that no further gap bridging water recovery would be required to meet the southern connected Basin's 2289 GL contribution to meeting the Basin wide target of 2750 GL.

This report sets out the proposed SDL adjustment amount resulting from the package of supply measures nominated by state governments in the southern Basin. The information in the report provides an account of how the Authority arrived at the adjustment amount, including the tests applied to protect the aims of the Basin Plan, and the outcomes expected from the package of projects nominated by state governments.

Invitation to provide feedback

A public comment period on the proposed SDL adjustment is open from **Tuesday 3 October 2017 until Friday 3 November 2017.**

Interested parties can provide feedback on the proposed SDL Adjustment Mechanism outcome and provide input that can be used to strengthen implementation of the proposed projects by visiting mdba.gov.au.

Following consideration of public feedback, the Authority will make a final determination and provide this along with information and advice resulting from the public feedback to the Commonwealth minister responsible for water by 15 December 2017.

Structure of the report

This report is set out in the following way:

Section 1: Murray–Darling Basin Plan

An overview of the Murray–Darling Basin Plan, sustainable diversion limits and water recovery to date.

Section 2: Changing the sustainable diversion limits

Outlines how the sustainable diversion limits in the Basin Plan can change.

Section 3: SDL adjustment projects

Presents information on how the process of adjusting the sustainable diversion limit occurs, from feasibility studies through to the design and implementation of the projects.

Section 4: Determining the adjustment

This section outlines the framework used to assess the proposed suite of projects to adjust the sustainable diversion limits.

Section 5: SDL adjustment projects and outcomes

Information on the proposed projects nominated by state governments that have been assessed by the Authority and their expected outcomes.

Section 6: Proposed adjustment amounts

Proposed sustainable diversion limit adjustment amounts for the southern Basin, including adjustment amounts at a catchment level.

Section 7: Next steps in the Adjustment Mechanism (beyond 2017)

This section presents how projects will be refined and implemented through to 2024.

Section 8: Public comment period

More information on how feedback can be provided on the proposed adjustment and the suite of projects and how this information will be used.

Supporting information

The Authority is also providing a range of supporting documents on the Authority's website which share information on the assessment framework and independent advice provided to the Authority as part of the assessment process. These include:

- Benchmark conditions of development for assessment of the SDL supply contribution
- Modelling assessment to determine SDL Adjustment Volume
- Independent Review of Hydrologic Modelling for SDL Adjustment (by Bewsher Consulting)
- Independent Expert Panel Murray–Darling Basin Plan SDL Limits of Change Review
- The SDL adjustment assessment framework for supply measures.

These documents are more technical in nature and thus are intended for those interested in further details of the assessment process. They are available at www.mdba.gov.au/sdlam-reports.

Section 1: The Murray–Darling Basin Plan

The Murray–Darling Basin Plan (Basin Plan) aims to safeguard one of Australia's key national assets, the Murray–Darling Basin (The Basin). The Basin covers more than one million square kilometres, provides water to almost three million Australians, houses 40 percent of Australia's farms and generates around $19.4 billion annually from agricultural produce. It is also home to diversity of water dependent ecosystems that support thousands of plant and animal species including more than 46 species of native fish and 98 species of waterbirds.

The Basin Plan is a coordinated approach to water management across the Basin in four states (South Australia, Victoria, New South Wales and Queensland) and the Australian Capital Territory. It is a flexible and adaptive plan that aims to balance the needs of Basin communities and the environment to achieve a healthy and productive river system.

The Basin Plan was developed as a requirement of the *Water Act 2007 (Cwlth)* and is a significant step in the ongoing process of managing the Basin's water. It does this by managing the Basin as one system. The aim of the Basin Plan is to ensure that water is shared between all users in a sustainable way. This will enable the river systems to continue to support communities, industries and environments in the long-term as they adapt to changes, including a changing climate.

The Basin Plan contains specific objectives and frameworks to ensure:

- water is used in a sustainable way
- good quality water is delivered to people, businesses and the environment
- environmental water is used effectively
- state governments are committed to implementation of the Basin Plan
- communities always have access to drinking water
- water trade is efficient and fair
- implementation of the Basin Plan is monitored and evaluated.

There are several key components of water management in the Basin which work as an integrated package (illustrated in Figure 1). This report focuses on the sustainable diversion limit component. Figure 2 provides a snapshot of the broader implementation actions and milestones of the Basin Plan.

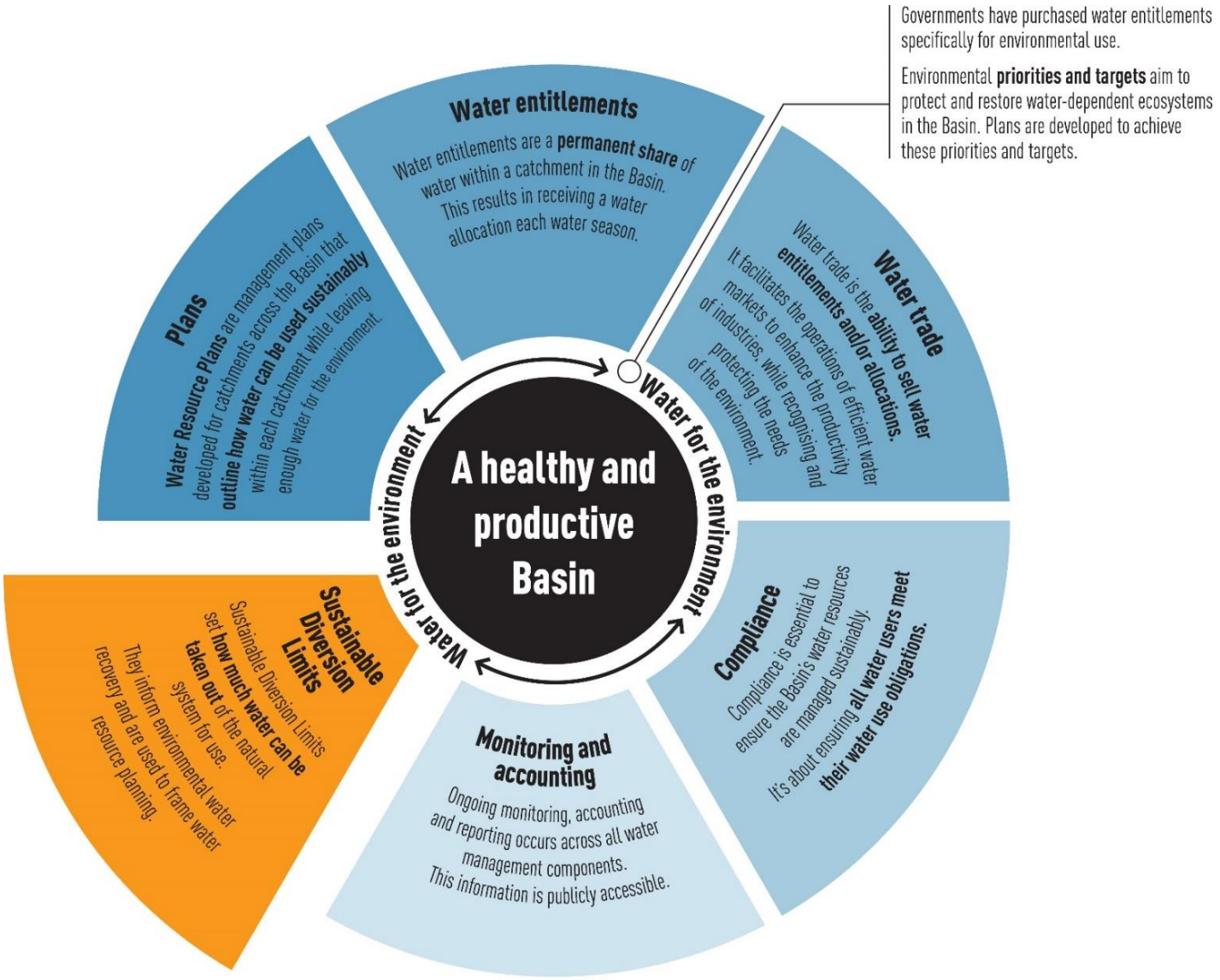


Figure 1: Components of water management in the Murray–Darling Basin

Figure 2: Overview of key Basin Plan milestones

Sustainable diversion limits

At its heart, the Basin Plan determines the amount of water that can be extracted or taken annually from the Basin for consumptive use (urban, industrial and agricultural). The volume determined is set through long-term average sustainable diversion limits (SDLs) – the level of extraction that will achieve a sustainable balance between the environment and extractive uses for water. While striving to improve the condition of the natural environment of the Basin, the setting of the SDLs recognised that there must be a balance between water for the environment and water for communities and industries. As a result, the SDLs were carefully calculated to balance environmental, social and economic outcomes. Each river catchment in the Basin has its own SDL, and there is also a limit for the Basin as a whole.

The SDLs will make more water available for the environment. Water recovered is used by managers of water for the environment, including the Commonwealth Environment Water Holder, to improve and maintain the health of waterways, lakes, major wetlands and floodplains within the Basin, as well as protect important habitats for animals and plants. The SDLs for groundwater will ensure that resources are not over-allocated in the future, and can sustain communities and environments that depend on groundwater.

Across the Basin, the SDLs set in 2012 were lower than the amount that was being used. As a consequence, water has been recovered to meet the limit. Across the Basin the additional amount of water needed to meet the SDLs and improve river and wetland health is 2750 GL per year on average (illustrated in Figure 3). The recovery target is made up of two components: a local, within catchment amount, and a downstream shared target for broader system outcomes. The southern Basin's share of the 2750 GL recovery is 2289 GL.

The SDLs come into effect in 2019, and Basin state governments are currently working to develop water resource plans for each catchment of the Basin which will implement the new limits.

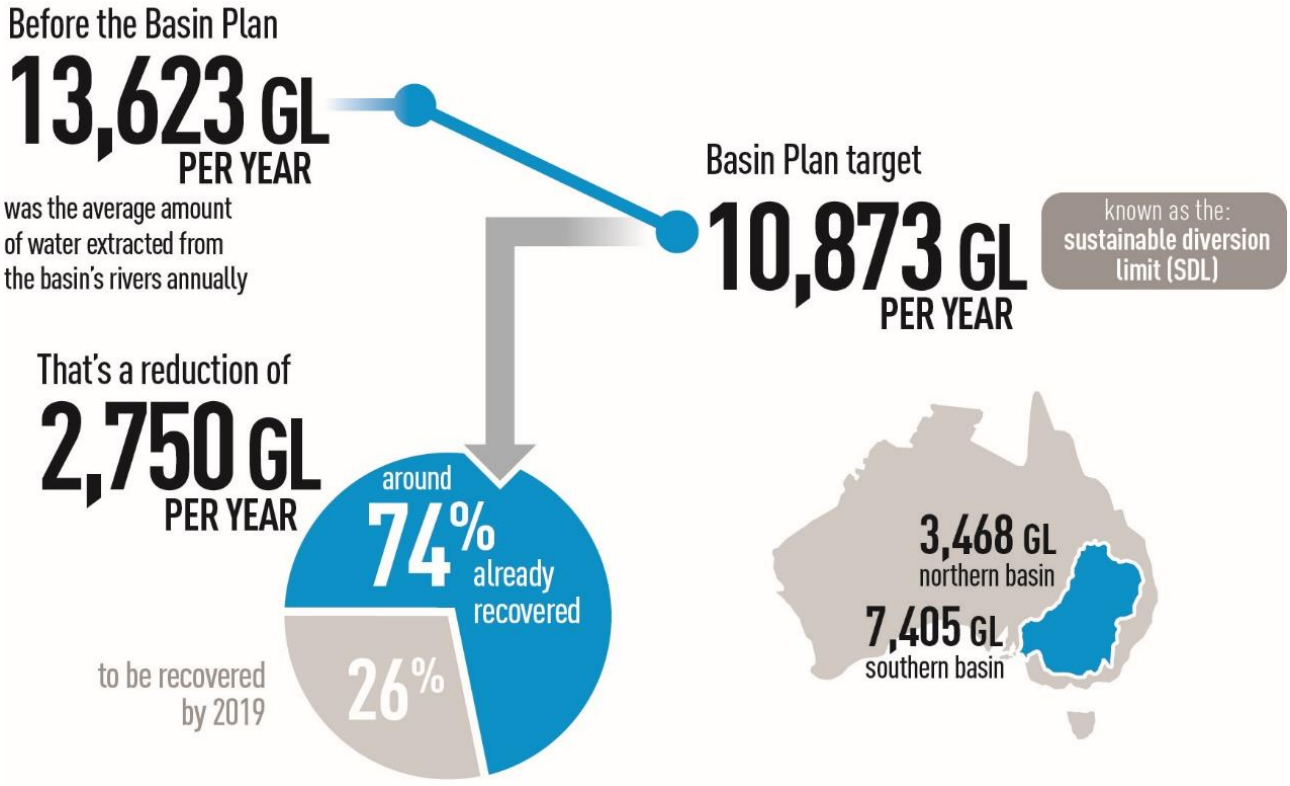


Figure 3: Basin Plan sustainable diversion limit target and water recovery progress

Water recovery update

The Commonwealth is responsible for water recovery through directly purchasing water entitlements, or acquiring water entitlements through investment in infrastructure modernisation. The water recovery program is being implemented over several years to allow communities and industry to transition to the new SDLs.

As of 30 June 2017, 74 per cent of the required Basin-wide water recovery had been achieved. This consists of 74 per cent of water recovered in the northern Basin and 75 per cent in the southern Basin (see Figure 3).

Water recovery figures for your catchment are available online at www.mdba.gov.au/water-recovery.

Section 2: Changing the sustainable diversion limits

The Basin Plan was made using the best available information at the time. It was also acknowledged that there was the opportunity to improve our understanding of the river system and make changes prior to SDL implementation in July 2019. The SDL Adjustment Mechanism will operate to determine whether there will be a reduction in the recovery volume in the south, while the Northern Basin Review operates in the north.

The Northern Basin Review

At the time the Basin Plan was established, the Authority recognised more work was needed to improve knowledge of the hydrology, environment and socio-economic implications of Basin Plan settings in the less regulated river systems in the north. A commitment was made, supported by all Basin governments, to undertake a review and assess whether Basin Plan settings in the north are appropriate.

The review has resulted in the Authority recommending a new SDL for the northern Basin as a proposed amendment to the Basin Plan. Information relating to the Northern Basin Review can be found at: mdba.gov.au/BPamendments

The SDL Adjustment Mechanism

When settling the Basin Plan in 2012, Basin governments recognised that before 2019, when SDLs come into effect, a range of changes could be explored to improve the operation of the river system, and deliver both consumptive water and water for the environment more efficiently. These changes mean that the objectives of the Basin Plan could be achieved with less water. Basin governments included what is called the SDL Adjustment Mechanism in the Basin Plan to provide the opportunity and incentive to find ways to improve how the Basin's water resources are used, and potentially amend the SDLs set in 2012 as a result.

The SDL Adjustment Mechanism allows SDLs to both potentially increase by up to 650 GL in response to the more efficient use of water for the environment, and decrease by 450 GL in response to more efficient consumptive use subject to the measures having a neutral social and economic impact (Figure 4).

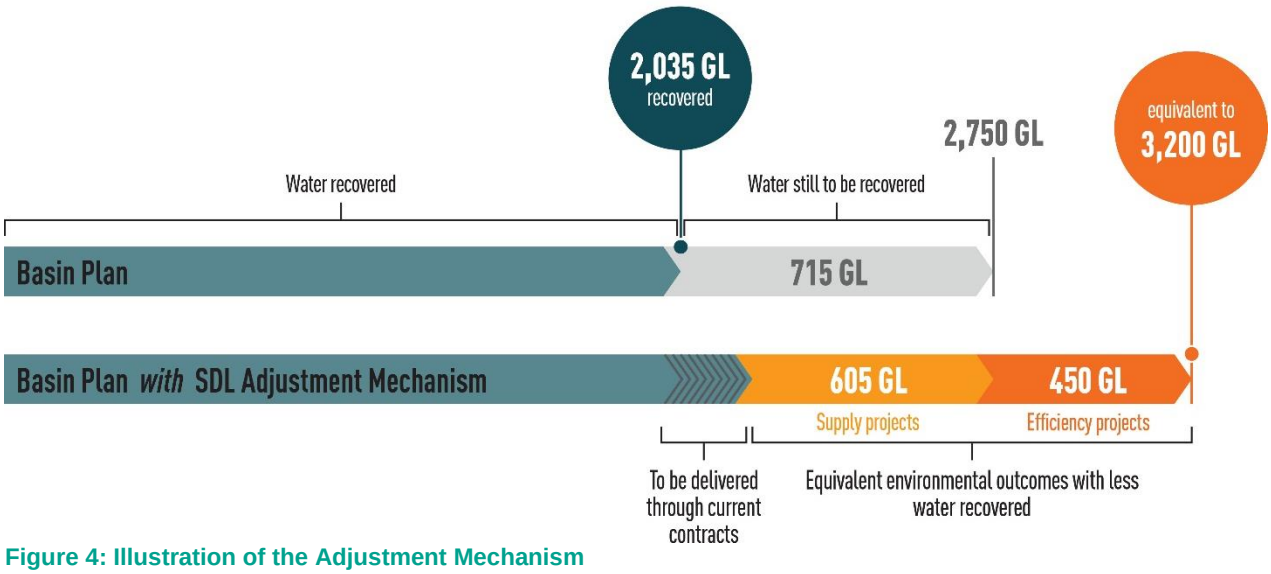


Figure 4: Illustration of the Adjustment Mechanism

The Basin Plan limits the net change of Basin-wide SDLs in response to these efficiencies to no more than five per cent of Basin-wide SDLs of 10,873GL (i.e. approximately 544 gigalitres for surface water SDLs). It also includes safeguards for the reliability of supply for consumptive users, places limits on any change to environmental outcomes and ensures that all third party risks must be addressed or mitigated.

The more efficient delivery of water for both environmental and consumptive use means that less water is needed to achieve the current settings of the Basin Plan. The SDLs for surface water catchments in the southern connected Basin can be adjusted as a result, and this will both reduce the amount of water recovery needed in the southern Basin, and provide a mechanism to improve the environmental outcomes of the Basin Plan.

The Basin Plan is a long term reform with many inter-related elements. The SDL Adjustment Mechanism is one part of the framework established by governments to manage the amount of water extracted from the Basin's river and groundwater systems.

Council of Australian Governments

On 9 December 2016, Premiers and Chief Ministers from Basin state and territory government reaffirmed the commitment of governments to the implementation of the Basin Plan through the Council of Australian Governments (COAG). Ministers noted that the Murray–Darling Basin is of vital economic and environmental significance to a large part of Australia and it is critical that the Basin Plan is implemented on time and in full. COAG also noted that Basin governments are seeking to offset, in full, the remaining water recovery in the southern Basin.

On 12 June 2017 COAG endorsed a report by the Murray–Darling Basin Ministerial Council to the COAG - Implementing the Basin Plan.

Section 3: The SDL adjustment process

Over the last four years Basin state governments developed and proposed projects designed to improve the efficiency of how the river system is managed. These projects have been considered as part of the SDL Adjustment Mechanism. The key steps in the process that jurisdictions have worked through to come up with a final package of projects, and the next steps are set out in Figure 5.

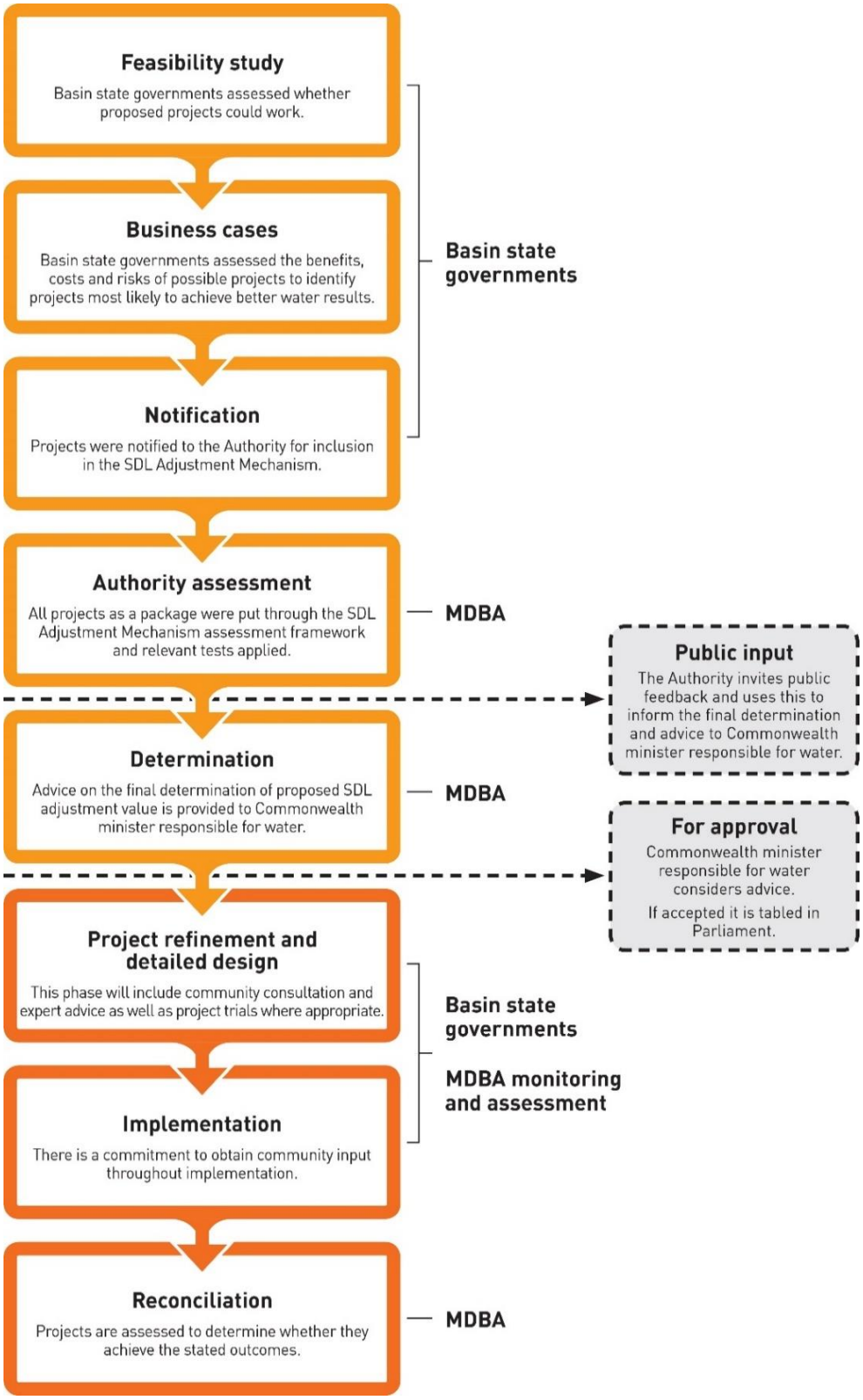


Figure 5: SDL adjustment process

Project types

Being smarter and more efficient in how Basin water resources are used means finding ways to save water and deliver it more effectively for both environmental and consumptive use. This can be done by changing river management practices, using infrastructure to achieve efficiencies, or overcoming some of the physical barriers to delivering water in the system.

In achieving efficiencies for environmental or consumptive water use, projects under the Adjustment Mechanism aim to either improve the socio-economic or environmental outcomes of the Basin Plan, and in some cases achieve both. There are three types of projects outlined in Figure 6.

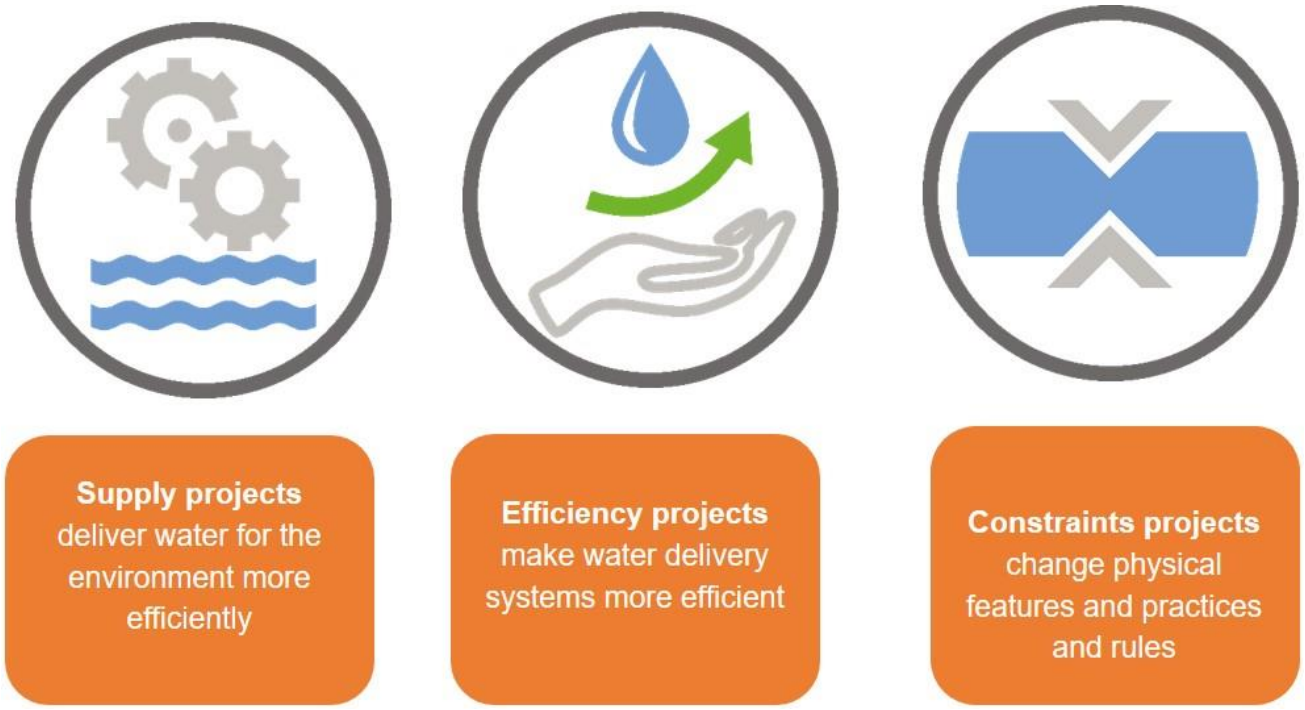


Figure 6: Types of SDL Adjustment Mechanism projects

Supply projects change the way the system is managed to achieve equivalent environmental outcomes using less water.

Supply projects are new ways to manage the Basin's rivers to more efficiently deliver water for the environment. To do this, projects can streamline the way the river is operated or build environmental infrastructure works. Supply projects must deliver equivalent or better environmental outcomes compared to those achieved under current Basin Plan settings, using less water. This water can then remain in the river for consumptive uses such as irrigated agriculture and allows the SDL to increase. Examples include:

- **infrastructure works** (like the installation of regulators or building levee banks) that allow water for the environment to be diverted onto floodplains and retained. This allows the floodplain to return to a more natural flooding regime (in frequency, duration and depth) and delivers ecological outcomes using a comparatively small volume of water. Some works also reinstate flow pathways and variability removed during the major river management

works early last century.

- **changes to rules** which operate storages and rivers in the Basin to provide flow rates or timing better suited to when the environment needs water. The rule changes can provide increased flexibility to access water for the environment, reduce restrictions on existing works operations and enable more efficient and effective use of current infrastructure.
- **reconfiguring lakes or storage systems to reduce evaporation**. This represents a major change as evaporative savings provide additional water for environmental water managers to use.

Efficiency projects provide water for the environment through more efficient use of irrigation, urban and industrial water.

Efficiency projects result in a decreased volume of water required for a consumptive use. Examples include increasing the efficiency of on or off-farm water delivery systems, urban water delivery or industrial water use, or stock and domestic water supply. This can be done by replacing or upgrading on-farm irrigation, transforming a business so that it produces the same or more output with less water, lining channels to reduce water losses within an irrigation or water supply network or replacing a water supply. Efficiency measures must have neutral or improved socio-economic outcomes, and decrease the SDL through decreasing the amount of water previously lost through inefficiencies. This water remains in the river for environmental use.

The efficiency measures program under the SDL Adjustment Mechanism is available across all catchments in both the northern and southern Basin. It is a voluntary program for participants and funds projects brought forward through to the end of 2023. The aim is to achieve up to 450 GL agreed by Basin governments as part of the SDL Adjustment Mechanism in the development of the Basin Plan.

As part of the COAG commitment to implementing the Basin Plan, governments are currently reviewing how efficiency measures can be designed and targeted to achieve their aims including the requirement to have neutral or improved socio-economic outcomes.

Constraints projects propose changes to physical structures or river management practices to better deliver or more efficiently use water for the environment.

In developing the Basin Plan, governments identified a number of constraints preventing the full benefits of water for the environment from being achieved. Constraints projects increase the flexibility to release and move water for the environment through the system, and better deliver this water when and where the environment will benefit most. This maximises environmental outcomes and can provide floodplain outcomes that were previously difficult to achieve. Constraint relaxation projects also improve the capacity of other supply projects to achieve their intended outcomes, allowing the SDL to increase.

Any changes to flow rates over the long term will require state governments to work closely with all potentially affected land holders, industries and communities. State governments have committed to the principles below for constraint projects:

- extensive community consultation including identifying the most effective way to mitigate adverse impacts

- funding infrastructure to ensure that third party impacts of proposed flows are mitigated
- no managed flows at increased levels to occur until all necessary works are complete, noting that it may be possible to have a staged relaxation of constraints.

Constraints projects can include changes to physical aspects of the river such as raising low-lying bridges to improve access points, or operational changes such as river management rules or creating easements to enable higher managed flows to be delivered.

Mitigating any third party impacts from higher managed flow levels has the benefit of also mitigating the impacts of natural flow events at the same levels. In addition, communities can benefit through increased infrastructure projects operating in their area, providing economic opportunities for local contractors and the flow on benefits from this investment.

Notification process

On 5 May 2016 the Basin Officials Committee notified the Authority of 36 supply and two efficiency measure projects to take into account in the SDL Adjustment Mechanism. The Basin Plan was amended following this in 2016 to provide for a second notification by 30 June 2017. This allowed more time for state governments to develop additional projects and maximise the benefits of the SDL Adjustment Mechanism. A further supply measure project was notified on 28 June 2017.

Supply projects can be amended through to 31 December 2023. Amendments must be notified as soon as possible after any relevant information has changed, or the project withdrawn if the measure will not enter into operation by 30 June 2024.

Efficiency projects are part of an ongoing program across the whole of the Basin, and additional projects can be notified until 31 December 2023.

Both supply and efficiency measures can only be notified if they will enter operation by 30 June 2024, and they are not anticipated in the Basin Plan.

Basin governments' assessments

During the development of the SDL Adjustment Mechanism in the Basin Plan, Basin governments agreed a set of criteria for supply and constraint projects to determine their viability and suitability to be considered as a project. These criteria can be accessed at www.mdba.gov.au/assessment-criteria.

At the feasibility stage projects were required to demonstrate technically feasibility, including that they are likely to achieve their intended outcomes and potential risks and impacts were manageable and acceptable.

State governments assessed project business cases in terms of anticipated ecological benefit, and whether the proposal can effectively deliver on stated outcomes over the long term to produce an enduring change. Projects cannot have unmitigated third party risks, including salinity and water quality impacts. As part of this process, Basin governments also specified actions which the proponent/s would need to undertake in project refinement, design and implementation, including risk mitigation.

Aboriginal and cultural considerations

State governments were required to address environmental and heritage regulations, and where relevant undertake a desktop cultural heritage assessment for each project. Risk strategies in the business case needed to consider implications for significant sites, such as burial sites and scar trees.

During project development and implementation state governments will undertake further work to identify any key cultural issues, risks or concerns which need to be addressed, in consultation with Aboriginal stakeholders. Identifying cultural flows is a key next step for the Basin Plan as a whole.

Funding the projects

The *Intergovernmental Agreement on Implementing Water Reform in the Murray–Darling Basin* came into effect on 5 June 2013 and was subsequently endorsed by all Basin governments. The agreement makes Commonwealth funding available to Basin state and territory governments for SDL adjustment projects. With a proposed SDL adjustment of 605 GL a total of $1,119 million is available to implement constraint and supply measure projects. Further funding is available under the Water for the Environment Special Account for efficiency measure and constraints projects. A number of SDL adjustment projects are already funded through other Commonwealth programs, such as The Living Murray and the State Priority Projects under the sustainable water use and infrastructure program.

The Intergovernmental Agreement is available on the Council of Australian Governments' website.

Section 4: Determining the adjustment

SDLs can be changed as long as the environmental outcomes remain equivalent to those in the Basin Plan and there are neutral or improved social and economic outcomes.

The Basin Plan sets out how to determine the SDL adjustment amount. For supply projects, a science-based assessment framework was agreed to by all Basin governments and was included in the Basin Plan. It specifies how the adjustment amount for supply projects is to be determined, and importantly contains a number of safeguards which must all be satisfied before any changes can be made to SDLs.

For efficiency projects, the adjustment takes into account water entitlements resulting from implementation of the projects.

Valuing the contribution of supply projects

The assessment framework for supply projects uses the Authority's river-modelling platform to simulate changes in the river's hydrology created by the supply projects. Changes in hydrology are then assessed for ecological impact. Further detail can be found in the document 'SDL adjustment assessment framework for supply measures' at www.mdba.gov.au/sdlam-reports.

The supply measure package is compared to a modelled representation of a fully implemented Basin Plan called the benchmark (which includes 2750 GL of water recovery). In this way lower volumes of water recovery are assessed to determine if the package of supply measures can achieve equivalent environmental outcomes. When comparing the two modelled scenarios, three tests are applied to ensure that the benefits of the Basin Plan are maintained and protected. These are:

Key terms

Benchmark – modelled representation of a fully implemented Basin Plan

Reliability – the reliability of water supply to users

Limits of change – ensure trade-offs in ecological outcomes do not result in unacceptable adverse change to key aspects of the ecosystem

1. **Were detrimental impacts on the reliability of supply to water users detected?**

   The state governments, as managers of water entitlements, developed a range of indicators for each valley to assess impacts on supply reliability. These indicators are used by state government experts to ensure changes to SDLs have no detrimental impacts on the reliability of water supply that are not offset or negated.

2. **Was the regional environmental outcome score equal to or higher than the benchmark scenario (environmental equivalence)?**

   To pass the environmental equivalence test, the region score achieved by modelling the package of supply projects must be better than, or equivalent to, the score that would be achieved under the Basin Plan. Exactly the same steps are applied to score both scenarios.

   The ecological assessment allows for trade-offs between environmental outcomes in river reaches, subject to the limits of change discussed below.

3. Were the environmental safeguards (limits of change) satisfied?

The limits of change safeguard environmental outcomes under the Basin Plan. The Basin Plan allows for lower environmental outcomes in one river reach to be offset by improvements in other river reaches. The limits of change set bounds on the amount of change permitted in each catchment to ensure that key aspects of the ecosystem are not subject to unacceptable adverse change. They are an essential component of the SDL adjustment method that enables optimisation of the adjustment outcome, while protecting ecosystems in all parts of the system.

Floodplain ecosystems require a range of flows that vary in height and duration to sustain their health and resilience. The limits of change rules protect this range of flows in each region. Limits were also developed to avoid adverse impacts on the Coorong, Lower Lakes and Murray Mouth.

Applying the SDL adjustment method

The Authority must determine the smallest water recovery volume that passes all three tests. If all tests are passed for a modelled SDL adjustment package scenario, an even smaller recovery volume will be simulated (see Figure 7). This cycle continues until the smallest recovery volume (and hence the highest possible adjustment to water recovery) is found which passes the requirements of the SDL Adjustment Mechanism.

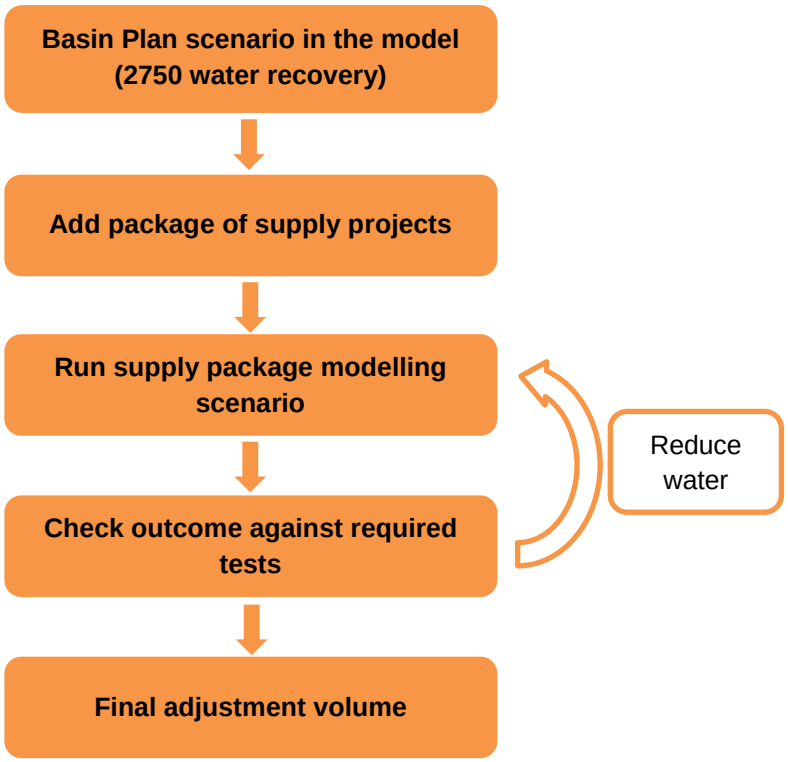


Figure 7: Applying the SDL adjustment method

Valuing the contribution of efficiency projects

The efficiency programs improve the environmental outcomes under the Basin Plan by investing in projects that reduce consumptive water inefficiencies and losses, and recover this water for the environment. The reduction in consumptive water must have no reduction in socio-economic outcomes. The water saved from these projects is registered as efficiency entitlements set aside as water for the environment and the SDL is reduced as a result.

Section 5: SDL adjustment projects and outcomes

SDL adjustment project package

Basin governments notified the Authority of 36 supply projects and 2 efficiency measures projects to be considered as part of the SDL Adjustment Mechanism, using changes to infrastructure and the way that the river is operated. In addition, a constraint project for the Goulburn catchment has been proposed, but has not been included in this determination.

The full package of projects notified is listed in Table 1, and highlighted in Figure 8. A more detailed description of the projects is at **Attachment A**.

The Authority maintains a register of SDL adjustment projects agreed by Basin governments on its website at www.mdba.gov.au/sdlam-projects. As efficiency projects are added to the notified package of projects through to 31 December 2023, the register will be updated to include entitlements as they are acquired. The register will also record supply project amendments through to December 2023.

Projects are at a range of stages in their design and implementation, for example The Living Murray (TLM) projects have been built, while other projects are at the design and consultation stage.

Table 1: Package of supply, constraints and efficiency measures

Map ref.	Project title	Proponent state(s)
1	South East Flows Restoration Project	South Australia
2	Flows for the Future	South Australia
3	South Australian Riverland Floodplain Integrated Infrastructure Program (SARFIIP)	South Australia
4	Riverine Recovery Project	South Australia
5	Chowilla Floodplain TLM Project	South Australia / New South Wales / Victoria
6	South Australian Murray key focus area	South Australia
7	Lindsay Island (Stage 1) Upper Lindsay watercourse Enhancement TLM Project	Victoria / New South Wales / South Australia
8	Lindsay Island (Stage 2) Floodplain Management Project	Victoria
9	Mulcra Island Environmental Flows TLM Project	Victoria / New South Wales / South Australia
10	SDL offsets in the Lower Murray NSW	New South Wales

11	Wallpolla Island Floodplain Management Project	Victoria
12	Hattah Lakes North Floodplain Management Project	Victoria
13	Hattah Lakes Environmental Flows TLM Project	Victoria / New South Wales / South Australia
14	Belsar-Yungera Floodplain Management Project	Victoria
15	Burra Creek Floodplain Management Proposal	Victoria
16	Vinifera Floodplain Management Project	Victoria
17	Nyah Floodplain Management Project	Victoria
18	Guttrum and Benwell State Forests Floodplain Environmental Works Project	Victoria
19	Murray and Murrumbidgee Valley National Parks SDL Adjustment Supply Measure	New South Wales
20	Gunbower Forest TLM Project	Victoria / New South Wales / South Australia
21	Gunbower National Park Floodplain Management Project	Victoria
22	Flexible Rates of Fall in River Levels Downstream of Hume Dam	Victoria / New South Wales
23	TLM environmental works and measures – Koondrook-Perricoota Forest Flood Enhancement proposal	New South Wales / Victoria / South Australia
24	Barmah–Millewa Forest Environmental Water Allocation	Victoria / New South Wales
25	New Goulburn key focus area*	Victoria
26	Yarrawonga to Wakool junction key focus area	New South Wales
27	Improved regulation of the River Murray**	Victoria / New South Wales

28	Hume to Yarrawonga key focus area	Victoria / New South Wales
29	Hume Dam airspace management and pre-release rules	Victoria / New South Wales
30	2011 Snowy Water Licence Schedule 4 Amendments to River Murray Increased Flows Call Out Provisions	New South Wales / Victoria
31	Enhanced environmental water delivery (Hydro Cues)	New South Wales / Victoria / South Australia
32	Nimmie Caira Infrastructure Modifications Proposal	New South Wales
33	Modernising Supply Systems for Effluent Creeks – Murrumbidgee River	New South Wales
34	Improved Flow Management Works at the Murrumbidgee River – Yanco Creek Offtake	New South Wales
35	Computer Aided River Management (CARM) Murrumbidgee	New South Wales
36	Murrumbidgee key focus area	New South Wales
37	Structural and operational changes at Menindee Lakes, including the Lower Darling key focus area constraint project	New South Wales
N/A	On Farm Irrigation Efficiency and Other Water Use Efficiencies***	Commonwealth program
N/A	Urban or Industrial and Mining areas water efficiency***	Commonwealth program

*Submitted as a constraint project only and not modelled as part of the SDL adjustment determination

**Not modelled as part of the SDL adjustment determination

***Efficiency projects are not location specific and operate across the Basin.

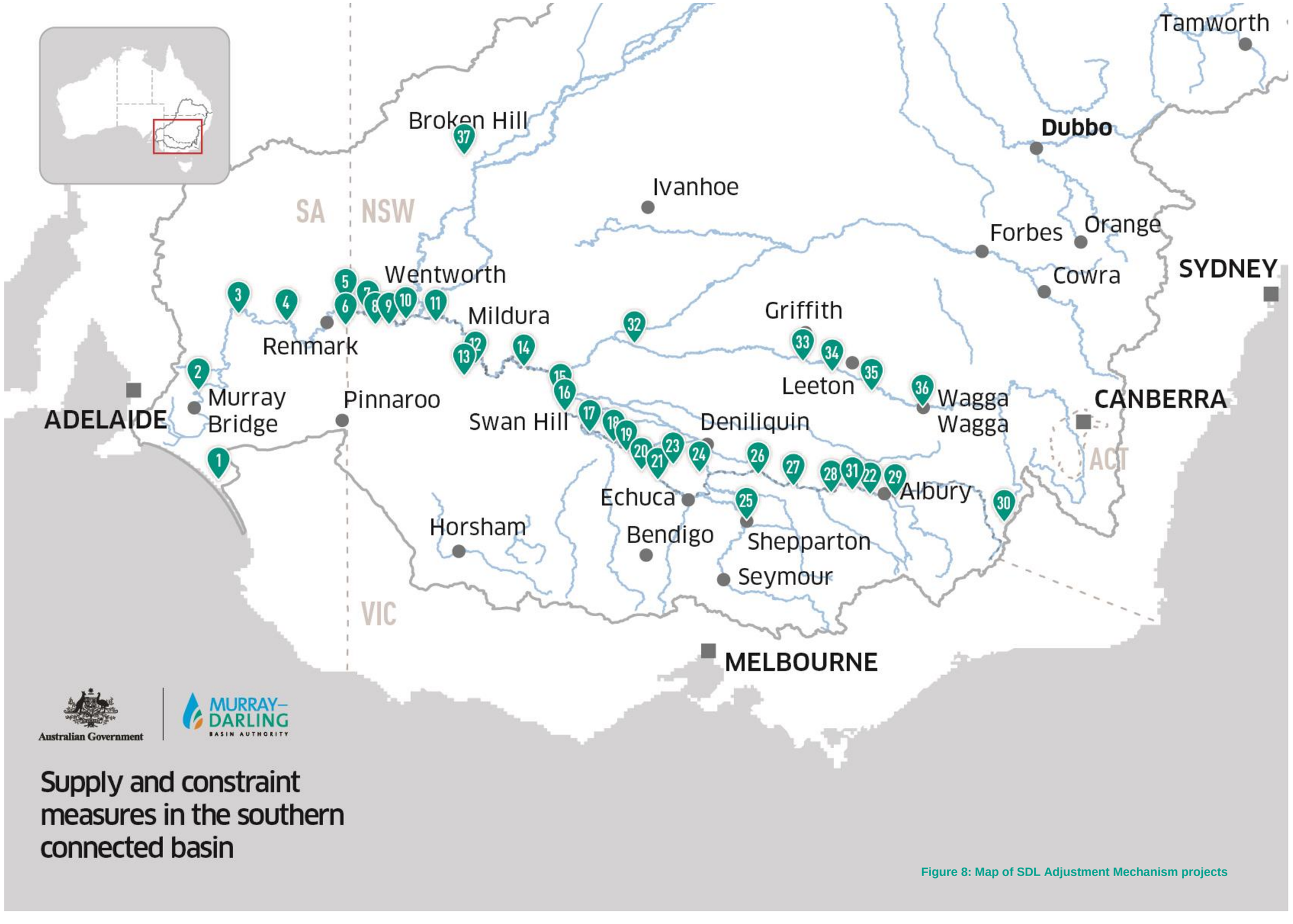


Figure 8: Map of SDL Adjustment Mechanism projects

Expected outcomes from the projects

The SDL adjustment project package can achieve equivalent environmental outcomes from less water. This facilitates the opportunity for a 605 GL SDL adjustment outcome. As a result, more water can remain in the system for other user uses, including for irrigated agriculture.

The projects at an individual level also aim to provide a range of benefits. These may apply over the whole length of a river and/or a river reach. Some project examples are discussed below as a demonstration of the landscape level benefits that they aim to deliver.

Environmental works

Environmental works projects inundate floodplain areas but use less water. These projects use structures like environmental regulators to direct water to, and retain water on the floodplain, without having to raise the river level. Because this uses less water than a managed overbank flow, watering can be undertaken more often, for longer durations and during droughts. The projects can therefore help to restore a more natural watering regime, both increasing ecological resilience and using less water in the long-term. In addition, improvements in the condition of important wetland areas provide ecological benefits to species dependent on the wetlands for habitat and breeding opportunities. The improved condition of these areas can also enhance recreational and cultural values for local communities, including Aboriginal communities.

Examples of environmental works projects in the SDL adjustment package include:

- The Living Murray proposals, in which works such as regulators and levees are used to provide water to wetlands and improve floodplain connectivity. The structures allow managers to deliver water to over 37,000 ha of significant forests, wetlands and lakes along the River Murray, and hold water on the floodplain for longer. This simulates natural flows using only a fraction of the water required for an overbank flow, and the water can be returned to the river and re-used downstream.
- Victoria's nine environmental works projects located along the Victorian Murray look to build upon and complement The Living Murray icon sites. In the same manner as The Living Murray proposals, these projects use works and operating strategies to benefit a range of ecological, social, cultural and economic values. They aim to provide ecological resilience to native flora and fauna, drought refuges for native species, and breeding opportunities for fauna, including recreationally-fished species.
- New South Wales has proposed the "SDL offsets in the Lower Murray New South Wales" project, which combines operational changes to the Murray Lock 8 and 9 weirs and a series of environmental works. The operational changes to weir pool heights better deliver water onto the floodplain at ecologically beneficial times and return surrounding wetlands to more natural wetting/drying regimes. Works in the Carrs, Capitts and Bunberoo Creek systems aim to improve environmental water delivery to the area and a fishway on Frenchman's creek will provide passage through one of the last major barriers to fish movement along the River Murray, promoting connectivity between breeding sites, feeding grounds and migratory routes.
- The Improved flow management works in the New South Wales project "Murrumbidgee Rivers – Yanco Creek offtake" are designed to reinstate a better flow regime to wetlands important for waterbirds and vegetation communities critical to fish species including the

Murray Cod. The mid-Murrumbidgee wetlands support many rare and threatened fauna species, including the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed endangered Trout Cod, the vulnerable southern bell frog and numerous bird species.

- South Australia's "South East Flows Restoration Project" will construct a channel from both existing and new drains to divert additional water from the Upper South East into the Coorong South Lagoon. This will provide fresh water to the Coorong and provide positive ecological benefits by reducing salinity levels, especially in the South Lagoon. Reducing salinity levels will improve resilience before, during and after drought periods.
- The New South Wales Government has developed a proposal for the Menindee Lakes that aims to reduce evaporation, optimise the significant natural, cultural and economic values of the Lakes, and continue their use for recreational and tourism purposes. The proposal aims to move the management of the Lakes towards outcome based operating rules, rather than the current approach. The proposal includes new regulators to separate the management of Lakes Menindee and Cawndilla and to enable the managed use of Lake Cawndilla as a storage option, reducing its evaporative losses.

Projects to change river operations

Projects that change how the river system is operated can provide a range of benefits, taking advantage of new information made available in emerging technologies and data sources, and trialling new ways to make river management more efficient. For example:

- The Computer Aided River Management for the Murrumbidgee River uses better and more reliable information in the form of metering, inundation models and loss estimates to provide more accurate releases for downstream orders and save operational loss water.
- The Victoria/New South Wales "Barmah–Millewa Forest Environmental Water Allocation (BMFEWA)" project looks to better coordinate BMFEWA and other environmental water in the reach to reduce any use of water for the environment when it may provide limited environmental benefit.
- Improving the management of water for the environment in the Hume Dam is the focus of the Victoria/New South Wales "Hume Dam Airspace Management project". The project aims to change airspace management to result in more water being made available for both the environment and irrigation.
- Improved operations at Hume Dam is also the focus of the Victoria/New South Wales "Flexible Rates of Fall in River Levels Downstream of Hume Dam" project. This project has been developed and trialled over a number of years, and will use the knowledge gained to optimise draw down rates in the River Murray downstream of Hume Dam, to reduce unseasonal flooding and negative impacts on the ecology of the Barmah–Millewa forest.

The Basin has historically been managed to deliver water for human needs, including irrigation and stock and domestic use. The timing and variability of flows needed by the environment is different to consumptive users, and river management, which takes into account the needs of the environment can deliver significant benefits and efficiencies. Supply projects such as:

- "Enhanced environmental water delivery" aim to do this by reinstating more natural flow regimes and overbank flow events by aligning water for the environment delivery with natural flows, particularly in tributary streams. When applied in conjunction with the gradual relaxing of constraints, through constraints management projects, the benefits to the environment are substantial. Changed operating rules, combined with relaxed constraints, can also result in social and economic benefits. This is associated with being able to manage moderate flooding more effectively.

Constraints projects

Relaxing constraints allows the better delivery of water for the environment when and where it is needed to maximise environmental outcomes. Projects contribute towards achieving ecological targets and flows in the southern connected Basin, which were considered important during the development of the Basin Plan. In particular, relaxing constraints provides opportunities for environmental watering of large areas of floodplain in New South Wales, Victoria and South Australia. This improves the health of forests, fish and bird habitats, the connection between the river and the floodplain, and replenishes groundwater. It also works to improve the capacity of other supply projects to achieve their intended environmental outcomes.

The effects of addressing constraints will vary across areas in different river catchments.

A number of constraints projects have been notified as supply measures.

Some key secondary benefits for communities include:

- increased pasture growth for floodplain graziers
- funding for on-farm infrastructure improvements, such as new bridges or crossings
- funding for upgrades to ageing public flood infrastructure, such as levees, roads and crossings
- better water quality as saline pools are flushed out and floodplain litter washed away to reduce the risk and severity of blackwater events
- recreation and tourism associated with the higher flows and healthy wetlands, such as fishing, kayaking and camping
- the opportunity to provide goods and services through the construction of water management structures.

The circumstances and the triggers under which constraints projects may be operated by river operators are yet to be fully negotiated. State governments have committed to the principles below for constraint projects:

- extensive community consultation, including identifying the most effective way to mitigate adverse impacts
- funding infrastructure to ensure that third party impacts of proposed flows are mitigated
- no managed flows at increased levels to occur until all necessary works are complete, noting that it may be possible to have a staged relaxation of constraints.

While there are multiple environmental and community benefits to relaxing constraints, governments recognise that some parts of the community also has concerns. A key element of constraint relaxation is for unacceptable impacts arising from changes to the delivery of water for the environment to be mitigated. State governments will undertake detailed engagement to understand concerns and design mitigation strategies that meet community needs, with any change to flow rates over the long-term requiring extensive consultation with all potentially affected land holders, industries and communities.

Efficiency projects

The Commonwealth's efficiency program has been running for a number of years, funding on-farm and off-farm irrigation projects that more efficiently deliver water for irrigation to the farm or the crop, with the irrigator providing a significant proportion of the saved water to the Commonwealth in return for funding. Project reviews have consistently shown benefits to the irrigator that are broad and long lasting. These include increased crop yield and quality, improved crop flexibility and better use of labour. Economic benefits can also accrue to local communities through the program's requirements for materials and services and production increases. The projects have reportedly also improved irrigator confidence in the future and assisted in succession planning.

Efficiency projects need to meet Basin Plan requirements for neutral or improved socio-economic outcomes. In response to community concerns, the Commonwealth in consultation with Basin state governments commissioned an independent review to provide advice on how to best design the efficiency measure program to recover 450 GL of water by 2024, and have neutral or improved socio-economic outcomes as required by the Basin Plan. The study will also report on the potential social-economic impacts arising from efficiency measure projects at a range of scales and will provide an anticipated cost of recovering water through efficiency measure projects.

The review, conducted by EY, will report back to Basin governments in December 2017.

Ramsar sites

The Basin plan requires that any changes to the SDLs take account of Australia's international obligations under the Ramsar Convention and advise the Commonwealth minister responsible for water on the implications of a proposal for any declared Ramsar wetland. The Ramsar Convention (an international treaty signed in Ramsar, Iran, in 1971) aims to halt the worldwide loss of wetlands and to conserve, through wise use and management, those that remain. Australia has 65 Ramsar sites, 16 of which are in the Murray–Darling Basin. Eight are located in the southern-connected Basin and are potentially affected by SDL adjustment projects. These are:

1. Barmah Forest
2. NSW Central Murray State Forests
3. Gunbower Forest
4. Hattah-Kulkyne Lakes
5. Fivebough and Tuckerbil Swamps
6. 'Riverland'
7. Banrock Station Wetland Complex
8. The Coorong and Lakes Alexandrina and Albert.

Analysis undertaken by the Authority indicates there may be changes to the hydrological regime as a result of operating the SDL Adjustment Mechanism. This could include changes to the volume, timing, duration and frequency of surface water flows. These changes may affect flows to and within Ramsar wetlands in the southern Basin, with the potential to change their ecological character in both positive and negative ways.

Supply measure projects can increase outcomes for Ramsar wetlands in a number of ways, including greater floodplain connectivity and improved seasonality and duration of water for the environment. An analysis of the outcomes from the SDL adjustment package has determined that the proposed adjustments meet the ecological equivalence test and the limits of change safeguards and are not likely to have a significant impact on the eight relevant Ramsar wetlands. More detail is provided in **Attachment B**.

As part of project delivery, proponents must obtain all necessary approvals including those under the Environment Protection and Biodiversity Conservation Act (EPBC Act). This requires the proponent to consider any adverse impacts on Ramsar sites. In addition, ongoing project refinement and implementation through to 2024 will need to consider potential impacts on Ramsar wetlands. This may include coordinating the package as a whole to maximise the potential for any positive benefits through additional flows and connectivity, and avoid any adverse impacts through appropriate management and operating regimes. The additional environmental benefits from efficiency measures will also assist to maintain the character of Ramsar wetlands.

Proposed SDL adjustments

The Authority has determined the proposed adjustment amounts and how these should be apportioned. Table 2 is based on the package of 36 supply measure projects submitted by state governments. The supply projects were assessed through the SDL Adjustment Mechanism framework described in this report, and required tests were applied to the resulting proposed adjustment. This includes no adverse impacts on reliability of supply that are not offset or negated, the achievement of environmental equivalence and no breach of the limits of change that has the potential for adverse ecological impacts.

Table 2 is based on the package of 36 supply measure projects submitted by state governments. The supply projects were assessed through the SDL Adjustment Mechanism framework described in this report, and required tests were applied to the resulting proposed adjustment. This includes no adverse impacts on reliability of supply that are not offset or negated, the achievement of environmental equivalence and no breach of the limits of change that has the potential for adverse ecological impacts.

Table 2: Proposed SDL adjustments for each resource unit (catchment area)

SDL resource unit	Current SDL (GL)	Apportionment of supply contribution (GL)	Reallocation of shared reduction (GL)	Proposed SDL (GL)#
14 Murrumbidgee	1938.1	162.0	0.0	2100.1
15 New South Wales Murray	1341.7	124.8	0.0	1466.5
16 Lower Darling	45.5	0.0	0.0	45.5
17 Victorian Murray	1251.7	72.8	0.0	1324.5
18 Kiewa	23.3	1.3	0.0	24.6
19 Ovens	80.3	3.0	0.0	83.3
20 Goulburn	1153.0	174.5	0.0	1327.5
21 Broken	54.6	1.1	0.0	55.7
22 Campaspe	120.9	2.6	0.0	123.5
23 Loddon	155.8	10.9	0.0	166.7
25 South Australian Murray	483.1	52.0	1.9	533.2
27 Eastern Mount Lofty Ranges	26.4	0.0	-1.9	28.3
29 Australian Capital Territory	47.6	0.0	0.0	47.6
Total	**6722.0**	**605**	**0.0**	7327

* The Basin Plan limits the net adjustment for supply and efficiency measures to SDLs to 5% of the Basin-wide SDL, or 544 GL. The full supply contribution of 605 GL can be reached once sufficient efficiency measures have been delivered to reduce the net adjustment to 544 GL.

this column was updated on 13/10/17 to correct an error.

Table 3: Proposed changes to water recovery in the southern connected Basin

SDL resource unit	Water recovery target under the Basin Plan (GL)	Proposed adjusted water recovery target (GL)	Water recovery completed to 30 June 2017 (GL)	Water recovery remaining after proposed adjustments (GL)
14 Murrumbidgee	563.0	401.0	401.0	0.0
15 New South Wales Murray	470.0	345.2	352.3	0.0
16 Lower Darling	15.0	15.0	20.0	0.0
17 Victorian Murray	455.4	382.6	397.0	0.0
18 Kiewa	1.3	0.0	0.0	0.0
19 Ovens	3.1	0.1	0.1	0.0
20 Goulburn	536.4	361.9	361.9	0.0
21 Broken	1.6	0.5	0.5	0.0
22 Campaspe	31.7	29.1	29.1	0.0
23 Loddon	22.8	11.9	11.9	0.0
25 South Australian Murray	181.9	131.8	143.9	0.0
27 Eastern Mount Lofty Ranges	1.9	0.0	0.0	0.0
29 Australian Capital Territory	4.9	4.9	4.9	0.0
Total	**2289.0**	**1684.0**	**1722.6**	**0.0**

Ecological outcomes/limits of change

The limits of change rules were developed and agreed by the Authority and Basin state governments prior to the Basin Plan being settled. They were developed using the best available modelling and scientific information at the time, but it was also understood that improvements in knowledge would occur. As a result, the Basin Plan allows for a subset of limits of change which relate to specific flow indicators to be reviewed where minor breaches occur. In these circumstances, new lines of evidence can be considered to assess whether the intended site-specific ecological targets can be achieved, for example mitigating strategies may be available that allow the ecological outcomes of the Basin Plan to be achieved despite limits of change being in breach. In this case the breached limit of change may not apply.

In making its SDL adjustment determination, the Authority engaged an independent expert review panel to consider any potential breaches to the limits of change rules, based on early modelling of the projects. The panel consisted of ecologists and river operators with significant experience in these matters. Once the final model run was completed in September 2017, the panel provided their findings and recommendations to the Authority. The panel considered relevant new evidence on whether environmental outcomes were adversely affected, including the potential for available mitigating actions to achieve the Basin Plan's ecological outcomes.

The Panel analysed the failure to achieve specific targets for two river reaches with respect to overbank flows and four sites with respect to base flows and concluded that none of the site specific overbank target breaches were material or significant in terms of their likely impact on ecological responses of birds, fish or vegetation. All breaches were considered sufficiently close to their targets to be:

- within the limits of modelling (and assumptions made within the models) or measurement precision, and/or
- within the capacity of river operators to optimise releases and flows to achieve the "missed" targets, and/or
- within the limits of our current understanding of cause and effect relationships between hydrology and ecosystem function.

The investigation and analysis by the panel, and the consideration of the panel's recommendations by the Authority, used a strong evidence-base to provide confidence that environmental outcomes can be achieved despite a limit of change rule being triggered.

The limits of change metric results are at **Attachment C**.

Reliability

In their assessment of potential impacts on the reliability of supply for the proposed SDL adjustment, state government managers took into account the fact the model represents 2009 conditions and policy and management changes since then that may have negated or offset any issues associated with the proposed adjustment.

The issue of reliability was considered by the Basin Officials Committee who agreed that if the operation of the SDL Adjustment Mechanism has the potential to result in reduction of reliability for entitlement holders, state governments will work together to find real world solutions to address those reliability concerns, consistent with the requirements in the Basin Plan.

SDL Adjustment Mechanism assumptions

In making its determination of the proposed adjustment amounts, the Authority has used a number of assumptions:

Reallocation of the shared reduction amounts

For each catchment the SDLs are made up of two components: the local reduction and the shared reduction. The local water recovery amounts, set out in Schedule 2 of the Basin Plan, must be achieved from infrastructure efficiencies and buyback within that catchment. The shared water recovery is set at a zone level in Chapter 6 of the Basin Plan. There are five zones:

- northern Basin
- southern Basin Victoria
- southern Basin New South Wales
- southern Basin South Australia
- southern Basin Australian Capital Territory.

For the purposes of the Adjustment Mechanism, state governments were given the opportunity to request a change to the way shared reduction amounts for a zone were divided to better align with state priorities. One reallocation request was received in the southern Basin from South Australia, moving 1.9 GL of shared water recovery from the Eastern Mt Lofty Ranges to the South Australian Murray.

Apportionment

The Authority has worked out the proposed adjustment to SDLs from the net result of the full package of supply and efficiency projects. Adjustment values are not calculated for each project individually due to the interlinked and interdependent nature of river management.

To work out the proposed SDL adjustments for each water resource plan area, the Authority needs to allocate the overall adjustment value between catchments. This process is called apportionment.

On 9 December 2016, the COAG noted that Basin governments are seeking to offset the full remaining water recovery amount in the southern Basin. The way that the total SDL adjustment amount is distributed between catchments is a key element in achieving this goal.

The Authority has used the following principles for apportionment:

- distribute the net adjustment in a way that aims to meet any remaining water recovery in each catchment, and minimise under or over recovery outcomes at the catchment and state levels for the southern connected Basin
- if additional water is available above the remaining total southern connected Basin water recovery target, the remaining amount will be distributed in a way that optimises the SDL adjustment outcome within the model
- once the water recovery target is met, the surplus supply contribution is apportioned to deliver the supply contribution to the states in proportion to those ratios set out in section 6.05 of the Basin Plan.

Some water recovery in the southern Basin is contracted but not yet delivered. Water recovery assumptions in the Authority's apportionment of the total adjustment amount have been made with the expectation that all contracted water recovery will be delivered. Subject to these existing water recovery contracts being delivered and the implementation of the SDL Adjustment Mechanism efficiency component, this will mean no further water recovery in the southern Basin.

Basin governments have indicated that they will continue to discuss the approach to apportionment during the public feedback period.

The five per cent limit

The SDL Adjustment Mechanism allows a net adjustment of Basin-wide surface water SDLs by up to five per cent, or 544 GL, of the Basin-wide limit of 10,873 GL. Where the proposed adjustment determination result exceeds this amount after the net supply/efficiency outcome is calculated, the overall adjustment must be reduced to within the five per cent amount. If further efficiency entitlements are recovered the net increase is recalculated, taking into account total supply and efficiency adjustment amounts. In other words, where the Authority determines an SDL adjustment of over 544 GL, each GL of water over this amount, will require a matching GL of water through the efficiency component of the Adjustment Mechanism. For example, an SDL adjustment of 544 GL can increase one GL to 545 with one GL of water from efficiency project, and to 564 GL with 20 GL of water from efficiency projects and so on.

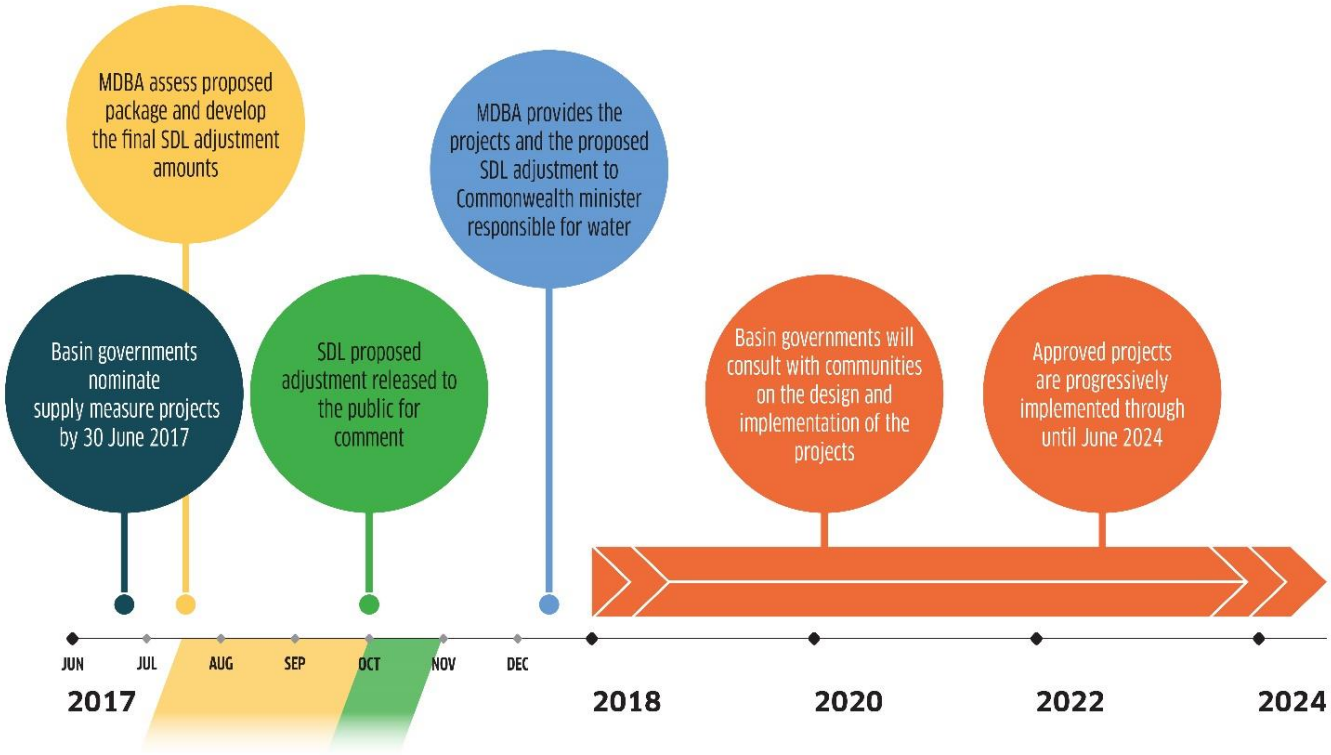
As the expected adjustment is above the five per cent threshold, efficiency projects will be required to bring the system back into balance.

With the water recovery task in the southern connected Basin of 571 GL (30 June 2017) the proposed adjustment amount, once the five per cent rule has been applied, does not account for the total remaining water recovery. As a consequence additional water through efficiency will be required for the net adjustment amount to reach the full water recovery target in the southern connected Basin, before SDLs come into effect in 2019.

Water recovery

The determination of the proposed adjustment amounts, and the application of both apportionment and the five per cent rule, all use the Commonwealth's water recovery figures as at 30 June 2017. These figures include recovered water and water that is contracted to be recovered. The Authority will work with jurisdictions to adjust apportionment if required to account for any change to the assumptions in the period prior to making its final determination.

Section 7: Next steps – beyond 2017



Project design and nomination

Basin state governments have worked collaboratively to develop the package of projects that have been nominated for the SDL Adjustment Mechanism. State and Commonwealth agencies have also undertaken rigorous project assessments against the agreed criteria in the phased process set out in Figure 5. These assessments make sure that the full package of projects is sensible, will achieve the aims of the SDL Adjustment Mechanism, and will improve the socio-economic and environmental outcomes of the Basin Plan.

Draft Determination

The Authority has the role to independently assess the nominated projects to determine an appropriate adjustment to the SDLs. The Authority also has a role to facilitate public input to the draft determination. This report outlines the Authority's assessment and now invites interested people to submit feedback until 3 November.

Implementation

For both supply and efficiency projects the determination is just the start of the process. Local knowledge is integral to the successful design and implementation of individual supply projects, and will provide valuable input as the projects adapt and evolve over time in response to new information. Community involvement will allow governments to understand the positive environmental, social and economic benefits the projects can provide, and mitigate any adverse impacts before projects are fully implemented. This input is critical to the ongoing detailed design and implementation. There will be focused engagement on the package of projects, and Basin state governments will work in partnership to provide information to communities about how they can contribute through to 2024. An adaptive approach is envisaged (outlined in Box 1).

State and Commonwealth governments will work together to implement projects in a coordinated way, to take advantage of interactions and interdependencies including coordination of the delivery of water for the environment.

Box 1 - The proposed adaptive implementation approach

The Authority has used the information in project notification business cases, provided by Basin state governments, to determine the proposed SDL adjustment amount.

The assumptions used to model each project in the SDL Adjustment Mechanism assessment framework do not necessarily represent a commitment to a particular project design or operating strategy. Basin governments have agreed to take an adaptive approach to project implementation including ongoing community consultation on key projects. For most projects the next step is for Basin state governments to further refine project design, with the involvement of a wide range of people including communities, industries and water management experts. It is anticipated that some projects and their scope will be significantly further shaped whilst others will adopt existing business case parameters. Along with community consultation, the following will help to further inform project design:

- further technical advice and assessment
- compliance with regulations, including environmental impact assessment and cultural and heritage legislation
- advice and refinement in consultation with river operators and governments, including negotiation of changes to river operating rules.

Where projects are significantly altered the proponent state government/s will amend the project notification, and the potential impacts of changes on the SDL adjustment value will be carefully considered. As a package environmental outcomes equivalent to 605 GL must be achieved.

The Authority will implement a transparent and accountable process to respond to changes during project design and implementation. The Authority will monitor and assess projects from 2018 to 2024 to ensure projects are on track to achieve stated outcomes. This will be done using a method that allows regular reporting against multiple lines of evidence and judgement, underpinned by rigorous modelling to enable the validation of real water savings. This will assist the Authority's consideration of project outcomes and SDL adjustment reconciliation.

Ongoing reporting will provide state governments with an adaptive 'no-surprises' approach by identifying where a project may be unable to achieve its intended outcomes for a range of reasons. This work will ensure, as a package, the projects achieve the equivalent outcomes.

The reporting framework will include an assessment of the potential impact on the original SDL adjustment outcome, however SDLs will not be amended at these checkpoints. Through this ongoing oversight, governments will seek to achieve the outcomes of the 2017 SDL adjustment determination, with full water recovery in the southern connected Basin achieved through supply project implementation and efficiency projects. The Authority expects that most projects will change in some way during design and implementation, and this approach provides governments and communities with the flexibility to strengthen and improve the projects in the SDL Adjustment Mechanism.

Section 8: Public comment period

The Sustainable Diversion Limit Adjustment Mechanism assessment (draft determination) is available for public comment from **3 October 2017–3 November 2017**.

More information is available on the Authority's website at www.mdba.gov.au/SDLAM, or you can contact the Authority at engagement@mdba.gov.au, or call 1800 230 067.

How your feedback will be used

Basin governments are aware of a range of issues and opportunities that could strengthen the projects and minimise risks.

There is a commitment to continue to strengthen projects during the next stage of project design and implementation.

The public can provide input on issues or opportunities in relation to the package.

The feedback received will be used to provide advice, along with the SDL assessment, to the Commonwealth minister responsible for water– once approved, it is then tabled in Parliament.

Project-specific feedback will be provided to Basin state governments to strengthen project design and implementation.

References

Bewsher, D. 2016. Review of the Hydrological Modelling Frameworks used to inform Potential Basin Plan Amendments. Murray-Darling Basin Authority.

Brookes, J, T Hillman, G Jones, and M Stewardson. 2014. SDL Adjustment Ecological Elements Method Development Report. Review of Final Project Report by the Independent Review Panel. Murray-Darling Basin Authority.

Campbell, B, E Coote, J Foster, H Johnson, and N Sloane. 2016. “Decision Support Systems - assisting implementation of long-term environmental water planning.” Edited by G J Vietz, A J Flatley and I D Rutherford. Proceedings of the 8th Australian Stream Management Conference. Leura, NSW. 547-561.

Commonwealth Government of Australia. 2012. Water Act 2007 - Basin Plan 2012. Canberra: Commonwealth of Australia.

Green, D, and P Alexander. 2006. River Murray Wetland Database: NSW, Victoria. Wetland Commence-to-flow levels: June 2006. Albury: Murray Wetlands Working Group.

MDBA. 2013. Returning water to Hattah Lakes - Episodes 1 and 2. https://www.mdba.gov.au/managing-water/environmental-water/delivering-environmental-water/hattah-lakes.

Murray-Darling Basin Authority. 2014d. Basin Annual Environmental Watering Priorities 2014-15. Canberra: Murray-Darling Basin Authority.

Murray-Darling Basin Authority. 2014c. Basin-wide environmental watering strategy 2014. Canberra: Murray-Darling Basin Authority.

Murray-Darling Basin Authority. 2014a. River Murray from Hume Dam to Yarrawonga Weir reach report: Constraints Management Strategy. Canberra: Murray-Darling Basin Authority.

Murray-Darling Basin Authority. 2011. The proposed “environmentally sustainable level of take” for surface water of the Murray-Darling Basin: Methods and outcomes. Canberra: Murray-Darling Basin Authority.

Overton, I C, C A Pollino, J Roberts, Reid J R W, N R Bond, H M McGinness, B Gawne, et al. 2014. “Development of the Murray-Darling Basin Plan SDL Adjustment Ecological Elements Method. Report prepared by CSIRO for the Murray-Darling Basin Authority.”

Links to further reading

Intergovernmental Agreement on Implementing Water Reform in the Murray Darling Basin Juen 2013 (revised March 2017): https://www.coag.gov.au/about-coag/agreements/intergovernmental-agreement-implementing-water-reform-murray-darling-basin

SDL adjustment projects: https://www.mdba.gov.au/basin-plan-roll-out/sustainable-diversion-limits/sdl-adjustment-proposals-state-projects

Commonwealth On-Farm Further Irrigation Efficiency Program (COFFIE): http://www.agriculture.gov.au/water/mdb/programs/basin-wide/coffie

Phase 2 Assessment Guidelines for Supply and Constraint Measure Business Cases: http://www.mdba.gov.au/sites/default/files/pubs/Phase2-Assessment-Guidelines.docx

Hydrological modelling: https://www.mdba.gov.au/managing-water/hydrological-modelling

Hydrologic modelling to inform the proposed Basin Plan: methods and results: https://www.mdba.gov.au/publications/mdba-reports/hydrologic-modelling-inform-proposed-basin-plan-methods-results

Review of the Hydrological Modelling Frameworks used to inform Potential Basin Plan Amendments (2016): https://www.mdba.gov.au/publications/independent-reports/BPamendments-review-hydrological-modelling

Assessing environmental water requirements for the Basin's rivers (background to hydrological indicator site and site-specific flow indicators SFIs). https://www.mdba.gov.au/publications/mdba-reports/assessing-environmental-water-requirements-basins-rivers

Ecological Elements method: https://www.mdba.gov.au/publications/independent-reports/development-murray-darling-basin-plan-sdl-adjustment-ecological

SDL Adjustment Ecological Elements Method Development Report, Review of Final Project Report by the Independent Review Panel: https://www.mdba.gov.au/publications/independent-reports/sdl-adjustment-ecological-elements-method-development-report-review

Efficiency measures, links to independent review terms of reference: http://www.agriculture.gov.au/water/mdb/programs/

Hattah Lakes case study and related links: https://www.mdba.gov.au/managing-water/environmental-water/delivering-environmental-water/hattah-lakes

Australia's Ramsar Sites: http://www.environment.gov.au/water/wetlands/publications/factsheet-australias-ramsar-sites

Basin-wide environmental watering strategy 2014: https://www.mdba.gov.au/publications/mdba-reports/basin-wide-environmental-watering-strategy-2014

Attachment A - package of supply, constraint and efficiency projects agreed by the Murray-Darling Basin Ministerial Council on 16 June 2017

Operational rules changes and system enhancements		
Project title	**Proponent state(s)**	**Project description**
2011 Snowy Water Licence Schedule 4 Amendments to River Murray Increased Flows Call Out Provisions	New South Wales / Victoria	Amendments to Snowy Hydro licence in 2011 allow the water recovered by the River Murray Increased Flows (RMIF) to be held and called out. Previously the release of the water was at the discretion of Snowy Hydro and was generally at times suited to Snowy Hydro's commercial outcomes. The proposal intends to provide a means to control the timing of RMIF water releases from the Snowy Scheme, allowing more flexibility to achieve environmental outcomes targeted in the River Murray below Hume Dam.
Barmah–Millewa Forest Environmental Water Allocation	Victoria / New South Wales	Rule change to vary the rules associated with the water set aside by Victoria and New South Wales in an environmental account (the Barmah–Millewa Forest Environmental Watering Account or BMFEWA) to water the Barmah–Millewa Forest proposed to allow the use of other environmental entitlements to target the environmental requirements specified in the Basin Plan. This measure proposes to not initiate or continue release from BMFEWA if a four monthly flood has already occurred.
Computer Aided River Management (CARM) Murrumbidgee	New South Wales	The CARM project aims to use better information in the form of metering, inundation models and more accurate loss estimates to allow operators to more accurately make releases to meet downstream orders. The saved operational loss may then be calculated and set aside to achieve environmental outcomes. A callable entitlement as a result of the envisaged saving will allow delivery of previous losses (which were also contributing to environmental outcomes) in a more managed way.
Enhanced environmental water delivery (Hydro Cues)	New South Wales / Victoria / South Australia	This project will achieve enhanced environmental outcomes by increasing environmental water holders' ability to time releases of environmental water from dams with increases in natural flows caused by rainfall. Proponents and environmental water holders will work together to explore opportunities to better mimic natural conditions without impacting long and short-term reliability. The environmental benefits, in part, will be dependent on the extent to which constraints projects are implemented. Any changes will be tested progressively and monitored in an adaptive management process consistent with agreed constraints outcomes. Proponents acknowledge the need for focussed engagement and consultation with communities on this project.
Flexible Rates of Fall in River Levels Downstream of Hume Dam	Victoria / New South Wales	Rule change to allow Hume releases to be reduced more quickly when flows have not been elevated for an extended period beforehand, with the water saved released at a different point in time or in a different flow pattern that would provide additional environmental benefits. The additional flexibility improves Hume Dam operational efficiency.
Hume Dam airspace management and pre-release rules	Victoria / New South Wales	Rule change to allow future environmental water releases in airspace management.
Improved Regulation of the River Murray	Victoria / New South Wales	The proposal focused on recent observed improvements in reducing river operational losses. While notified as a supply measure, there was no agreement by all jurisdictions for the project to be modelled as part of the SDL adjustment determination in September 2017.
Structural and operational changes at Menindee Lakes	New South Wales	This project is a package of operational changes and infrastructure works designed to improve the efficiency of the Menindee Lakes system. The enhanced Menindee project introduces some new works and measures to incorporate a wider range of infrastructure, operations, regulatory and adjustment options which in combination will deliver greater water efficiency savings. The proponent acknowledges the need for consultation with communities and the need to set out transparent governance arrangements.

Operational rules changes and system enhancements		
Project title	**Proponent state(s)**	**Project description**
SDL offsets in the Lower Murray NSW	New South Wales	The project aims to improve environmental water delivery and achieve better environmental and operational outcomes than achieved under the SDL benchmark model. This is to be done through the manipulation of weir pools, construction of a replacement pump station for Lake Cullulleraine (in Victoria), and works in the Carrs, Capitts and Bunberoo Creek systems to provide evaporative and seepage water savings. Weir pools can create unnatural inundation of connected wetlands when the river is held artificially high. Lowering the weir pool can be used to return wetlands to a more natural wetting/drying regime, while raising it can allow water to reach areas that would be difficult to water under most conditions. The strategy of raising and lowering the weirs should provide an environmental benefit compared to an artificially constant weir pool level.
Hume to Yarrawonga key focus area	Victoria / New South Wales	Investigation of opportunities to address physical and policy constraints to the delivery of higher regulated flows (up to 40,000 megalitres per day from Hume Dam). Investigations will include the potential effects of higher flows on third parties and mitigation options to address unacceptable impacts (including easements and/or infrastructure) to allow the delivery of these flows (to support improved river and wetland health outcomes). Landholder acceptance of potential works will be critical. This project must be considered in relation to the other southern connected Basin constraints projects.
Yarrawonga to Wakool junction key focus area	New South Wales	Investigation of opportunities to address physical and policy constraints to enable the delivery of higher flows (up to 30,000 megalitres per day downstream of Yarrawonga Weir, with a buffer for flows up to 50,000 megalitres per day). New South Wales will consult communities on mitigation options to address unacceptable impacts (including easements and/or infrastructure) to allow the delivery of these flows (to support improved river and wetland health outcomes). Landholder acceptance of potential works will be critical. This project must be considered in relation to the other southern connected Basin constraints projects.
South Australian Murray key focus area	South Australia	Investigation of opportunities to address physical and policy constraints to the delivery of higher regulated flows up to 80,000 megalitres per day at the South Australian border. Higher flows are important for maintaining longitudinal connectivity from the border to the Coorong, Lower Lakes and Murray Mouth and promoting lateral connectivity to deliver water to the wetlands, floodplains, creeks and anabranches connected to the main river channel. Landholder acceptance of potential works will be critical. This project must be considered in relation to the other southern connected Basin constraints projects.
New Goulburn key focus area*	Victoria	Investigation of opportunities to address in-channel constraints to the delivery of higher regulated flows up to 20,000 megalitres per day at Shepparton. Allowing the delivery of flows to the top of the bank would improve river health outcomes. This work will be done in a staged and bottom-up way with communities to understand the risks, impacts and costs, and develop feasible, practical and acceptable solutions to mitigate third party impacts. Building on this work, in close consultation with landholders and communities, further improvements to environmental water delivery will also be investigated. Landholder acceptance of potential works will be critical. This project must be considered in relation to the other southern connected Basin constraints projects.
Lower Darling key focus area (notified as part of the Menindee project)	New South Wales	As part of the 'Structural and operational changes at Menindee Lakes' project, investigation of opportunities to address physical and policy constraints to the delivery of higher regulated flows (up to 14,000 megalitres per day at Weir 32). Investigations will include the potential effects of higher flows on third parties and mitigation options to address unacceptable impacts (including easements and/or infrastructure) to allow the delivery of these flows (to support improved river and wetland health outcomes). Landholder acceptance of potential works will be critical. This project must be considered in relation to the other southern connected Basin constraints projects.
Murrumbidgee key focus area	New South Wales	Investigation of opportunities to address physical and policy constraints to the delivery of higher regulated flows (up to 40,000 megalitres per day at Wagga Wagga). Investigations will include the potential effects of higher flows on third parties and mitigation options to address unacceptable impacts (including easements and/or infrastructure) to allow the delivery of these flows (to support improved river and wetland health outcomes). Landholder acceptance of potential works will be critical. This project must be considered in relation to the other southern connected Basin constraints projects.

* This project is not notified as a supply measure and not included in the SLD adjustment determination

Environmental works		
Project title	**Proponent state(s)**	**Project description**
Belsar-Yungera Floodplain Management Project	Victoria	This proposed supply measure will maintain and improve flora and fauna habitat values and provide periodic breeding opportunities for wetland species, such as fish, frogs and waterbirds. Managed flows will be able to be delivered to 2,370 hectares of highly valued floodplain, representing one third of the total area. The works can be operated flexibly to meet the water requirements of different vegetation communities, mimicking a broad range of River Murray flows up to 170,000 megalitres per day. Through the construction of three large regulators, a series of smaller supporting regulators, track raising (levees) and a pipeline (to allow use of temporary pumps), this project will connect extensive areas of floodplain through tiered watering events. These works will make use of natural flow paths to increase the extent, frequency and duration of inundation from either Basin Plan flows or pumping during low flow events.
Burra Creek Floodplain Management Proposal	Victoria	The proposed works will enable inundation of an area of 407 hectares. This represents 33 percent of the total forest area and almost all of the flood dependent communities found within the forest, and provides a greater extent of watering than is possible under Basin Plan flows. The works involve the construction of three large regulators, raising tracks to form levees, and the removal of barriers to flow on the floodplain.
Chowilla Floodplain TLM Project	South Australia / New South Wales/ Victoria	The Chowilla Floodplain works is part of a program of The Living Murray (TLM) works at icon sites along the River Murray to ensure that environmental water recovered as part of TLM is used efficiently and ecological elements are maintained. The Chowilla Floodplain project involves a major environmental regulator on the Chowilla Creek and a range of complementary works. The environmental regulator will allow flows to be managed to enable flooding across the floodplain under relatively low river flow conditions.
Flows for the Future	South Australia	The project proposes activities that reduce the interception of low flows and result in additional flows to riverine environments in the Eastern Mount Lofty Ranges (EMLR) and to the River Murray including the Coorong, Lower Lakes and Murray Mouth in South Australia. The project will help restore the natural low flow patterns within the EMLR through measures that will improve the passage of low flows and freshes to improve ecological habitat conditions.
Gunbower Forest TLM Project	Victoria / New South Wales / South Australia	A suite of engineering works have been built through TLM to deliver environmental water to the Gunbower Forest Icon Site, watering up to 4,800 hectares. These works and associated operating regime have been designed to achieve the ecological objectives that have been set for the forest. The works include two main components: • Lower Landscape Works — target the forest wetlands and use relatively small volumes of water. Works included refurbishing existing regulators within the forest, constructing new regulators and decommissioning of a single regulator. These regulators deliver water from either Gunbower Creek or the River Murray (when flows exceed 14,000 megalitres per day). • Hipwell Road Channel — targets large areas of river red gums and can create the conditions required for large colonial waterbird breeding events. Works include construction of a channel to deliver water from Gunbower Creek to the forest, a new weir in Gunbower Creek and associated works.
Gunbower National Park Floodplain Management Project	Victoria	The project has been developed to enable the delivery of environmental water to the wetlands and forest of the Gunbower National Park. It will mimic a natural flood event of up to 50,000 megalitres per day across 500 hectares. This includes almost half of the permanent and temporary wetlands in the project area and 20 percent (250 hectares) of river red gum with flood dependent understorey. The package of works include regulator and creek enhancement works. The mid forest works will consist of a 100 megalitres per day pump station location on the River Murray and a number of regulators. This will enable the provision of water to approximately 500 hectares of Gunbower National Park, currently unable to be watered by any other infrastructure.

Environmental works		
Project title	**Proponent state(s)**	**Project description**
Guttrum and Benwell State Forests Floodplain Environmental Works Project	Victoria	The project will reinstate a more natural flooding regime for the Guttrum and Benwell Forests, addressing, in particular, the reduced frequency and duration of floods. The proposed works will water 1,200 hectares via pump stations, including semi-permanent wetlands and 82 percent of the river red gum forest with flood dependent understorey. The works will include two separate pump stations to deliver environmental water into Guttrum Forest, one pump station in Benwell Forest and containment works (regulators and levees) in both forests to contain water on the floodplain. The works have been designed to meet the environmental watering requirements of the ecological values by mimicking a 26,000 megalitres per day flood event in the River Murray for Guttrum Forest and a 24,000 megalitres per day flood event for Benwell Forest.
Hattah Lakes Environmental Flows TLM Project	Victoria / New South Wales / South Australia	The project aims to deliver a watering regime that will achieve the ecological objectives for the Hattah Lakes Living Murray Icon Site. The on-ground works have been designed to increase the frequency, duration and extent of flooding across the lakes and surrounding floodplain. The package of works enables watering of 6,000 hectares and includes: • a new pumping station at Messenger's Crossing • sill lowering in Chalka Creek South • four new regulators (Messenger's, Oatey's, Cantala, Kramen) and associated works • refurbishment of an existing regulator (Little Hattah) • three new stop banks or levees.
Hattah Lakes North Floodplain Management Project	Victoria	This project will complement TLM works at the Hattah Lakes Icon Site by enhancing flooding across higher floodplain terraces. The project will also increase the flexibility for environmental water management across the lakes. The proposed works will water an additional 1,130 hectares of floodplain through the construction of two new regulators, a causeway across an existing track and 1.7 kilometres of levees along track alignments.
Improved Flow Management Works at the Murrumbidgee River – Yanco Creek Offtake	New South Wales	This proposal aims to return the Yanco Creek system closer to a pre-development wetting/drying regime, while improving infrastructure that supplies irrigation and stock and domestic water. Upgrades to Yanco Weir on the Murrumbidgee River would result in more control over flows through the proposed Yanco Creek regulator. This may provide the Commonwealth Environmental Water Holder and the Office of Environment and Heritage with more flexibility in managing flows within the Murrumbidgee River system.
Lindsay Island (Stage 1) Upper Lindsay watercourse Enhancement TLM Project	Victoria / New South Wales / South Australia	Lindsay Island is part of the Lindsay-Wallpolla Icon Site. The Stage 1 works were funded by TLM and aimed to maintain existing high quality habitat for native fish, increase the extent of flowing habitat on Lindsay Island by about 28 kilometres, improve fish passage between the Lindsay Island anabranches and the River Murray and improve the condition of riparian vegetation. These works will contribute to achieving the ecological objectives that have been set for the site, focusing on in-stream habitat. The works include three new regulators: • Upper Lindsay River regulators (north and south inlets) • Mullaroo Creek regulator and fishway.
Lindsay Island (Stage 2) Floodplain Management Project	Victoria	The Lindsay Island Floodplain Project will inundate 5,152 hectares of the floodplain and connect many parts of the floodplain through tiered watering events, including areas of unique fast-flowing aquatic habitat, through to sections of black box, lignum and onto the higher alluvial terraces. The proposed works will be operated in tandem with the recently completed TLM works at this site (Lindsay State 1) and Lock 7 to mimic flows of 40,000 megalitres per day to 120,000 megalitres per day. The proposed works include two components: • primary: Berribee Regulator and fishway, five containment regulators and 2.6 kilometres of levees along track alignments • secondary: 13 regulators and associated works, and 4.9 kilometres of levees along track alignments.

Environmental works		
Project title	**Proponent state(s)**	**Project description**
Modernising Supply Systems for Effluent Creeks – Murrumbidgee River	New South Wales	This proposal involves returning parts of three creek systems closer to a pre-development wetting/drying regime, while improving infrastructure that supplies irrigation and stock and domestic water. This project may provide the Commonwealth Environmental Water Holder and the Office of Environment and Heritage with more flexibility in managing flows within the Murrumbidgee River system.
Mulcra Island Environmental Flows TLM Project	Victoria / New South Wales / South Australia	Mulcra Island is part of the Lindsay-Wallpolla Islands Icon Site. The works have been funded through TLM and will assist in achieving the ecological objectives that have been set for the icon site by increasing the frequency, duration and extent of wetland and floodplain inundation, improving fish access to the creek and introducing flows to the upper Potterwalkagee Creek. The works enable watering of 820 hectares and included the construction of seven environmental regulators and associated works, including sill lowering, stream rehabilitation and upgrading access tracks.
Murray and Murrumbidgee Valley National Parks SDL Adjustment Supply Measure	New South Wales	The proposal is for a suite of works across the national park estate in the Murray and Murrumbidgee valley. It aims to deliver more targeted environmental watering than achieved under benchmark conditions of development and benefit public land areas exceeding 70,000 hectares .Benefits identified include improved native fish outcomes and a reduction in the frequency and level of flooding on private land holdings and blackwater events.
Nimmie Caira Infrastructure Modifications Proposal	New South Wales	Reconfigure water delivery infrastructure to more effectively deliver environmental flows to the Nimmie-Caira floodplain and other parts of the Lowbidgee. This project, along with the Murray and Murrumbidgee Valley National Parks SDL adjustment supply measure, has the potential to supply significant additional environmental benefit to the area.
Nyah Floodplain Management Project	Victoria	The proposed works will water almost 500 hectares of floodplain within Nyah Forest, replicating River Murray flows of up to 25,000 megalitres per day. The works will influence over 53 percent of the total forest area and almost all of the flood dependent communities. The works consist of four regulators, three on the downstream end of Parnee Malloo Creek and one on the upstream end. Additional works to contain water within the forest include 1.7 kilometres of low level track raising, forming a levee at the downstream end of the forest.
Riverine Recovery Project	South Australia	This project aims to return a number of wetlands to a more natural wetting/drying regime which results in evaporative savings. These savings are assigned to the Commonwealth Government as a South Australian Class 9 water access entitlement. This entitlement can be used for environmental purposes either within or upstream of the South Australian/Victorian border.
South Australian Riverland Floodplain Integrated Infrastructure Program (SARFIIP)	South Australia	The project aims to create an integrated and resilient floodplain along the South Australian River Murray, between the border and Lock 1, through a package of works and measures that enable floodplain inundation and freshening of groundwater lenses with particular focus on the Pike and Katarapko floodplains. Environmental works on the Pike and Katarapko floodplains will optimise the frequency, duration and extent of inundation events to protect and restore these floodplain ecosystems and contribute to Basin Plan environmental outcomes. Salinity management measures will complement the floodplain inundation works to manage ecological risk, enhance ecological condition by maximising the area of soil salinity that is within the tolerances of target vegetation and to manage any long term and real time in-stream salinity risk.
South East Flows Restoration Project	South Australia	The project will use a combination of newly constructed drains and widened existing drains within the Upper South East drainage system to divert additional water that currently flows to the sea from the Blackford Drain in the Upper South East into the Coorong South Lagoon. The diverted water will provide significant environmental outcomes for en route wetlands of the Upper South East through the provision of additional water of suitable quality, as well as salinity improvements in the Coorong South Lagoon.

Environmental works		
Project title	**Proponent state(s)**	**Project description**
TLM environmental works and measures – Koondrook–Perricoota Forest Flood Enhancement proposal	New South Wales / Victoria / South Australia	Koondrook–Perricoota Forest is a highly significant floodplain ecosystem on the Murray River in New South Wales. The Koondrook–Perricoota Forest is a large mosaic of river red gum, black box and grey box communities, interspersed by wetland ecosystems in New South Wales. Covering 32,000 hectares the state forest (Crown land) is managed by Forests NSW and is listed on the Register of the National Estate. The structures have been built and partially commissioned by NSW Water and MDBA River Murray Operations.
Vinifera Floodplain Management Project	Victoria	The Vinifera Floodplain project will water up to 350 hectares of floodplain within Vinifera Forest. This represents 55 percent of the total forest area (638 hectares) and almost all of the flood dependent communities. The proposed works involve construction of four regulators and 1.1 kilometres of low level track raising to enable control of both flood and pumped flows into and out of Vinifera Creek. Water will be delivered to the site through a combination of natural inflows or temporary pumping when river flows are insufficient.
Wallpolla Island Floodplain Management Project	Victoria	Wallpolla Island is part of TLM's Lindsay–Wallpolla Islands Icon Site. The proposed works will complement existing TLM works at this icon site. This project will increase the frequency and duration of floodplain inundation across 2,650 hectares, providing significant benefit to nationally important species, threatened vegetation communities, ecological values, carbon cycling and downstream water quality. This will benefit both Wallpolla Island and the broader Lower Murray region. The proposed works include four major regulators, 22 smaller containment regulators and 4.5 kilometres of levees (raised tracks). The works have been designed to complement weir pool manipulation activities (Locks 8 and 9) and connect areas of flowing aquatic habitat with sections of black box, lignum and higher alluvial terraces. This will enable watering at a landscape scale, mimicking flows of 30,000 megalitres per day to 120,000 megalitres per day.

Efficiency Measures		
Project title	**Proponent**	**Project description**

On Farm Irrigation Efficiency and Other Water Use Efficiencies	Commonwealth	The set of works listed below to be undertaken on farm and/or off farm with the participation of consumptive water users decreases or will decrease the quantity of water required for one or more consumptive uses in a set of surface water SDL resource units, compared with the quantity required under the benchmark conditions of development, with the water savings transferred to the Commonwealth and forming part of the Commonwealth environmental water holdings:
		• Installing, upgrading and/or reconfiguring water delivery and irrigation infrastructure or technology.
		• Upgrading, closure, restructuring, reconfiguring and/or installing water delivery systems.
		• Improving irrigation water delivery management systems and associated telemetry and controls.
		• Upgrading and/or installing of delivery system operation technologies.
		• Changing the management of dams, weirs, locks and other river infrastructure.
		• Modifying, reconfiguring and/or replacing water delivery channels and/or fencing.
		• Constructing channels and/or upgrading to regulatory channel structures.
		• Decommissioning water delivery channels.
		• Installing, upgrading and/or reconfiguring surface and/or sub-surface piping.
		• Installing, upgrading, improving and/or reconfiguring:
		  ○ pump systems
		  ○ pump stations and associated power and control arrangements
		  ○ fertigation systems
		  ○ pumping equipment
		  ○ pump houses.
		• Improving connection to a water re-use system; reconfiguring filtration; reducing seepage, leakage or other system, transmission or storage losses.
		• Removing redundant structures and/or streamlining irrigation delivery infrastructure and/or technology.
		• Rationalising individual irrigators and/or other water users within a water supply scheme.
		• Modifying and/or improving irrigated area layout or design.
		• Constructing or upgrading drainage and reuse/recirculation systems and practices.
		• Improving water use efficiency through laser or GPS levelling.
		• Renewing surface irrigation through paddock land-forming works.
		• Installing, upgrading, improving and/or reconfiguring surface and/or sub-surface irrigation systems:
		  ○ pressurised irrigation systems
		  ○ overhead irrigation systems
		  ○ drip, trickle, sprinkler or micro-sprinkler systems
		  ○ multi line irrigation systems
		  ○ micro and mini irrigation systems
		  ○ spray irrigation technologies.
		• Improving flood irrigation.
		• Installing, upgrading and/or reconfiguring irrigation automation, sensing, control and monitoring systems and scheduling tools.
		• Installing, upgrading and/or reconfiguring water metering systems.

Efficiency Measures		
Project title	**Proponent**	**Project description**
		• Installing river level and channel gauges. • Installing remote monitoring. • Installing, upgrading, improving and/or reconfiguring irrigation systems as a temperature mitigation strategy to minimise the need to overwater on high temperature days or reduce frost incidence or impact. • Installing weather proof netting and/or wind breaks. • Installing, upgrading and/or reconfiguring moisture monitoring equipment; moisture sensors and irrigation timers; moisture probes, relays and computer and communication equipment to monitor soil moisture levels. • Improving soil moisture holding capacity through mulching, manuring, cultivation and/or addressing soil acidity and alkalinity. • Upgrading, improving, and/or reconfiguring surface or sub-surface storages to reduce losses or installing or upgrading equipment to reduce losses. • Installing, upgrading, improving and/or reconfiguring surface or sub-surface storages. • Water harvesting. • Transferring to covered, intensive production systems. • Reconfiguring or diversifying crops or changing cropping times to reduce water requirement. • Changing to non-irrigation production systems. • Changing land or environmental management. • Modernising water supply control systems and its telemetry. • Changing water supply - replacing MDB water supply with groundwater, recycled water or water supply from a desalinisation plant. • Recovering and/or reusing wastewater. • Recycling water through hydroponics. • Recharging aquifers and/or underground storage of water. *Project is for all units in the Murray-Darling Basin Plan*

Efficiency Measures		
Project title	**Proponent**	**Project description**
Urban or Industrial and Mining areas water efficiency	Commonwealth	The set of works listed below to be undertaken in urban or industrial areas with the participation of consumptive water users decreases or will decrease the quantity of water required for one or more consumptive uses in a set of surface water SDL resource units, compared with the quantity required under the benchmark conditions of development, with the water savings transferred to the Commonwealth and forming part of the Commonwealth environmental water holdings: • Constructing, replacing, upgrading, improving, or refurbishing bulk water infrastructure. • Improving management of bulk water supplies. • Upgrading, improving and/or refurbishing bulk water transport and/or distribution infrastructure. • Replacing surface water with fit-for-purpose water delivered from alternative supplies. • Improving economic regulation, competition and/or governance arrangements that lead to an increase in efficiency, availability, effectiveness and/or sustainability of the urban water sector. • Constructing, replacing, upgrading, installing, improving, or refurbishing filtration and/or water treatment infrastructure. • Constructing, replacing, installing, upgrading, refurbishing and/or improving the operation of urban water delivery infrastructure. • Improving systems for monitoring and predicting leaks. • Constructing, replacing, installing, upgrading, refurbishing and/or improving the operation of stock and domestic delivery infrastructure. • Constructing, replacing, upgrading, installing, improving or refurbishing water recycling and/or water reuse infrastructure. • Constructing, replacing, installing, upgrading, improving or refurbishing stormwater and waste-water capture and quality improvement infrastructure. • Constructing, replacing, installing, upgrading, improving or refurbishing stormwater and waste-water reuse infrastructure and/or devices. • Constructing, replacing, upgrading, installing, improving or refurbishing water sensitive urban design infrastructure and/or landscaping. • Improving management, use and/or integration of urban water sources. • Constructing, replacing, installing, upgrading, improving and/or refurbishing water efficient devices and/or technology. • Installing alternative household and/or community water supplies. • Metering and/or pressure management. • Reducing demand through demand management. • Undertaking water audits and/or offering rebates. • Consolidating and/or returning water entitlements where existing available water is no longer required for urban or other use. Programmes will be designed requiring adherence to all relevant approvals and regulations. *Project is for all units in the Murray-Darling Basin Plan.*

Attachment B – Analysis of impacts on Ramsar wetlands

Basin Plan requirements

The Basin Plan requires the Authority to provide the Federal minister for water with advice on the implications of a proposal for any declared Ramsar wetland. In this context the proposal is the package of SDL projects as a whole.

Analysis outcomes

Modelling undertaken by the Authority indicates there will be changes to the hydrological regime as a result of operating the SDL Adjustment Mechanism. This includes changes to the volume, timing, duration and frequency of surface water flows which may affect flows to and within Ramsar wetlands in the southern basin. This has the potential to change their ecological character in both positive and negative ways.

An analysis of the outcomes from the SDL adjustment package has determined that the proposed adjustments meet the ecological equivalence test and the limits of change safeguards within the SDL Adjustment Mechanism. They are not likely to have significant adverse impacts on the eight potentially affected Ramsar wetlands. More detail is provided below.

It is important to note that this advice has been prepared to meet the requirements of Basin Plan 7.10(2) and does not replace the need for Basin state governments to undertake their own assessment of potential impacts during project design and implementation before they take an action.

Method used to assess potential impact

The Commonwealth and state governments prepared ecological character descriptions (ECDs) for Ramsar sites, identifying the critical components, processes and services unique to each wetland. The ECDs set out limits of acceptable change (LAC) that allow ecological change to be measured against wetland condition when first listed as a Ramsar site.

Hydrology is identified as a critical component and process in the ECDs of all eight potentially impacted Ramsar wetlands. Many of the ECDs identify LACs for the hydrological regime. For example, one of the LACs for Gunbower Forest requires:

> ‘No less than four events in any 10 year period of 13,700 ML/day for three months (Murray River at Torrumbarry); and a maximum interval of three years between the stated flow event.’

LACs are a tool by which ecological change can be measured, but exceeding a LAC does not necessarily indicate there has been a negative change in ecological character.

Under the Basin Plan changes to the hydrological regime are safeguarded by limits of change set out in Schedule 6, which aim to prevent adverse impacts at site-specific flow indicators (SFIs). The ECDs were prepared prior to, and independently of, the Basin Plan. Consequently, the ecological requirements of Ramsar listed wetlands were considered when developing the

SFIs and limits of change in the Basin Plan. However, while the ECDs and the SFIs share many commonalities in relation to geographic location and environmental water requirements, it is not fully possible to make a direct comparison or assessment between the two metrics.

In its analysis of potential impacts the Authority has applied a modified form of the Matters of National Environmental Significance Significant impact guidelines 1.1 (EPBC Act 1999). The guidelines were produced to:

> 'assist any person who proposes to take an action to decide whether or not they should submit a referral to the Australian Government Department of the Environment (the Department) for a decision by the Australian Government Environment Minister (the minister) on whether assessment and approval is required under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).'

The guidelines have four self-assessment questions. Three of these are relevant to assessing potential impacts of the SDL Adjustment Mechanism on the Ramsar wetlands:

1. Are there any Ramsar wetlands located in the area of the proposed action?
2. Considering the proposed action at its broadest scope, is there potential for impacts on Ramsar wetlands?
3. Are any impacts of the proposed action on Ramsar wetlands likely to be significant impacts?

The guidelines also include advice on determining significant impact. One of these is relevant to assessing potential impacts of the SDL Adjustment Mechanism on Ramsar wetlands:

> 'An action is likely to have a significant impact on the ecological character of a declared Ramsar wetland if there is a real chance or possibility that it will result in a substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland.'

Assessment results

Question 1: Are there any Ramsar wetlands located in the area of the proposed action?

There are eight Ramsar listed sites in affected units in the southern-connected system:

1. Barmah Forest
2. NSW Central Murray State Forests
3. Gunbower Forest
4. Hattah-Kulkyne Lakes
5. Fivebough and Tuckerbil Swamps
6. 'Riverland'
7. Banrock Station Wetland Complex
8. The Coorong and Lakes Alexandrina and Albert

While there are 16 Ramsar listed sites in the Murray–Darling Basin, the remaining eight are not likely to be affected by the SDL Adjustment Mechanism. This is because they are located outside the affected water planning units, are located in disconnected river systems, or are upstream of any proposed action.

Question 2: Considering the proposed action at its broadest scope, is there potential for impacts on Ramsar wetlands?

SDL adjustment projects may change the timing, duration and frequency of surface water flows. This change is usually beneficial, and is the primary way in which equivalent environmental outcomes can be achieved with less water.

This has the potential to impact both positively and negatively on the ecological character of Ramsar wetlands by changing their hydrological regime.

Question 3: Are any impacts of the proposed action on Ramsar wetlands likely to be significant?

SDL supply measure projects will either enhance or are not likely to have a significant impact on the hydrological regime and therefore the ecological character of Ramsar wetlands. This conclusion is based on Authority's modelling of SFIs located at each wetland or nearby Ramsar wetlands. The modelling included all SDL supply measure projects which was compared against the Basin Plan benchmark scenario, to check that any change (adverse, beneficial or neutral) was within the limits of change.

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Table 3 Limits of Acceptable Change (ECD) and Site-Specific Flow Indicators (Basin Plan) Requirements

Ramsar wetland in southern basin	Limits of Acceptable Change for Hydrology (ECDs)	Indicator sites most closely representing Ramsar wetlands (Basin Plan)	Overbank SFIs (Basin Plan)
Barmah Forest	Minimum of 10,400 ML/day (Murray River at Yarrawonga) no less than 7 years in any 10 year period, with a mean duration no less than 100 days; and a maximum interval of 4 years between the flow threshold. Minimum of 16,000 ML/day (Murray River at Yarrawonga) no less than 7 years in any 10 year period, with a mean duration no less than 90 days; and a maximum interval of 4 years between the flow threshold. Minimum of 35,000 ML/day (Murray River at Yarrawonga) no less than 10 years in any 20 year period, with a mean duration no less than 60 days; and a maximum interval of 10 years between the flow threshold. Minimum of 60,000 ML/day (Murray River at Yarrawonga) no less than 12 years in any 50 year period, with a mean duration no less than 21 days; and a maximum interval of 12 years between the flow threshold.	Barmah–Millewa Forest	12,500 ML/day for 70 days 16,000 ML/day for 98 days 25,000 ML/day for 42 days 35,000 ML/day for 30 days 50,000 ML/day for 21 days 60,000 ML/day for 14 days 15,000 ML/day for 150 days
NSW Central Murray State Forests	Number of events in any 10 year period (based on average recurrence intervals) for the specified flow events, not to be less than the following: Millewa Forest Group (Murray River flow downstream of Yarrawonga); • 12,500 ML/day for 70 days – 5 events • 16,000 ML/day for 98 days – 3 events Koondrook-Perricoota Forest Group (Murray River flow at Torrumbarry Weir); • 16,000 ML/ day for 90 days – 3 events Werai Forest Group (Edward River flow at Deniliquin); • 5,000 ML/day for 60 days – 4 events In any 20 year period the interval between the following flow events to be no more than: • 13 years for the Millewa Forest Group (Murray River downstream of Yarrawonga) – 25,000 ML/day for 60 days; • 12 years for the Koondrook-Perricoota Forest Group (Murray River downstream of Torrumbarry) – 30,000 ML/day for 60 days; and • 15 years for the Werai Forest Group (Edwards River downstream of Deniliquin) – 18,000 ML/day for 30 days.	Barmah–Millewa Forest	12,500 ML/d 70 days 16,000 ML/day for 98 days
		Gunbower–Koondrook–Perricoota	16,000 ML/day for 90 days 30,000 ML/day for 60 days
Gunbower Forest	No less than four events in any 10 year period of 13,700 ML/day for three months (Murray River at Torrumbarry); and a maximum interval of three years between the stated flow event. No less than five events in any 20 year period of 30,000 ML/day for two months (Murray River at Torrumbarry) and a maximum	Gunbower–Koondrook–Perricoota	20,000 ML/day for 60 days 40,000 ML/day for 60 days

	interval of five years between the stated flow event. No less than 10 events in any 50 year period of 40,000 ML/day for one month (Murray River at Torrumbarry) and a maximum interval of 10 years between the stated flow event.		
Hattah-Kulkyne Lakes	No less than three filling events for Lakes Lockie, Hattah, Yerang and Mournpall in any 10 year period (40,000 ML/day). No less than two filling events for Lakes Cantala and Bulla in any 10 year period (50,000 ML/day). No less than one filling event for Lakes Arawak, Brockie, Bitterang, Konardin and Yelwell in any 10 year period (70,000 ML/day). No less than one filling event at Lake Kramen in any 20 year period (152,000 ML/day).	Hattah Lakes	40,000 ML/day for 60 days 50,000 ML/day for 60 days 70,000 ML/day for 42 days 150,000 ML/day for 7 days
Fivebough and Tuckerbil Swamps	Limits of Acceptable Change for Hydrology have not been developed for this site	Mid-Murrumbidgee	26,850 ML/day for 45 days 26,850 ML/day for 5 days 34,650 ML/day for 5 days 44,000 ML/day for 3 days 63,250 ML/day for 3 days
Riverland	The Limits of Acceptable Change for the Riverland site are expressed as detailed hydrologic regime requirements for each vegetation community. Summarised flow rates and duration are: 50,000 ML/d for 120 days 60,000 ML/d for 120 days 70,000 ML/d for 120 days 80,000 ML/d for 120 days	Chowilla Floodplains	60,000 ML/day for 60 days 80,000 ML/day for 30 days
Banrock Station Wetland Complex	From time of listing in 2002: Maintenance of Banrock Lagoon as permanently inundated, allowing for seasonal fluctuations of inflows from the River Murray. Depth 8.5-8.8 m AHD. Frequency of inundation - alternating years of stable and fluctuating levels. No complete drying of wetland bed. Maintain Eastern Lagoon as drier site with inundation for 3-6 months during managed spring flood to 9.3 m AHD in Banrock and Eastern Lagoons. In wet years (rainfall greater than 300 mm) peak flows of 30,000 ML/day, in dry years (rainfall 250-300 mm) peak flows of 40,000-	Chowilla Floodplains	40,000 ML/day for 30 days 40,000 ML/day for 90 days 60,000 ML/day for 60 days 80,000 ML/day for 30 days

	80,000 ML/day. Frequency of inundation 1 in 4 years. Duration 4-7 months. Magnitude as above. Maximum interval without inundation 5 years. From 2007 (changed water management practice): Banrock Lagoon not > 9 months without flow-through phase (8.5m AHD). Banrock and Eastern Lagoon not > 24 months without inundation to 9.2 AHD.		
The Coorong and Lakes Alexandrina and Albert	The Limits of Acceptable Change are extensive and complex.	Coorong, Lower Lakes, Murray Mouth limits of change	% of time salinity in Lake Alexandrina < 1500 EC % of time salinity in Lake Alexandrina < 1000 EC % of years with 3yr rolling average barrage flow > 2,000 GL/y, with a minimum of 650 GL/y % of years with 2yr rolling Barrage flow > 600 GL % of time when salinity in south Coorong < 100 g/L % of years with average annual depth at Murray Mouth > 1 m % of years with average annual depth at Murray Mouth > 0.7 m

Attachment C – Modelling metrics

The modelling undertaken to inform the Basin Plan, and the determination of the SDL uses historic climate records over the 114-year period from 1 July 1895 to 30 June 2009. This period includes times of drought and very high flow, therefore representing a broad range of climatic conditions that have occurred across the Basin, and providing a good basis for testing the robustness of the proposed SDLs and possible environmental outcomes.

Four key modelling scenarios were used in this analysis. Each model run is outlined below:

Without development

- The without development scenario is a near-natural condition model run. It is based on the baseline scenario, giving the best available estimate of what flows would have been like with no human use or management of flows.

Baseline

- The baseline scenario represents a starting point against which the effect of implementing the Basin Plan can be assessed. This scenario is the best available estimate of water resource use in the Basin as at June 2009, and reflects the water policy framework and operating rules that were in place at that time.

Benchmark

- The benchmark scenario represents a fully implemented Basin Plan. This is recovery of 2750GL of water for the environment, but retains the water policy framework and operating rules as set in 2009. The Benchmark is the point of comparison for the SDL Adjustment Mechanism.

SDL 605

- The SDL 605 scenario represents a SDL supply contribution of 605 GL, with all of the proposed supply measures fully implemented in the model. It continues to apply the water policy frameworks and operating rules as set in 2009, unless these are specifically altered by a supply proposal.

Ecological Assessment Scores

The following section presents the Ecological Assessment Scores for the modelled scenarios. Table 1 presents the overall reach score.

Table 4. Reach wise ecological score

Assessment Reach	Without Development	Baseline	Benchmark	SDL 605
Upper-Murray – Barmah-Millewa Forest	6935	4003	5100	5017
Upper-central Murray – Gunbower-Koondrook-Perricoota	7030	3405	5567	6376
Mid-Murray – Hattah Lakes	5577	2738	3387	3955
Lower-Murray - Chowilla	6080	2791	3970	4271
Edward Wakool	6292	3224	4169	4120
Lower Darling	4271	2637	2791	2805
Mid- Murrumbidgee	6360	4163	4646	4495
Lower Murrumbidgee	7524	5094	6502	6331
Lower Goulburn Floodplain	8641	6814	8219	8038
Southern basin region score	**6523**	**3874**	**4928**	**5045**

Attachment C – Modelling metric

Table 5. Ecological element, ecological class scores and overall reach score for each reach

	Class	Ecological Element	Without development			Baseline			Benchmark			SDL 605		
			EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score
Upper Murray – Barmah-Millewa Forest	Bird	Waterbirds – health	6685	5301	6935	2463	1657	4003	4456	3485	5100	4017	3232	5017
		Bitterns, crakes and rails	5439			781			2868			2719		
		Colonial-nesting waterbirds	4395			1623			3140			2930		
		Waterbirds – breeding	4684			1763			3474			3263		
	Vegetation	River Red Gum forests	7806	7442		4304	4271		5371	4986		5254	5073	
		River Red Gum woodlands	7858			4859			4534			4671		
		Blackbox forests and woodlands	7873			4531			4335			4822		
		Shrublands	na			na			na			na		
		Tall grasslands, sedge and rushlands	6408			3543			4426			4625		
		Benthic herblands	7263			4120			6263			5991		
	Fish	Short-lived fish	8097	8063		6048	6081		6961	6831		6834	6745	
		Long-lived fish	8030			6114			6701			6655		

	Class	Ecological Element	Without development			Baseline			Benchmark			SDL 605		
			EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score
Mid-upper Murray – Gunbower-Koondrook Perricoota	Bird	Waterbirds – health	7198	5009	7030	2183	1161	3405	4637	3161	5567	5981	3752	6376
		Bitterns, crakes and rails	4706			417			2947			3247		
		Colonial-nesting waterbirds	3816			754			2351			2172		
		Waterbirds – breeding	4316			1289			2711			3610		
	Vegetation	River Red Gum forests	8177	7911		3809	3555		6568	6396		7783	7590	
		River Red Gum woodlands	8111			3528			6422			7984		
		Blackbox forests and woodlands	8503			3381			7263			8073		
		Shrublands	na			na			na			na		
		Tall grasslands, sedge and rushlands	6853			3502			5332			6520		
		Benthic herblands	na			na			na			na		
	Fish	Short-lived fish	8197	8170		5532	5498		7233	7142		7958	7785	
		Long-lived fish	8143			5464			7051			7613		

	Class	Ecological Element	Without development			Baseline			Benchmark			SDL 605		
			EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score
Mid Murray – Hattah Lakes	Bird	Waterbirds – health	4267	3913	5577	1073	1217	2738	1797	1853	3387	2318	2349	3955
		Bitterns, crakes and rails	na			na			na			na		
		Colonial-nesting waterbirds	3342			1053			1500			1747		
		Waterbirds – breeding	4132			1526			2263			2981		
	Vegetation	River Red Gum forests	6434	5876		2095	2313		3500	3186		3435	3895	
		River Red Gum woodlands	6588			2026			3333			3666		
		Blackbox forests and woodlands	6547			1752			2733			3218		
		Shrublands	6274			3262			3671			3956		
		Tall grasslands, sedge and rushlands	4548			2321			2850			3234		
		Benthic herblands	4865			2423			3029			5858		
	Fish	Short-lived fish	7027	6942		4742	4683		5250	5122		5833	5622	
		Long-lived fish	6858			4623			4995			5410		

	Class	Ecological Element	Without development			Baseline			Benchmark			SDL 605		
			EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score
Lower Murray - Chowilla	Bird	Waterbirds – health	4491	4856	6080	1031	1281	2791	2183	2611	3970	2398	2792	4271
		Bitterns, crakes and rails	5794			794			2399			2666		
		Colonial-nesting waterbirds	4219			1456			2570			2608		
		Waterbirds – breeding	4921			1842			3289			3495		
	Vegetation	River Red Gum forests	6244	6256		1628	2324		3456	3725		4042	4118	
		River Red Gum woodlands	6682			1574			3881			4170		
		Blackbox forests and woodlands	6483			1613			2704			3308		
		Shrublands	6340			3161			4115			4529		
		Tall grasslands, sedge and rushlands	5332			2686			3705			3898		
		Benthic herblands	6454			3284			4488			4759		
	Fish	Short-lived fish	7363	7128		4987	4767		5916	5575		6356	5902	
		Long-lived fish	6894			4547			5234			5449		

	Class	Ecological Element	Without development			Baseline			Benchmark			SDL 605		
			EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score
Edward Wakool	Bird	Waterbirds – health	4719	5447	6292	1874	1690	3224	2306	3401	4169	2039	3255	4120
		Bitterns, crakes and rails	7886			1044			5746			5219		
		Colonial-nesting waterbirds	3921			1553			2026			2158		
		Waterbirds – breeding	5263			2289			3526			3605		
	Vegetation	River Red Gum forests	6173	6078		2081	2773		3248	3495		3154	3389	
		River Red Gum woodlands	6333			2029			3099			3016		
		Blackbox forests and woodlands	6917			3026			3155			2718		
		Shrublands	6505			3737			3897			4091		
		Tall grasslands, sedge and rushlands	5213			2966			3635			3523		
		Benthic herblands	5327			2799			3936			3833		
	Fish	Short-lived fish	7574	7351		5410	5209		5973	5611		6075	5717	
		Long-lived fish	7129			5008			5248			5359		

	Class	Ecological Element	Without development			Baseline			Benchmark			SDL 605		
			EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score
Lower Darling	Bird	Waterbirds – health	2361	3312	4271	961	1309	2637	1040	1467	2791	1095	1416	2805
		Bitterns, crakes and rails	na			na			na			na		
		Colonial-nesting waterbirds	na			na			na			na		
		Waterbirds – breeding	4263			1658			1895			1737		
	Vegetation	River Red Gum forests	3829	3696		1729	2009		2028	2188		2010	2255	
		River Red Gum woodlands	na			na			na			na		
		Blackbox forests and woodlands	2958			1569			1788			1793		
		Shrublands	4520			3110			3176			3333		
		Tall grasslands, sedge and rushlands	4314			1993			2185			2314		
		Benthic herblands	2861			1642			1764			1827		
	Fish	Short-lived fish	6079	5804		4668	4593		4820	4716		4812	4744	
		Long-lived fish	5529			4517			4613			4677		

	Class	Ecological Element	Without development			Baseline			Benchmark			SDL 605		
			EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score
Mid-Murrumbidgee	Bird	Waterbirds – health	4285	4361	6360	1744	1809	4163	1690	2723	4646	1812	2407	4495
		Bitterns, crakes and rails	5632			1780			4861			3658		
		Colonial-nesting waterbirds	3526			1684			2000			1895		
		Waterbirds – breeding	4000			2026			2342			2263		
	Vegetation	River Red Gum forests	7182	7307		4214	4747		4603	5008		4665	4993	
		River Red Gum woodlands	7878			4765			5122			5485		
		Blackbox forests and woodlands	8067			5991			5881			5672		
		Shrublands	na			na			na			na		
		Tall grasslands, sedge and rushlands	6101			4017			4427			4149		
		Benthic herblands	na			na			na			na		
	Fish	Short-lived fish	7701	7411		6152	5934		6596	6207		6440	6086	
		Long-lived fish	7122			5717			5819			5733		

	Class	Ecological Element	Without development			Baseline			Benchmark			SDL 6050		
			EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score
Lower Murrumbidgee	Bird	Waterbirds – health	7807	7034	7524	4319	3311	5094	6117	5340	6502	5980	4940	6331
		Bitterns, crakes and rails	6807			1420			3890			3309		
		Colonial-nesting waterbirds	6367			3130			4811			4493		
		Waterbirds – breeding	7153			4376			6541			5976		
	Vegetation	River Red Gum forests	8256	7529		6161	5363		7462	6772		7336	6614	
		River Red Gum woodlands	8107			5454			7210			6843		
		Blackbox forests and woodlands	8407			5836			7515			7235		
		Shrublands	7277			5297			6369			6279		
		Tall grasslands, sedge and rushlands	7678			5487			6929			6927		
		Benthic herblands	5451			3940			5146			5066		
	Fish	Short-lived fish	7887	8009		6799	6608		7505	7394		7563	7438	
		Long-lived fish	8131			6417			7284			7314		

	Class	Ecological Element	Without development			Baseline			Benchmark			SDL 605		
			EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score	EE score	EC score	Reach Score
Lower Goulburn Floodplain	Bird	Waterbirds – health	8898	8238	8641	6946	5749	6814	8419	7604	8219	8297	7267	8038
		Bitterns, crakes and rails	na			na			na			na		
		Colonial-nesting waterbirds	na			na			na			na		
		Waterbirds – breeding	7579			4553			6789			6237		
	Vegetation	River Red Gum forests	8989	8781		7657	6981		8765	8413		8728	8301	
		River Red Gum woodlands	9000			8014			8816			8928		
		Blackbox forests and woodlands	9000			7852			8914			8896		
		Shrublands	na			na			na			na		
		Tall grasslands, sedge and rushlands	8404			5812			7875			7666		
		Benthic herblands	8512			5572			7697			7285		
	Fish	Short-lived fish	8907	8903		7696	7711		8651	8639		8545	8546	
		Long-lived fish	8898			7727			8627			8547		

Overbank flow requirement

The following section presents the modelled output for the Site-Specific Flow Indicators (SFI) for each reach. These flows are all overbank flows that engage different levels of the floodplain. The SFIs were determined to reflect key ecological processes (Overton et al. 2014). The statistics show the percentage of years that the SFI's are met.

Table 6. Percentage of years with a successful event for overbank flow indicators in the southern connected Basin.

Overbank flow indicators – Upper Murray Barmah-Millewa Forest	Without Development	Baseline	Benchmark	Limit of Change	SDL 605
12,500 ML/d for a total duration of 70 days (with min duration of 7 consecutive days) between Jun & Nov	87%	50%	76%	70%	71%
16,000 ML/d for a total duration of 98 days (with min duration of 7 consecutive days) between Jun & Nov	66%	30%	53%	48%	49%
25,000 ML/d for a total duration of 42 days (with min duration of 7 consecutive days) between Jun & Nov	66%	30%	50%	45%	49%
35,000 ML/d for a total duration of 30 days (with min duration of 7 consecutive days) between Jun & May	53%	24%	36%	33%	35%
50,000 ML/d for a total duration of 21 days (with min duration of 7 consecutive days) between Jun & May	39%	18%	17%	17%	18%
60,000 ML/d for a total duration of 14 days (with min duration of 7 consecutive days) between Jun & May	33%	14%	14%	14%	14%
15,000 ML/d for a total duration of 150 days (with min duration of 7 consecutive days) between Jun & Dec	44%	11%	35%	32%	32%

Overbank flow indicators – Mid-Upper Murray Gunbower-Koondrook-Perricoota	Without Development	Baseline	Benchmark	Limit of Change	SDL 605
16,000 ML/d for a total duration of 90 days (with min duration of 7 consecutive days) between Jun & Nov	86%	31%	68%	61%	61%
20,000 ML/d for a total duration of 60 days (with min duration of 7 consecutive days) between Jun & Nov	87%	34%	64%	60%	61%
30,000 ML/d for a total duration of 60 days (with min duration of 7 consecutive days) between Jun & May	60%	25%	40%	36%	38%
40,000 ML/d for a total duration of 60 days (with min duration of 7 consecutive days) between Jun & May	39%	11%	24%	22%	23%
20,000 ML/d for a total duration of 150 days (with min duration of 7 consecutive days) between Jun & Dec	43%	7%	26%	23%	23%

Attachment C – Modelling metric

Overbank flow indicators – Mid Murray Hattah Lakes	Without Development	Baseline	Benchmark	Limit of Change	SDL 605
40,000 ML/d for a total duration of 60 days (with min duration of 7 consecutive days) between Jun & Dec	67%	30%	46%	41%	41%
50,000 ML/d for a total duration of 60 days (with min duration of 7 consecutive days) between Jun & Dec	47%	19%	30%	30%	32%
70,000 ML/d for a total duration of 42 days (with min duration of 7 consecutive days) between Jun & Dec	38%	11%	18%	16%	16%
85,000 ML/d for a total duration of 30 days (with min duration of 7 consecutive days) between Jun & May	33%	10%	11%	10%	11%
120,000 ML/d for a total duration of 14 days (with min duration of 7 consecutive days) between Jun & May	23%	8%	8%	8%	8%
150,000 ML/d for a total duration of 7 days (with min duration of 7 consecutive days) between Jun & May	17%	5%	6%	5%	6%

Overbank flow indicators – Lower Murray Chowilla	Without Development	Baseline	Benchmark	Limit of Change	SDL 605
40,000 ML/d for a total duration of 30 days (with min duration of 7 consecutive days) between Jun & Dec	80%	37%	55%	50%	51%
40,000 ML/d for a total duration of 90 days (with min duration of 7 consecutive days) between Jun & Dec	58%	22%	38%	34%	34%
60,000 ML/d for a total duration of 60 days (with min duration of 7 consecutive days) between Jun & Dec	41%	12%	27%	25%	26%
80,000 ML/d for a total duration of 30 days (with min duration of 7 consecutive days) between Jun & May	34%	10%	15%	14%	14%
100,000 ML/d for a total duration of 21 days (with min duration of 1 day) between Jun & May	19%	6%	7%	6%	6%
125,000 ML/d for a total duration of 7 days (with min duration of 1 day) between Jun & May	17%	4%	5%	4%	5%

Overbank flow indicators – Edward-Wakool	Without Development	Baseline	Benchmark	Limit of Change	SDL 605
5,000 ML/d for a total duration of 60 days (with min duration of 7 consecutive days) between Jun & Dec	82%	39%	66%	60%	65%
5,000 ML/d for a total duration of 120 days (with min duration of 7 consecutive days) between Jun & Dec	52%	22%	36%	35%	35%
18,000 ML/d for a total duration of 28 days (with min duration of 5 consecutive days) between Jun & Dec	39%	15%	16%	15%	18%
30,000 ML/d for a total duration of 21 days (with min duration of 6 consecutive days) between Jun & Dec	28%	12%	13%	12%	12%

Overbank flow indicators – Lower Darling*	Without Development	Baseline	Benchmark	Limit of Change	SDL 605
17,000 ML/d for 18 consecutive days between Jun & May	47%	18%	21%	20%	19%
20,000 ML/d for 30 consecutive days between Jun & May	27%	10%	11%	10%	15%
25,000 ML/d for 45 consecutive days between Jun & May	14%	8%	8%	8%	9%
45,000 ML/d for 2 consecutive days between Jun & May	10%	7%	7%	7%	8%

Overbank flow indicators – Mid-Murrumbidgee	Without Development	Baseline	Benchmark	Limit of Change	SDL 605
26,850 ML/d for a total duration of 45 days (with min duration of 1 day) between Jul & Nov	28%	11%	11%	11%	11%
26,850 ML/d for 5 consecutive days between Jun & Nov	67%	46%	60%	54%	54%
34,650 ML/d for 5 consecutive days between Jun & Nov	57%	29%	41%	37%	38%
44,000 ML/d for 3 consecutive days between Jun & Nov	44%	22%	23%	22%	23%
63,250 ML/d for 3 consecutive days between Jun & Nov	21%	11%	10%	10%	10%

Overbank flow indicators – Lower Murrumbidgee	Without Development	Baseline	Benchmark	Limit of Change	SDL 605
Total volume of 175 GL (flow > 5,000 ML/d) between Jul & Sep	94%	68%	94%	85%	86%
Total volume of 270 GL (flow > 5,000 ML/d) between Jul & Sep	92%	57%	86%	77%	78%
Total volume of 400 GL (flow > 5,000 ML/d) between Jul & Oct	92%	52%	83%	75%	77%
Total volume of 800 GL (flow > 5,000 ML/d) between Jul & Oct	78%	39%	60%	54%	56%
Total volume of 1,700 GL (flow > 5,000 ML/d) between Jul & Nov	56%	18%	30%	27%	27%
Total volume of 2,700 GL (flow > 5,000 ML/d) between May & Feb	44%	9%	18%	16%	16%

Overbank flow indicators – Lower Goulburn floodplain	Without Development	Baseline	Benchmark	Limit of Change	SDL 605
25,000 ML/d for a median duration of 5 days between Jun & Nov	90%	57%	82%	74%	75%
40,000 ML/d for a median duration of 4 days between Jun & Nov	72%	38%	61%	55%	57%

*Site-specific flow indicators at this location were assessed by the Independent Expert Panel, see Section 4.

Fresh Requirement

The following section presents the modelled output for the fresh indicators. These are flows that are above normal regulated flow, but do not result in flow onto the floodplain. As with SFIs, these are presented as the percentage of years that the fresh is achieved.

Table 7. Percentage of years with a successful event for fresh flow indicators in the southern connected Basin

Fresh flow indicator – Riverland Chowilla floodplain	Without Development	Baseline	Benchmark	Limit of Change	SDL 605
20,000 ML/d for 60 consecutive days between Aug & Dec	89%	43%	69%	69%	77%

Fresh flow indicator – Edward-Wakool	Without Development	Baseline	Benchmark	Limit of Change	SDL 605
1,500 ML/d for a total duration of 180 days (with min duration of 1 day) between Jun & Mar	75%	96%	94%	94%	96%

Fresh flow indicator – Lower Darling	Without Development	Baseline	Benchmark	Limit of Change	SDL 605
7,000 ML/d for 10 consecutive days between Jun & May	95%	57%	54%	54%	61%

Fresh flow indicator – Lower Murrumbidgee	Without Development	Baseline	Benchmark	Limit of Change	SDL 605
1,100 ML/d for 25 consecutive days between Dec & May	96%	32%	47%	47%	54%
4,500 ML/d for 20 consecutive days between Oct & Dec	90%	35%	53%	53%	57%
3,100 ML/d for 30 consecutive days between Oct & Mar	91%	29%	42%	42%	52%

Fresh flow indicator – Lower Goulburn floodplain	Without Development	Baseline	Benchmark	Limit of Change	SDL 605
Two events annually of 2,500 ML/d for 4 consecutive days (with min duration of 30 days between events) between Dec & Apr	60%	10%	56%	56%	56%

5,000 ML/d for 14 consecutive days between Oct & Nov	82%	28%	59%	59%	59%

Coorong, Lower Lakes and Murray Mouth Indicators

The following section presents the modelled output for the Coorong, Lower Lakes and Murray Mouth (CLLMM). These limits of change are specified in the Basin Plan as Target frequencies that must be maintained or improved.

Table 8. Flow and Salinity limits of change indicator achievement for the Coorong, Lower Lakes and Murray Mouth

Coorong, Lower Lakes and Murray Mouth – Limits of Change indicators	Target	Without development	Baseline	Benchmark	SDL 605
% of time salinity in Lake Alexandrina < 1500 EC	100%	87%	96%	100%	100%
% of time salinity in Lake Alexandrina < 1000 EC	95%	85%	89%	99%	96%
% of years with 3yr rolling average barrage flow > 2,000 GL/y, with a minimum of 650 GL/y	95%	97%	77%	97%	96%
% of years with 2yr rolling Barrage flow > 600 GL	100%	100%	97%	100%	100%
% of time when salinity in south Coorong < 100 g/L	96%	100%	93%	100%	100%
% of years with average annual depth at Murray Mouth > 1 m	90%	100%	76%	93%	92%
% of years with average annual depth at Murray Mouth > 0.7 m	95%	100%	84%	96%	96%

Baseflow requirement

This section presents the modelled output for the baseflow metric. Baseflows are important for maintaining connectivity, refugia and water quality in the river channel. The baseflows are presented as a volumetric difference between the target volume (GL per year) and that achieved under the modelled scenario.

The Independent Expert Panel looked at the baseflow metrics and results (see section 4).

Table 9. Annual average baseflow requirement and baseflow shortfalls

Site description	Baseflow requirement (GL/yr)	Benchmark	SDL 605
Murrumbidgee @ Darlington Point	645	1	1
Murrumbidgee @ Balranald	597	21	23
Goulburn @ U/S Goulburn Weir	757	0	1
Goulburn @ McCoys Bridge	746	0	5
Campaspe @ U/S Campaspe Weir	19	0	0
Campaspe @ Rochester	36	0	0
Loddon @ U/S Serpentine Weir	12	0	0
Loddon @ Appin South	12	0	0
Murray @ D/S Yarrawonga Weir	1469	2	5
Murray River @ D/S Torrumbarry	2002	4	27
Murray River @ D/S Euston	2999	9	12
Flow to SA	3220	9	3
Darling @ Burtundy	151	1	1

Reliability of water supply

The following section presents the modelled outputs of metrics that were developed by each State, to assess the reliability of supply for users of each river valley. The state governments used these as part of their assessment of reliability for their entitlement holders.

Table 10.Reliability of water supply in the southern connected Basin

Goulburn reliability	Baseline	Benchmark	SDL 605
Percentage of years with full HRWS allocation in February	95%	97%	97%
Percentage of years with full LRWS allocation in February	43%	68%	60%
Percentage of years with LRWS allocation in February > 0	75%	91%	87%
Minimum February allocation	28%	39%	37%
Long term average HRWS allocation in February	98%	99%	99%
Long term average LRWS allocation in February	59%	81%	75%
1999-2009 average HRWS allocation in February	81%	88%	86%
1999-2009 average LRWS allocation in February	0%	7%	5%

Campaspe reliability	Baseline	Benchmark	SDL 605
Percentage of years with full HRWS allocation in February	95%	97%	97%
Percentage of years with full LRWS allocation in February	76%	86%	83%
Percentage of years with LRWS allocation in February > 0	89%	95%	95%
Minimum February allocation	42%	6%	3%
Long term average HRWS allocation in February	98%	98%	98%
Long term average LRWS allocation in February	81%	92%	90%
1999-2009 average HRWS allocation in February	84%	80%	78%
1999-2009 average LRWS allocation in February	19%	37%	35%

Loddon reliability	Baseline	Benchmark	SDL 605
Percentage of years with full HRWS allocation in February	92%	97%	94%
Percentage of years with full LRWS allocation in February	43%	68%	60%
Percentage of years with LRWS allocation in February > 0	75%	91%	86%
Minimum February allocation	0%	0%	0%
Long term average HRWS allocation in February	96%	97%	96%
Long term average LRWS allocation in February	59%	81%	75%
1999-2009 average HRWS allocation in February	66%	73%	67%
1999-2009 average LRWS allocation in February	0%	7%	5%

Murrumbidgee reliability	Baseline	Benchmark	SDL 605
Long term average of %-age allocation at the start of year (GS)	33%	37%	38%
Long term average of %-age allocation in September (GS)	45%	48%	50%
Long term average of %-age allocation at the end of year (GS)	73%	77%	79%
Minimum %-age allocation at the end of year (GS)	2%	2%	8%
1999-2009 average of %-age allocation at the end of year (GS)	39%	45%	43%

NSW Murray reliability	Baseline	Benchmark	SDL 605
Long term average of %-age allocation at the start of year (HS)	97%	94%	97%
Long term average of %-age allocation in February (HS)	99%	99%	99%
Long term average of %-age allocation at the end of year (HS)	99%	99%	99%
Minimum %-age allocation at the end of year (HS)	97%	97%	97%
1999-2009 average of %-age allocation at the end of year (HS)	98%	98%	98%
Long term average of %-age allocation at the start of year (GS)	45%	52%	51%
Long term average of %-age allocation in September (GS)	63%	68%	66%
Long term average of %-age allocation at the end of year (GS)	86%	89%	89%
Minimum %-age allocation at the end of year (GS)	2%	5%	7%
1999-2009 average of %-age allocation at the end of year (GS)	60%	58%	59%

VIC Murray reliability	Baseline	Benchmark	SDL 605
Percentage of years with full HRWS allocation in February	97%	98%	99%
Percentage of years with full LRWS allocation in February	79%	94%	94%
Percentage of years with LRWS allocation in February > 0	86%	98%	98%
Minimum February allocation	23%	47%	73%
Long term average HRWS February allocation	99%	99%	100%
Long term average LRWS February allocation	83%	96%	97%
1999-2009 average HRWS February allocation	85%	94%	98%
1999-2009 average LRWS February allocation	42%	74%	80%

Attachment C – Modelling metric

SA Murray reliability	Baseline	Benchmark	SDL 605
Percentage years with full entitlement in June	69%	86%	82%
Percentage years with full entitlement in May	76%	92%	86%
Long term average % entitlement in June	91%	97%	95%
Long term average % entitlement in May	98%	99%	99%
Maximum number of sequential years not at full entitlement in June	10	6	5
Maximum number of sequential years not at full entitlement in May	9	6	6
Minimum % entitlement in May	48%	52%	49%
Minimum three year rolling average of % entitlement in May	77%	67%	67%
1999-2009 average % entitlement in June	71%	79%	74%
1999-2009 average % entitlement in May	89%	91%	90%

Lower Darling reliability	Baseline	Benchmark	SDL 605
Long term average of Lower Darling General Security EOY Allocation	94%	98%	99%
Long term average of Lower Darling LWU EOY Allocation	100%	100%	100%

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