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MURRAY–DARLING BASIN AUTHORITY

The 2020 Basin Plan Evaluation

Plan implementation evidence report

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Acknowledgement of the Traditional Owners of the Murray–Darling Basin
The Murray−Darling Basin Authority pays respect to the Traditional Owners and their Nations of the Murray−Darling Basin. We acknowledge their deep cultural, social, environmental, spiritual and economic connection to their lands and waters.

The guidance and support received from the Murray Lower Darling Rivers Indigenous Nations, the Northern Basin Aboriginal Nations and our many Traditional Owner friends and colleagues is very much valued and appreciated.

Aboriginal people should be aware that this publication may contain images, names or quotations of deceased persons.

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Department of Primary Industries, New South Wales
NSW Department of Industry, New South Wales

Ultimately, responsibility for information provided and views set out in this report is entirely the MDBA's and does not necessarily reflect the position of the Australian Government or contributors.

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Introduction

Following the 2017 evaluation, the Authority updated its evaluation methodology to provide an enhanced approach for the 2020 evaluation. This work is captured in the Framework for evaluating the Murray–Darling Basin Plan (MDBA 2019a).

The Basin Plan 2020 Evaluation

The Basin Plan 2020 evaluation aims to determine the effectiveness of the Basin Plan in achieving its objectives and outcomes. The approach to the evaluation is to review available evidence relating to thirteen different themes that are listed in the Basin Plan program logic (Figure 1).

The Basin Plan program logic is the central element of the current evaluation framework. This logic connects each element of the plan with the desired outcomes and has structured and guided the work by the MDBA to gather and analyse evidence and prepare the Basin Plan 2020 Evaluation.

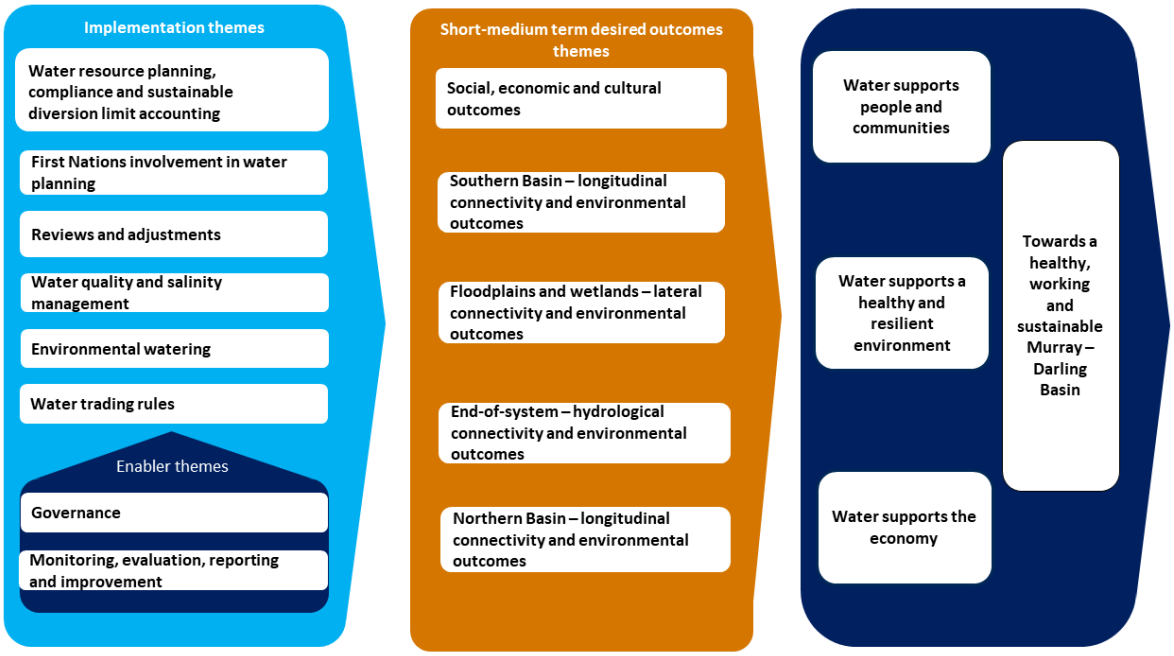

Figure 1 Basin Plan program logic

Figure 1 also captures the scope of the Basin Plan 2020 Evaluation, which is built on the assessment of thirteen themes under the three main categories of: 'Implementation', 'Outcome' and 'Enabler'. The enabler themes are activities related to the Plan that support and enable its implementation. Implementation themes capture the key elements of the plan that are intended to be agents of change. The outcomes themes assess progress toward the expected social, economic, cultural and environmental outcomes of the Basin Plan.

Evaluation approach

Guided by the evaluation framework, the key steps from evidence to theme findings included:

1. Development of a theme level program logic for each theme.
2. Posing questions to assess the available evidence against the logic.
3. Establishing performance descriptors for each theme which capture the key objectives and outcomes against which the specific progress and impact of the Basin Plan can be judged.
4. Confidence rating evidence resources to identify the relative fitness of evidence to robustly inform the evaluation.
5. Compiling the available evidence into packs with analysis in response to the questions. This was undertaken via a mix of in-house resources and the contracting of specialist expertise.
6. Making clear judgements against performance descriptors, based on the available evidence and its analysis.
7. Engaging four expert panels to review the compiled evidence, theme findings and performance descriptor judgements.
8. Refining the theme analysis into a series of supporting technical reports/appendices that underpin an overarching evaluation report.

Once the findings had been completed the information was drawn together to inform the overarching evaluation report and address the key evaluation questions listed in the Basin Plan (Box 1). The evaluation outcomes are intended to inform ongoing improvement of the Basin Plan and support the communication of the effectiveness and impacts of the Basin Plan.

Box 1: Basin Plan Key Evaluation Questions (Chapter 13)

a. To what extent has the intended purpose of the Basin Plan set out in section 20 of the Act been achieved?
b. To what extent have the objectives targets and outcomes set out in the Basin Plan been achieved?
c. How has the Basin Plan contributed to the changes to the environmental, social and economic condition in the Murray–Darling Basin?
d. What, if any unanticipated outcomes have resulted from the implementation of the Basin Plan?
e. How could the effectiveness of the Basin Plan be improved?
f. To what extent were the actions required by the Basin Plan suited to meeting the objectives of the Basin Plan?
g. To what extent has the program for monitoring and evaluating the effectiveness of the Basin Plan contributed to adaptive management and improving the availability of the scientific knowledge of the Murray–Darling Basin?

For implementation and enabler themes, the evaluation has implemented a consistent approach to reporting performance and applying confidence ratings. Illustrated below in Table 1, these are applied to each theme in this document.

Table 1 Performance descriptors for implementation and enabler themes.
Evaluation ratings are labelled 1-6, with 1 being the lowest performance rating and 6 being the highest performance rating

Evaluation rating	Effectiveness of implementation
6	The implementation has been highly successful exceeding the requirements based on the implementation timeframe. No areas of improvement have been identified.
5	The implementation is good. The expected outcomes based on the implementation timeframe have been mostly met or exceeded. There are some minor deficiencies and shortcomings. Small improvements will further optimise the implementation and operation.
4	The implementation is satisfactory. There is a mix between expected outcomes that have been met and not met, but on balance more have been met than not. There are identified shortcomings which need to be addressed. Improvements or change is required in some areas.
3	The implementation is just satisfactory. There is a mix between expected outcomes that have been met and not met, but on balance more have been not met than met. There are identified shortcomings which need to be addressed. Improvements or change is required in some areas.
2	The implementation is not suitable in its current format. A large portion of the expected outcomes have not been met. There are major deficiencies and shortcomings in the implementation. Extensive improvement or change is required.
1	The implementation requirements have not been met. The implementation has not occurred or has failed to deliver the requirements. Fundamental improvement or change is required.

Water resource planning, compliance, and sustainable diversion limit accounting

Overview

This theme comprises three closely inter-related elements: water resource planning; compliance; and sustainable diversion limit accounting.

Water resource planning

Historically, the Basin state governments have been solely responsible for managing water in the Murray–Darling Basin, including through catchment based water planning arrangements. When the Basin Plan was made in 2012, it included requirements for Basin state governments to develop water resource plans consistent with the Basin Plan.

The water resource plan accreditation process includes a number of stages, for Basin state governments, the MDBA and the Australian Government Minister responsible for water. The MDBA is responsible for assessing water resource plans that are developed by Basin state governments and making recommendations on plan accreditation to the Australian Government Minister responsible for water. In undertaking its assessment of these plans, the MDBA is required to follow the process set out in the *Water Act 2007* (the Water Act). In addition, the MDBA undertakes considerable due diligence on its assessments and processes prior to making a recommendation to the Minister.

Compliance

Community concerns about water compliance particularly in the northern Basin culminated in a broadcast by the Four Corners program about water management in the Barwon–Darling titled *Pumped*, on 24 July 2017. The program triggered seven investigations, Basin-wide and within New South Wales and Queensland. The issues identified in these investigations include:

- allegations of water theft
- accuracy and coverage of metered take
- insufficient protection of environmental flows
- lack of transparency in compliance and enforcement arrangements
- lack of community confidence in water management
- certain individual cases of alleged non-compliance have remained unresolved for a long period of time.

The findings and recommendations of these investigations was responded to by Basin governments through the Murray–Darling Basin Compliance Compact. The Compact aims to restore public confidence in water resource management in the Basin by improving the transparency and accountability of water management and regulation and providing a more consistent approach to compliance and enforcement practices. The Compact sets priorities for action and commits Basin governments to work plans they must report on publicly. Implementation is ongoing.

Basin state governments are responsible for regulating water users against their own regulatory frameworks, and now must ensure water users comply with the Basin Plan through accredited state water resource plans. The MDBA regulates the Basin state government water agencies who have the front-line responsibility for water planning, river operations and water compliance. An Inspector-General for the Murray–Darling Basin provides greater confidence that Basin Plan compliance responsibilities are being met.

Sustainable diversion limit accounting

The sustainable diversion limit is focused on limiting consumptive water. Water usage patterns in the Basin are diverse. Usage year-to-year varies depending on climatic conditions, rainfall, trade, infrastructure development and individual business decisions.

Determining compliance with sustainable diversion limits relies on sound water accounting methods, and methods for monitoring and reporting on the actual amount of water use take. If water use is over the limit, the MDBA will work with Basin states to ensure that any potential breaches of sustainable diversion limits are investigated, and that appropriate action is taken if water use grows over time and does not remain within the limit.

Key theme findings

- All water resource plans were originally due 30 June 2019. Thirteen water resource plans have been accredited and are currently operational, including all Queensland, Victorian, Australian Capital Territory and South Australian water resource plans.
- New South Wales is behind initial water resource plans development timeframes. New South Wales submitted its nine proposed surface water plans and 11 proposed groundwater plans to the MDBA for assessment by 30 June 2020.
- Bilateral agreements were set up with Basin state governments in order to ensure key elements of plans such as sustainable diversion limits were in place from 1 July 2019 despite not having all water resource plans accredited.
- Water resource plans, and the arrangements put in place by the bilateral agreements, establish, for the first time, a framework for the integrated and adaptive management of the Basin's water resources as a whole.
- It is too early to evaluate the effectiveness of these plans in achieving water management objectives on the ground. However, the process of developing the plans and the Compliance Compact has led to improvements in water management.
- A number of challenges remain to be tackled, including improved arrangements for measurement and management of floodplain harvesting in the northern Basin.
- Lack of public confidence in water compliance prompted governments to take collective action to improve water compliance frameworks in each Basin State through commitment to a Compliance Compact.
- Basin governments are continuing to make progress against their Compliance Compact commitments.
- There is further work needed to achieve MDBA's and the Compliance Compact goal, of restoring public confidence in water management and ensure consistency in the water

management arrangements. A joint review of the Compact is underway to address remaining areas of concern including metering and measurement, and transparency and accountability.

- Sustainable diversion limit accounting arrangements are in place to enable sustainable diversion limit accounting and compliance reporting from 1 July 2019.
- Improving the transparency of the sustainable diversion limit framework has been identified as a core activity for the MDBA from 2020 to 2025.

Evaluation assessment

Table 2 Performance descriptors for water resource planning, compliance and sustainable diversion limit accouting implementation themes.

Evaluation ratings are labelled 1-6, with 1 being the lowest performance rating and 6 being the highest performance rating. Confidence ratings assess the confidence in the assessment given the available evidence.

Indicator	Evaluation rating	Confidence
The extent to which water resource plans have been developed, assessed and accredited on time	3. The implementation is just satisfactory	High
All Queensland, Victorian, Australian Capital Territory and South Australian water resource plans have been assessed as meeting Basin Plan requirements and accredited and are operational. New South Wales water resource plans which cover a significant amount of Basin water resources are not accredited. A number of challenges remain to be tackled, including improved arrangements for measurement and management of floodplain harvesting in the northern Basin.		
Intended outcomes at this point of implementation through water resource plan development, assessment and accreditation have been achieved	5. The implementation is good	Medium
Water resource plans, and the arrangements put in place by the bilateral agreements, establish, for the first time, a framework for the integrated and adaptive management of the Basin's water resources as a whole. The process of developing water resource plans has led to improvements in water management.		
The extent to which requirements in relation to sustainable diversion limit accounting have been put in place on time and as MDBA expected	5. The implementation is good	Medium
Sustainable diversion limit accounting arrangements are in place to enable limit accounting and compliance reporting of limits from 1 July 2019. Improvements in the transparency of the sustainable diversion limit accounting framework are required.		
The extent to which the Compliance Compact has been effective	5. The implementation is good	Medium
Basin governments are continuing to make considerable progress against their Compliance Compact commitments. There is further work needed to achieve MDBA's and the Compliance Compact goal, of restoring public confidence in water management and ensure consistency in the water management arrangements.		

Program logic

The program logic for this theme within the Basin Plan 2020 Evaluation is:

'The implementation of activities related to water planning, compliance, and sustainable diversion limit water accounting is expected to contribute to water that is fit for production, social uses and values, and cultural uses' (Figure 2).

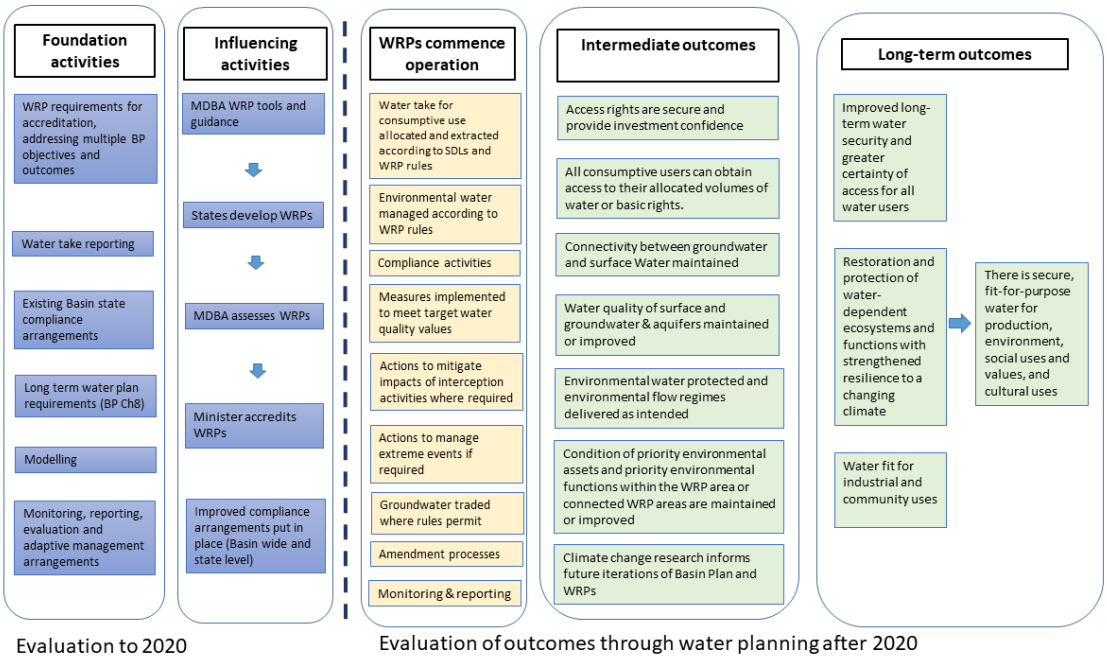

Figure 2 Water resource planning, compliance and sustainable diversion limit water accounting theme program logic

Evaluation questions

1. To what extent have mechanisms related to water resource plans been implemented on time?
2. To what extent has this implementation helped move towards achieving Basin Plan objectives?
3. What are the outcomes intended through the development of water resource plans?
4. To what extent have the intended outcomes been achieved at this point in implementation?
5. To what extent have groundwater management mechanisms helped move towards achieving Basin Plan objectives?
6. What are the requirements and intent in relation to groundwater management under Chapter 10 of the Basin Plan? To what extent have the requirements been met? What has been achieved through the water planning process to date?
7. What else needs to be done in regard to groundwater management in order to achieve Basin Plan objectives and outcomes? What are the risks if this isn't done? What opportunities are there, and are actions underway or planned?
8. To what extent have the MDBA's goals in relation to compliance been achieved on time and as MDBA expected?
9. What are the future opportunities for improving compliance with the Basin Plan?

10. To what extent have requirements in relation to sustainable diversion limit accounting been put in place on time and as MDBA expected?
11. What else needs to be done in regard to sustainable diversion limit accounting in order to achieve Basin Plan objectives and outcomes? What are the risks if this isn't done? What opportunities are there, and are actions underway or planned?

Summary of findings

Water resource planning

- There are 33 water resource plan areas in total, 19 for surface water, 19 for groundwater, including five that cover both. Thirteen water resource plans have been accredited and are currently operational, including all Queensland, Victorian, Australian Capital Territory and South Australian water resource plans.
- Submission of New South Wales water resource plans lagged behind schedule. The New South Wales Government submitted its nine proposed surface water resource plans and 11 proposed groundwater water resource plans to the MDBA for assessment by 30 June 2020.
- A range of factors contributed to delays in water resource plan development, including the Water Act requirement to assess each of the 55 water resource plan requirements in the Basin Plan, delays to stakeholder engagement activities due to drought and the lack of water availability, and a need to develop guidance to Basin state governments about addressing the 55 water resource plan requirements.
- Due to the delays in water resource plan accreditation, bilateral agreements were set up with Basin state governments in order to ensure key elements of water resource plans such as sustainable diversion limits were in place from 1 July 2019 despite not having water resource plans accredited.
- It is too early to evaluate the effectiveness of these plans in achieving water management objectives on the ground. However, the process of developing water resource plans and the Compliance Compact has led to improvements in water management. These include:
    - a comprehensive assessment of risks to water resources
    - improved water reporting and accounting arrangements and estimates of water take
    - maintained or improved protection of environmental water
    - the identification of objectives and outcomes for Aboriginal peoples with respect to water management
    - an ongoing program of audits to assess compliance with water management arrangements
    - the inclusion of water quality management plans within water resource plans.
- A number of challenges remain to be tackled, including improved arrangements for measurement and management of floodplain harvesting in the northern Basin.
- The water resource plans will continue to evolve and can be amended over time as new information becomes available or as legislation changes.
- Implementation of the Basin Plan has led to key improvements in the management of groundwater including:
    - the first comprehensive assessment of risks to groundwater resources across the Basin and their management

- increased transparency of the Basin state governments' decision-making pathway to manage groundwater
- identification of additional steps required outside water resource plan accreditation requirements to manage groundwater risks that occur on a local scale
- improvements in groundwater knowledge and highlighted knowledge and data gaps. These knowledge and data gaps increase long-term risks to the sustainable management of groundwater resources.

Compliance

Compliance is important to ensure consistency, transparency and accountability in water management which underpin public confidence. Compliance risks prompted governments to take collective action to improve water compliance frameworks through commitment to a Compliance Compact.

- Basin governments are continuing to make progress against their Compliance Compact commitments.
- There is further work needed to achieve MDBA's and the Compliance Compact goal, of restoring public confidence in water management and ensuring consistency in the water management arrangements. Remaining areas of concern are metering and measurement, and transparency and accountability. Metering reforms are at a critical phase – implementation of new metering policies is still to occur, and it is not clear whether the open and transparent culture of compliance at the heart of Compact commitments can be sustained.
- The MDBA and Basin states governments are working on improvements to detect unauthorised take including remote sensing technology and development of a range of water information platforms. In particular, there are opportunities for improved measurement through introducing telemetry in Basin jurisdictions.
- Joint audits and operations, such as the joint MDBA-Natural Resource Access Regulator (NRAR) review of the 2018 northern Basin environmental watering event, can help deliver more effective water compliance operations.
- The establishment of the Inspector-General of Water Compliance provides an opportunity for increased accountability and transparency across the Basin.
- The Water Compliance Community of Practice established in 2018 provides opportunities to increase collaboration and encourage the uptake of new technologies through the sharing of information and expertise.

Sustainable Diversion Limit accounting

- Sustainable diversion limit accounting arrangements are in place to enable accounting and compliance reporting of the limits from 1 July 2019.
- Improving the transparency of the sustainable diversion limit framework has been identified as a core activity for the MDBA from 2020 to 2025.

Water resource planning findings

To what extent have mechanisms related to water resource plans been implemented on time?

In 2012 when the Basin Plan came into effect it was required that all 33 water resource plans would be accredited by 1 July 2019. On 1 July 2019, one water resource plan had been accredited. As at 30 June 2020, thirteen water resource plans had been accredited and are currently operational, including all Queensland, Victorian, Australian Capital Territory and South Australian water resource plans. New South Wales submitted its nine proposed surface water resource plans and 11 proposed groundwater water resource plans to the MDBA for assessment by 30 June 2020.

Due to the delays in water resource plans accreditation, bilateral agreements with Basin state governments have ensured key elements of water resource plans were in place from 1 July 2019 despite not having all water resource plans accredited.

These key elements include annual limits on take and arrangements to monitor compliance with those limits, and arrangements to ensure the improved protection and management of environmental water in the northern Basin.

The delays in the submission of New South Wales water resource plans have seen the need for an extension of bilateral agreements with the New South Wales Government to ensure these key elements remain in effect until water resource plans are accredited.

A range of factors contributed to the slower than expected progress. For example, Chapter 10 of the Basin Plan sets out 55 requirements that a water resource plan has to fulfil for it to achieve accreditation. Many requirements are multi-faceted and interlinked. In determining if a water resource plan is consistent with the Basin Plan, the MDBA is required, by the Water Act, to formally assess if each provision, and its supporting evidence, fulfils the corresponding requirements in Chapter 10. The MDBA had to develop and provide guidance to Basin state governments about addressing the requirements through guidelines, policy statements and discussions. This process took longer than expected.

The Queensland Government and the MDBA have both reviewed the processes to develop, assess and accredit water resource plans.

The review commissioned by the Queensland Government in 2016 (unpublished) identified the following issue with the assessment process:

> *The assessment has been merits-based, rather than focused on procedural compliance. As such it has involved consideration of the basis, the detailed content, and the adequacy of the plan, rather than simply whether or not a plan includes provisions that at face value address each of the requirements of Chapter 10 and are consistent with the Basin Plan.*

The MDBA made changes to the process following the Queensland Government report and its own reviews. These changes aimed to streamline the assessment process and improve internal processes.

However, the Water Act requirement to confirm each and every requirement is met, rather than an 'on-balance' assessment placed limitations on how far MDBA could streamline the process. Ongoing drought and the lack of water availability has also made the conversation about future management arrangements a difficult one for many Basin communities. The political positions of governments, at times, contributed to the slower than expected progress.

In early 2019 a regulation was made that allowed the Australian Government Minister responsible for water to consider extensions for submission of water resource plans up to 31 December 2019.

A summary of when proposed water resource plan were submitted to the MDBA in 2019 is below.

- Proposed water resource plans were submitted by Victoria, South Australia and Queensland by 28 February 2019.
- Extensions for the submission (or resubmission) of water resource plans were provided for Victoria, Queensland, South Australia and the Australian Capital Territory until 30 April 2019.
- In some cases, further extensions (to 31 December 2019) were provided to allow time for states to make any additional changes to their proposed water resource plan to ensure consistency with the Basin Plan. However, New South Wales and the Australian Capital Territory were unable to submit all of their plans in 2019.

All South Australian and Queensland water resource plans were accredited by end of 2019 and all Victorian and Australian Capital Territory plans were accredited by 30 June 2020.

As extensions were granted, Basin state governments entered into bilateral agreements with the Australian Government to ensure key elements of water resource plans, including sustainable diversion limits were given effect from 1 July 2019 for plans not accredited by that date. These bilateral agreements have been published on the MDBA website. In the case of New South Wales, a new bilateral agreement was established on 1 June 2020 to cover the 2020-21 water year given New South Wales water resource plans were not accredited by 30 June 2020.

As New South Wales did not submit water resource plans to the MDBA for assessment by 31 December 2019 (as required under Division 2.1A of the *Water Regulations 2008*), the Minister entered into good faith negotiations with the New South Wales Minister responsible for water as set out in s 73 of the Act. Under these arrangements, it was agreed all New South Wales water resource plans were to be submitted to the MDBA for assessment by 30 June 2020. New South Wales submitted 11 groundwater water resource plans to the MDBA for assessment in early April 2020. The remaining nine New South Wales water resource plans were submitted to the MDBA for assessment on 30 June 2020.

Further information on the status of water resource plans can be found on the MDBA website.

To what extent has this implementation helped move towards achieving Basin Plan objectives?

Water resource plans and the arrangements put in place by the bilateral agreements, establish, for the first time, a framework for the integrated and adaptive management of the Basin's water resources as a whole.

Partly because of the delays in submission and accreditation of plans, it is too early to evaluate the effectiveness of these plans in achieving water management objectives on the ground. However, the process of developing plans and the Compliance Compact has led to improvements in water management. These include:

- incorporating state arrangements into Commonwealth law
- the first comprehensive assessment of risks to surface water and groundwater resources across the Basin and their management
- improved estimates of the amount of water taken for consumptive use
- establishment of new reporting and accounting arrangements for surface water and groundwater in accordance with the Basin Plan sustainable diversion limit compliance requirements
- annual assessment of sustainable diversion limit compliance, which commenced on 1 July 2019
- an ongoing program of independent audits to assess compliance with water management arrangements
- an ongoing program to improve metering and measurement of water take
- establishment of a water accounting framework that includes take by floodplain harvesting, farm dams, commercial plantations, and other previously unaccounted forms of take
- requirements that maintain the protection of planned environmental water
- the identification of objectives and outcomes for First Nations peoples with respect to water management
- the inclusion of descriptions of how water resources will be managed in response to extreme events, such as drought
- the inclusion of water quality management plans within water resource plans
- requirements to demonstrate consideration of long-term environmental watering plans.

Water resource plans are adaptive and can be continually improved as new information becomes available.

The making of an amendment to an accredited plan is a process which is governed by the Water Act. The whole plan as amended must be consistent with the Basin Plan and any amendments are subject to accreditation by the Australian Government Minister responsible for water. Section 66 of the Water Act also allows for minor or non-substantive amendments to be made to an accredited plan. More information about the process for amending a plan is available on the MDBA website.

In order to ensure plans are operating as intended, a number of challenges remain to be fully implemented. Work is underway to better ascertain historical and actual take of overland flows/floodplain harvesting in Queensland and New South Wales respectively. These two states have made significant advances in measurement and management of this form of water use. These arrangements have been reflected in Queensland plans, including a commitment to have measurement in place by 2022. However, further work is required to complete the commitment that all floodplain harvesting in the Border Rivers and Moonie will be fully measured by 31 December 2022. This will require particular forms of authorisations to be replaced with volumetric licences.

Interim estimates of floodplain harvesting take, and commitments to licensing and measurement are included in relevant New South Wales plans submitted for assessment on 30 June 2020. These estimates and commitments are being considered by the MDBA as part of the assessment of the proposed water resource plans. In the longer term, it is expected that further changes would be reflected in the plans following the licencing of floodplain harvesting in relevant northern New South Wales catchments. The New South Wales water resource plans submitted to the MDBA for assessment also include:

- rules to protect held environmental water from extraction in the Barwon–Darling and some unregulated sections of the Gwydir and Macquarie-Bogan rivers
- rules to prevent users extracting first flush flows after a continuous period of dry or low flow conditions
- limits on daily water take for all unregulated river A, B, and C class licences in the Barwon–Darling.

The plans will continue to evolve and be adapted over time as new information becomes available or as legislation changes. For example, while there are mechanisms embedded within the Basin Plan and water resource plans respond to the water resource implications of climate change, these instruments will need regular adaptation to continue to keep pace with the challenges of climate change. There are processes in place that allow for such improvements to be given effect, including the plan amendment provisions in the Water Act. Other functions that enable continuous improvement include the MDBA's role as an active, independent regulator, together with expert monitoring, science and evaluation in the Basin. Water resource plans will be regularly audited to ensure they are appropriately implemented, including as part of the MDBA's compliance and monitoring framework. In 2025, the MDBA will evaluate the implementation of plans to determine how effectively intended Basin Plan objectives and outcomes were met.

What are the outcomes intended through the development of water resource plans?

Water resource plans are the instrument through which Basin state governments implement some key aspects of the Basin Plan, in line with existing or improved state-based water management arrangements, for all systems within the Basin. They set out the rules and arrangements for matters such as annual limits on water take, water for the environment, managing water during extreme events, identifying First Nations peoples' objectives and outcomes of water, and strategies to achieve water quality standards. Importantly, water resource plans contain the arrangements for calculating how much water is taken and keeping that within sustainable limits. Improvements in the estimates of baseline diversion limits for different forms of take (e.g. floodplain harvesting) are expected to contribute to a better understanding of levels of take and improved accounting arrangements.

To what extent have the intended outcomes been achieved at this point in implementation?

Water resource plans, and interim bilateral arrangements with Basin state governments, establish, for the first time, a framework for the integrated and adaptive management of the Basin's water resources as a whole. Thirteen water resource plans have been accredited and include the required

rules and arrangements to progress the intended outcomes. In addition, the accredited plans include objectives and outcomes for First Nations peoples regarding the management of water in each area. The objectives and outcomes are developed in consultation with First Nations peoples.

However, it will take some time to see the impact of these plans in achieving water management objectives on the ground. Nonetheless, this is a major reform, and it is not without its challenges. As we work through these challenges and as new information becomes available, we expect to see the plans evolve and adapt.

Common challenges

Baseline diversion limits

Estimates of baseline diversion limits are improving through the accreditation of water resource plans. These new estimates do not mean that more water is available for use, it is just a way of bringing this use into the new system.

While increases in knowledge about baseline diversion limits are a significant improvement in our ability to properly account for and manage water, the changes in numbers are not well understood by the community. Improving the transparency of the sustainable diversion limit framework has been identified as a core activity within the MDBA's SDL accounting improvement strategy 2020-2025, which describes how identified risks will be addressed and prioritised over three tranches of work from 2020 to 2025 (MDBA 2020a).

Floodplain harvesting (Queensland and New South Wales)

Floodplain harvesting occurs when the water that flows across the floodplains during a flood or from rainfall is collected and used later. To date, it has been very difficult to accurately measure how much floodplain water has been used or 'harvested', meaning this water use is not accounted for in the rigorous way other water use is accounted for. Licensing floodplain harvesting and better measuring the amount of water used will bring this into the regulated system, improving compliance and accounting of water use in New South Wales and Queensland. While these states have made significant advances in measurement and management of this form of water use, more needs to be done.

Queensland

The Queensland Government placed a moratorium on additional floodplain harvesting development in 2000 and has prevented any growth in use since that time by using a combination of authorisations, metering and licences. Queensland has already metered and licenced floodplain harvesting in the Lower Balonne which is where the largest volumes of this type of water use occurs in the Queensland part of the Basin. Queensland have committed to fully regulating the remaining priority floodplain harvesting by 31 December 2022. The Queensland Government is working with floodplain harvesters in the Border Rivers and Moonie to extend measuring and licencing to meet this commitment.

Northern New South Wales

The New South Wales Government has been working to better understand how much water is harvested from floodplains now, and before the Basin Plan. The New South Wales Government has also been putting in place compliance measures. The *NSW Floodplain Harvesting Policy* seeks to establish a more accurate baseline of historic and current take by floodplain harvesting and bring the harvesting of water from floodplains into the water licensing framework to better manage water resources in the state. The policy is being rolled out in key areas of the New South Wales northern Murray–Darling Basin, including the New South Wales Border Rivers, Gwydir, Namoi, Macquarie, and Barwon–Darling valleys. The Department of Planning, Industry and Environment together with the MDBA commissioned an independent peer review of the implementation of the New South Wales Floodplain Harvesting Policy in northern New South Wales in 2019 (Weber and Claydon 2019). The key objective of the review was to provide transparency around the technical information and to provide stakeholders with confidence that the technical rigour and supporting processes are suitable to support policy implementation. The New South Wales Government and MDBA[1] have agreed to the review's recommendations, including:

- improving documentation and transparency of modelling to demonstrate that the models make use of the best available information and are fit for purpose;
- expanding consultation to inform stakeholders and the community about the information used in the models and how models are used to determine licence volumes;
- undertaking further assessment and communication on the anticipated downstream benefits of the licensing framework;
- developing an adaptive management framework that allows for improvements over time; and
- implementing an effective and efficient monitoring framework.

The New South Wales Government released a Floodplain Harvesting Action Plan in September 2019. The plan sets out the process for implementation of the Floodplain Harvesting Policy which will see floodplain harvesting brought into the water licensing framework from 1 July 2021. This process involves creating new work approvals, licences, rules and ways of measuring floodplain harvesting so that the harvesting take can be managed within the legal limits.

As this process continues until July 2021, interim arrangements have been included in the relevant New South Wales plans that were submitted to the MDBA in June 2020. The plans will be updated once the floodplain harvesting policy has been fully implemented.

Planned environmental water

Planned environmental water is defined in the Water Act. Planned environmental water is water that is committed or preserved by a law of the state to achieve environmental outcomes. Planned environmental water is often called 'rules-based environmental water' because it isn't held as an entitlement like consumptive water or environmental water held and used by the Commonwealth Environmental Water Holder (for example).

[1] The review recommended that the Department of Planning, Industry and Environment and the MDBA publish an updated summary document to succinctly describe how baseline diversion limits and sustainable diversion limits may change with updated information, including floodplain harvesting volumes determined in accordance with the Policy.

The Basin Plan requires that water resource plans do not reduce the protections for planned environmental water that were in place when it took effect in 2012. The planned environmental water protections that were in place when the Basin Plan took effect set the baseline of environmental protections that water recovery was calculated from. The requirement to maintain the level of protection ensures that these baseline rules are not changed in a way that could erode the significant investment in water recovery and put in doubt the future sustainability of our rivers and wetlands.

When a plan is submitted, this requires an assessment of the rules and arrangements in place for environmental protection in state law as of 2012. There is scope for rules associated with planned environmental water to be amended as long as, across the water resource plan area, there is no 'net reduction' and the protection afforded by arrangements in place pre-Basin Plan is at least maintained.

Because planned environmental water rules can occur in different parts of a water resource plan area, the information base can vary across the Basin, and environmental outcomes can be achieved using any number of different combinations of rules and protections, the no net reduction test (or "no backward step" assessment) has at times been challenging when assessing water resource plans submitted by the states as it requires assessment against multiple lines of evidence. Further information on how the no net reduction test is assessed is available in MDBA's position statement 6A on the MDBA website.

Connectivity

Historically, the Basin's water resources have not always been managed as a connected system. All water users benefit when rivers are linked across the whole system.

Water resource plans contemplate connections within and between resources. Water resource plans must address specific requirements on connectivity, including clearly identifying the connections for that particular catchment or groundwater aquifer, and clearly set out how these connections will be managed. If these connections cross state borders, the affected states need to work together to ensure all relevant plans have been developed in consideration of the level of water resource connectivity.

The level of water resource connectivity, whether within or across state boarders, will define the range of rules to manage connections that may be set out in the relevant plans.

Groundwater and surface water systems, like rivers and wetlands, can be highly connected and need coordinated management. In developing the plans, states need to consider connections between groundwater and surface water and ensure the health of both systems are maintained.

In the northern Basin, the New South Wales Government is conducting further work on connectivity as agreed under the toolkit measures and subsequent compliance reviews undertaken by the MDBA and Ken Matthews - *Independent investigation into NSW water management and compliance.* In response NSW is reviewing management strategies and has incorporated new policies into water resource plans. In the southern Basin, Murray River connections have been established for many years and will continue to be managed primarily through the Murray–Darling Basin Agreement.

To what extent have groundwater management mechanisms helped move towards achieving Basin Plan objectives?

The implementation of the Basin Plan has led to the first comprehensive assessment of risks to groundwater resources across the Basin and their management, and increased transparency of the Basin state governments' decision-making pathway to manage groundwater. This has led to further work that recognises that additional effort is required to manage, monitor and report on groundwater risks at the local scale.

Implementation has led to improvements in groundwater knowledge and highlighted knowledge and data gaps (e.g. improved knowledge about groundwater recharge; surface water—groundwater connectivity; impacts of increased groundwater use on river flows; climate change impacts; and groundwater water quality data). Where this occurred, water resource plan content focused on establishing a Basin state government's commitment to monitoring and implementing an adaptive management strategy that also addresses groundwater risks as they materialise in the future.

In the future, improvements to implementation of groundwater requirements in the Basin Plan will be made by addressing knowledge and data gaps through the MDBA knowledge framework and by working with Basin state governments to implement commitments made in water resource plans. In addition, amendments to some Basin Plan requirements would improve communication of their intent and hence implementation. This includes the definition of environmental water in a groundwater context. It also includes the need for long term watering plans to reflect environmental watering needs of groundwater dependent ecosystems, including having regard for groundwater-derived baseflows and groundwater recharge in areas that are highly connected to surface water resources.

What are the requirements and intent in relation to groundwater management under Chapter 10 of the Basin Plan? To what extent have the requirements been met? What has been achieved through the water planning process to date?

Chapter 10 of the Basin Plan contains a number of requirements specific to groundwater, as outlined below:

- management and use of connected water resources (s10.05)
- protection of planned environmental water (s10.09 and s10.28)
- accounting of water including groundwater specific managed aquifer recharge (s10.12(1)(h))
- consideration of water management of non-Basin water resources and the impact on Basin water resource (s10.14)
- Part 4 Division 3 outlines the need for consideration of rules relating to the:
    - protection of environmental water for priority groundwater dependent ecosystems (s10.18)
    - maintenance of significant hydrological connections, for example surface to groundwater connectivity (s10.19)
    - protection of physical and hydraulic characteristics of aquifers (s10.20)

    - three plan areas which require mandatory rules for priority environmental assets dependent on groundwater, groundwater and surface water connections, and productive base of groundwater per ss10.18-10.20 (s10.21)
- risks posed by interception activities, for example mining and coal seam gas operations (s10.23)
- setting targets, rules and measures to maintain the groundwater quality (s10.35)
- the three plan areas requiring mandatory rules for s10.35C (s10.35D)

See the question and answer for 'To what extent have water resource plans been developed, assessed and accredited on time?' for general information on plans, status and state specific issues.

The *SDL Reporting and Compliance Framework* applies to both surface water and groundwater – see sustainable diversion limit accounting section below.

In developing plans, a comprehensive risks assessment of the Basin's groundwater aquifers and water dependent ecosystems was established for each sustainable diversion limit resource unit and plan area. This included risks related to connected resources (i.e. surface water resources and other groundwater resources). These risk assessments provided the input to meeting the Chapter 10 requirements for groundwater. In many cases it also provided transparency on risk inputs as well as management of risks in a water resource plan area for the first time.

An example of a positive achievement for groundwater management resulting from the Basin Plan comes from the development of the Condamine-Balonne water resource plan. The water resource plan facilitates the recovery of groundwater from the Central Condamine Alluvium to meet the plan limit consistent with an industry-led proposal. This proposal involves the Commonwealth recovering water through a buyback tender, with the final plan then reducing licences to recover any residual volume. This has been a highly successful strategy with essentially all 35 gigalitres of groundwater recovery achieved.

As with all elements of the Basin Plan, groundwater management is undertaken within an adaptive management framework that includes collation of existing knowledge and development of new information on groundwater aquifers and ecosystems occurred during water resource plan development. For example, the New South Wales Government undertook a specific program to understand the location of groundwater dependent vegetation. This work will lead to further refinement of the environmental water requirements of priority ecosystem assets and functions. This also ensures that the operation of the plans will protect environmental water as required under s10.18 and s 10.19 of the Basin Plan.

Another example of improved groundwater knowledge in support of adaptive management is the MDBA commissioned independent review of return flows (water that enters groundwater then returns to the river channel). The review was undertaken by eminent hydrology experts (Wang et al 2018) and examined the risks posed by Basin Plan limits on groundwater take to river flow volume. The main findings of the review were:

- reduced return flows are not undermining the outcomes that can be achieved through the Basin Plan
- there is a need to continue to monitor and improve our understanding of return flows to reduce the uncertainty of the estimates.

This review is not the end of the process—the MDBA will continue to incorporate new science into the management of the Basin's water resources, through the Basin Plan.

The risks of not updating this information includes impacts to surface water baseline diversion limits and the appropriateness of existing state frameworks to ensure connectivity is maintained.

The water resource plan assessment process made apparent the data limitations that some states face in addressing some groundwater requirements under the Basin Plan. This is due to a paucity of baseline data and ongoing data collection related to groundwater parameters, including groundwater dependent ecosystems, environmental watering requirements and groundwater water quality. Where this occurred, water resource plan content focused on establishing a Basin state government's commitment to monitoring and implementing an adaptive management strategy that also addresses groundwater risks as they materialise in the future. This included MDBA developing a new approach with the New South Wales Government to provide greater clarity on how groundwater risks are managed. For example, the process pathway, table of triggers and actions set out in section 3 Schedule I of the proposed New South Wales groundwater plans are expected to increase transparency in proposed groundwater risk management and options to determine groundwater access restrictions if the proposed plans are accredited. The proposed adaptive management pathway includes water source specific trigger levels for groundwater drawdown, commitment to water quality monitoring for salinity in high priority areas and monitoring of drawdown near groundwater dependent ecosystems. It should be noted that at the time of writing the New South Wales groundwater plans were being assessed, and no decision has been made on whether they will be accredited.

What else needs to be done in regard to groundwater management in order to achieve Basin Plan objectives and outcomes? What are the risks if this isn't done? What opportunities are there, and are actions underway or planned?

The MDBA's *Statement of expectations for managing groundwater* outlines the Authority's objectives in relation to groundwater and how it proposes to address groundwater risks that may not be managed by plans (MDBA 2019b). Such risks include localised impacts on ecosystems or use that may occur from groundwater extraction despite groundwater take being within the plan limit. These risks may be managed through state frameworks. If new research or information becomes available to the MDBA on risks, the Authority has committed to support relevant Basin state governments in developing and implementing appropriate responses.

Groundwater dependent ecosystem locations and environmental watering requirements as well as aquifer water qualities are generally poorly understood due to limited monitoring. Establishing baseline information will greatly improve risk assessment inputs and considerations for appropriate management responses. This includes targeting priority areas for monitoring and improving knowledge, for example, including the impacts of groundwater extraction on environmental watering of groundwater dependent ecosystems.

In addition, some existing information MDBA used to develop the Basin Plan may not reflect current conditions and may require updating, for example, aquifer recharge volumes, the state of surface water to groundwater connectivity and characteristics, and implications of return flows.

The knowledge improvements required will be undertaken through commitments made by states in Plans, through Basin Plan Schedule 12 reporting by Basin state governments and through the MDBA's knowledge framework.

Improved information may be used to adjust sustainable diversion limits. Chapter 7, Part 4 of the Basin Plan enables adjustments to be made to the total Basin Plan limit for Basin groundwater resources, if better information becomes available. The Basin Plan includes limits on adjustments (s7.26).

The development of plans has resulted in:

- the first comprehensive assessment of risks to groundwater resources across the Basin and their management
- improved transparency of the Basin state governments' decision-making pathway to manage its groundwater
- improved groundwater knowledge to inform future monitoring, for example identification of groundwater dependent vegetation in New South Wales and limitations on new groundwater bore locations
- identification of additional steps required outside water resource plan accreditation requirements to manage groundwater risks that occur on a local scale, i.e. at a lower spatial scale than is required under Chapter 10 of the Basin Plan
- highlighted knowledge and data gaps for groundwater parameters, for example groundwater water quality data in New South Wales. This has resulted in prioritising monitoring and reporting efforts and enabling further focus for the MDBA knowledge framework.

Compliance findings

To what extent have the MDBA's goals in relation to compliance been achieved on time and as MDBA expected?

All governments have sought to improve their water compliance frameworks and water metering policies since 2017. Specifically, Basin jurisdictions and the Australian Government are continuing to make considerable progress against their Compliance Compact commitments, and in 2020 kept up the momentum that was acknowledged in the MDBA's Compliance Compact Interim Assurance Reports in 2018 and 2019 (MDBA 2019c).

There is still work through continuous improvement of the MDBA's compliance program to achieve MDBA's and the Compact goal, of restoring public confidence in water management and ensuring consistency in water management arrangements.

Basin States progress

The MDBA is satisfied that Basin state governments have made progress against their outstanding commitments under the Compliance Compact. NSW has significantly reformed their water compliance framework with an independent regulator with guaranteed funding. Queensland has just completed a reform of their natural resource compliance strategy including water – however improved compliance activity has yet to flow. There are some remaining key commitments which have not yet been met or are in still in progress. Two areas of concern are metering and measurement, and transparency and accountability.

Since the 2019 Compliance Compact Assurance Report was published, the MDBA has continued to monitor New South Wales and Queensland's progress in implementing floodplain harvesting reforms. The New South Wales Government's work to bring floodplain harvesting into its licensing framework is underway. Interim arrangements for floodplain harvesting have been developed for draft New South Wales plans and the New South Wales Government has completed consultation on the draft Floodplain Harvesting Monitoring and Auditing Strategy. In Queensland, overland flow take arrangements are outlined in their accredited plans and licensing has been completed in the Lower Balonne. The Queensland Overland Flow Measurement Policy is being further developed across other catchments, with measurement due to be standardised in 2022. The MDBA, and New South Wales and Queensland governments are collaborating on a joint discussion paper detailing floodplain harvesting measurement methods in both states.

Water meters provide the clearest measure of how much water is being used across the Basin. Robust metering arrangements are essential for ensuring compliance with licence conditions and sustainable diversion limits. The MDBA is working with Basin state governments to review and update the Metrological Assurance Framework Modernisation Program. Improvements have been proposed around risk management for metering compliance, and a process developed for accuracy checking of in-service meters.

The MDBA continues to monitor and conduct assurance of Basin state governments' progress in implementing their Compliance Compact metering commitments. The New South Wales Government has a risk-based policy requiring pattern approved meters and telemetry. All meters in New South Wales are expected to be pattern approved by 2023. South Australia requires new and replacement meters be pattern approved meters from 2019, however telemetry is not mandated. Victoria published its new metering policy in March 2020, and all meters are expected to be pattern approved with data telemetry by 2025. The Australian Capital Territory's 2015 Meter Guideline requires all new and replacement meters be pattern approved. The Queensland Government has completed its consultation on meters and has yet to finalise its non-urban water metering policy. The MDBA reported on Basin state government compliance arrangements via the 2019 Compact Assurance Report which was published in December 2019. The report found that most jurisdictions had good quality reporting of compliance actions taken, and that these systems were being continually improved.

MDBA progress

The MDBA has increased resourcing and expanded its work program on Basin Plan compliance and providing assurance of state-based water compliance frameworks. The MDBA has a risk-based assurance, review, and auditing program, to detect non-compliance.

The Independent Assurance Committee determined in December 2019 that the MDBA has completed most of its commitments in the area of improving transparency and accountability, and all of its commitments relating to compliance and enforcement frameworks. Outstanding commitments in relation to hydrometric data assurance for the River Murray and maintaining a register of measures to protect water for the environment were completed in mid-2020.

Next steps

The Compliance Compact is being jointly reviewed by its Parties in late 2020 with the review expected to be finalised in early 2021. The terms of reference for the review are to assess whether the Compliance Compact framework and commitments have been effective in achieving the intended outcomes of the Compliance Compact and identify further work necessary to achieve the intended outcomes of the Compliance Compact. Through the review the MDBA is seeking to ensure that the remaining Compact commitments on water metering and measurement are implemented and there is ongoing assurance around Basin state government progress.

The MDBA commenced its water resource plan compliance program from 1 July 2020. The MDBA will take a risk-based approach to ensuring compliance with plans using the full range of compliance tools including audits and assurance, public reporting and enforcement activity. The initial focus areas for water resource plan compliance in 2020-21 include:

- sustainable diversion limits and water accounting
- delivery, protection and monitoring of water for the environment
- licence conditions on water access rights.

What are the future opportunities for improving compliance with the Basin Plan?

Technology

Automating the detection of unauthorised water take is being pursued through the development of a range of water information platforms. The MDBA is developing methods to increase the use and application of satellite technology for a range of compliance purposes across the Basin. There are opportunities for improved measurement through introducing telemetry in Basin States. The MDBA, and New South Wales and Queensland governments have agreed to develop a joint discussion paper detailing floodplain harvesting measurement methods in both states. There is also work underway to improve the management of water meters and their compliance with State regulations through the Metrological Assurance Framework Modernisation Project. In addition to these initiatives, the Hydrometric Networks and Remote Sensing Program is investing $35 million in better public information to improve the transparency, consistency and accessibility of water information, and strengthen water compliance, in the northern Basin. The program will be delivered by project

partners MDBA, New South Wales and Queensland governments, the Bureau of Meteorology and Geoscience Australia by June 2023.

Joint investigations and collaborations

Joint audits and operations, such as the joint MDBA-Natural Resources Access Regulator review of the 2018 northern Basin environmental watering event, can help deliver more effective water compliance operations. More recently, the MDBA provided assistance through the analysis of publicly available satellite imagery during the first flush flows event in the northern Basin in February 2020.

Inspector-General of Water Compliance

The Australian Government has committed to establishing an independent Inspector-General of Water Compliance. This will bring together the compliance function of the MDBA with the assurance role of the Interim Inspector-General of Murray–Darling Basin Water Resources. The aim is to improve trust and transparency in implementing the Australian Government's Basin water reform agenda; deliver greater consistency and harmonisation of water regulation across the Basin; and strengthen Basin Plan compliance and enforcement.

Building capability and collaboration

The Water Compliance Community of Practice was established in 2018 and seeks to enhance the capability of water compliance practitioners across Australia. The MDBA is coordinating this approach which provides opportunities to increase collaboration and encourage the uptake of new technologies through the sharing of information and expertise. It is important that this Community of Practice continues to instil a culture of compliance and facilitate learning opportunities.

Sustainable diversion limit accounting findings

To what extent have requirements in relation to sustainable diversion limit accounting been put in place on time and as MDBA expected?

Compliance with the sustainable diversion limits is essential to delivering Basin Plan outcomes. The MDBA has been working with Basin state governments on transitioning from the Cap on diversions[2] (Cap) to sustainable diversion limit compliance so that the new arrangements will work as intended from 1 July 2019. The MDBA has also been working with states to establish groundwater accounting in the Basin, as groundwater limits will also be subject to the new sustainable diversion limit compliance. Since 2012, Basin state governments and the Commonwealth Environmental Water Holder have been required to report on water take data in each sustainable diversion limit resource unit (under s71 of the Water Act).

[2] In 1995, the Murray–Darling Basin Ministerial Council introduced the Murray–Darling Basin Cap on Surface Water Diversions (the Cap) to protect and enhance the riverine environment and protect the rights of water users. The Cap introduced long-term limits on how much water could be taken from rivers in 24 designated river valleys.

In preparation for sustainable diversion limit compliance commencing 1 July 2019, a trial water take account for each limit resource unit was published for each water year from 2012-13 to 2017-18. The primary purpose of this trial was to put in place the processes and procedures for accounting for water take ahead of formal sustainable diversion limit compliance reporting commencing. The account combines the trial limit accounting and final years of the Cap compliance reporting in a series of 'transition period water take' reports. The accounts set a benchmark against which the MDBA will monitor improvements in sustainable diversion limit water accounting.

Setting up the new reporting and accounting arrangements in accordance with the Basin Plan sustainable diversion limit compliance requirements has had its challenges; which resulted in delays in publishing the transition period water take reports for the initial years. The transition period water take reports for the four water years from 2012-13 to 2015-16 were published together in November 2017. However, with experience gained and, issues in the reporting process being resolved, the 2016-17 and 2017-18 water years' reports were published within each of the subsequent years. The 2018-19 water account is currently being prepared and is expected to be published before the end of 2020. The 2018-19 year will be the last year of the trial sustainable diversion limit accounts. It should be noted that during the period of 2012-13 to 2018-19 the trial limit accounting and reporting does not have formal compliance outcomes.

The MDBA also published the *SDL Reporting and Compliance Framework* in November 2018. This framework provides guidance in relation to how the MDBA will administer compliance with the sustainable diversion limits in accordance with the *Water Act 2007* and the Basin Plan.

Under the Basin Plan sustainable diversion limit compliance commences from the 2019-20 water year, following the commencement of plans. Basin state government reporting for the preceding 2019-20 water year is required by 31 October 2020. The MDBA will subsequently prepare and publish the Register of Take and sustainable diversion limit compliance outcomes.

There have been delays in relation to two key sustainable diversion limit accounting requirements which have been managed as follows. The first is accreditation of the plans to give effect to the limits. As not all plans were accredited by 30 June 2019, bilateral agreements were put in place with Basin state governments to enable the assessment of limit compliance to commence on 1 July 2019. Refer also to water resource planning evaluation questions above.

The second is that the update of long-term diversion limit equivalent factors is required to enable the estimates of how much water has been recovered to meet Basin Plan water recovery targets to be updated.

There are over 150 different classes of water entitlements in the Murray–Darling Basin. The long-term diversion limit equivalent factors are a way of comparing each of these entitlements, so they can be considered on equal terms. The long-term diversion limit equivalent factors are generally based on a set of planning assumptions, which considers such things as storage sizes, historical climate patterns, water resource plan rules, assumptions about irrigator crop selection and expected usage patterns. This work needs to be completed to determine whether water recovery is complete or incomplete relative to the Basin Plan targets for each sustainable diversion limit resource unit, and

whether a reasonable excuse[3] or adjustment to the accounts might be granted in relation to any incomplete recovery; which is a first step in the assessment of sustainable diversion limit compliance.

As at October 2020, Victoria, South Australia and Queensland had completed this work. The updated New South Wales factors will be finalised as part of water resource planning accreditation. Independent reviews of this work are available on the MDBA website.

With reporting requirements implemented, the trial accounts operational, the sustainable diversion limit compliance framework published and risk management strategies in place (such as annual compliance audits which inform the setting of compliance priorities (see *Sustainable Diversion Limit Reporting and Compliance Framework*), the MDBA is on track to deliver limit accounting and compliance reporting from 1 July 2019.

The first report assessing limit compliance is due to be published in March 2021. If water use is over the limits, the MDBA will investigate and request that Basin state governments investigate further in accordance with the *Sustainable Diversion Limit Reporting and Compliance Framework*.

What else needs to be done in regard to sustainable diversion limit accounting in order to achieve Basin Plan objectives and outcomes? What are the risks if this isn't done? What opportunities are there, and are actions underway or planned?

The MDBA engaged an independent panel to assess the conceptual robustness of the sustainable diversion limit accounting framework and its associated processes in order to ensure that best practice is applied to the limit water accounts. This review used international criteria from the Organisation for Economic Co-operation and Development and refined criteria more suited to water reform in the Murray–Darling Basin. The review found that, while the sustainable diversion limit accounting framework is conceptually sound, there are a range of issues that need to be addressed to improve existing water accounting methods to align with best practice (Turner et al. 2019). The review mainly suggested ways to make the sustainable diversion limit accounting process more credible and transparent for stakeholders. The sustainable diversion limit accounting 'health check' – independent panel review is available on the MDBA website.

The independent review identified 21 issues and separated them into two categories. Nine issues that directly related to the sustainable diversion limit accounting framework which will impact on the quantification of limits and 12 issues which relate more generally to the limit accounting framework including stakeholders' perceptions of compliance.

The top priority issue identified was sustainable diversion limit framework transparency in relation to communication of inputs, assumptions, uncertainties and risks. In response to the review, the MDBA has prepared a work program, entitled the *SDL accounting framework improvement strategy 2020 - 2025*, to progressively address issues/risks identified in the report over the coming years. This

[3] Reasonable excuse provisions, set out in chapter 6 of the Basin Plan, include the operation of the water resource plans, or circumstances outside of a Basin state's control (further information can be found in the MDBA SDL Reporting and Compliance Framework).

strategy is available on the MDBA website. If these issues are progressively addressed as set out in the Plan, it is hoped that confidence in the integrity of the accounts will improve over time.

The *Sustainable Diversion Limit Reporting and Compliance Framework* sets out MDBA's intentions for audit and assurance. Notably, the MDBA intends to use these mechanisms to give confidence that the sustainable diversion limit compliance assessments are being made on the basis of the best available data. The data and the processes used to collect and store it will be independently audited at regular intervals. In the first instance, an independent audit will be conducted of the MDBA's systems and processes for the 2019-20 water year once the first sustainable diversion limit compliance report has been published (i.e. after March 2021). Additionally, the MDBA will also prioritise up to two sustainable diversion limit resource units each year upon which to conduct a data audit.

First Nations involvement in water planning

Overview

The Murray–Darling Basin (Basin) encompasses more than 40 First Nations territories (both in part and whole). Traditional Owner knowledge and perspectives are invaluable in water planning and management and vital to achieving a healthy working Basin.

The Basin Plan includes several mechanisms for involving First Nations in the management of water:

- Chapter 10 of the Basin Plan requires the development of water resource plans by Basin state governments, which are required to identify Indigenous values and uses of water, in consultation with Traditional Owners (Part 14 of Chapter 10)
- Chapter 8 of the Basin Plan requires that Basin annual environmental watering priorities and the Basin-wide environmental watering strategy have regard to Indigenous values and uses
- Chapter 8 also requires environmental watering to be used in a way which maximises its benefits and effectiveness by having regard to Indigenous values.

The involvement of First Nations in water resource planning and delivery in the Basin began prior to the Water Act and Basin Plan. However, the implementation of the Basin Plan has formalised these partnerships and provided further opportunities for inclusive decision making. While much has been achieved, further work is required to ensure Traditional Owner knowledge and perspectives are considered consistently across all aspects of water planning, management and delivery and to ensure beneficial outcomes for First Nations across the Basin.

A critical component of First Nations involvement is through formalised representation. These formalised structures provide important pathways for First Nations to be involved in Basin water resource planning and decision-making. The *Water Amendment (Indigenous Authority Member) Bill 2019* was a significant achievement in that, for the first time, it will establish a position on the MDBA board for an Indigenous person. Other formal structures include the Indigenous Water sub-committee of the Basin Community Committee, which provides opportunities for First Nations to advise on and be involved in water resourcing planning and Basin Plan strategy and implementation.

The Murray Lower Darling Rivers Indigenous Nations (MLDRIN) and the Northern Basin Aboriginal Nations (NBAN) were formed in 1998 and 2010 respectively and each represent over 20 Nations in the Basin. One of their main functions is to be a primary conduit for the MDBA to engage with and seek input from First Nations on issues that cover multiple Nations and require coordination and general advice. The MDBA also engages with individual Nations on issues that relate to those Nations.

Key findings

- The Basin Plan provides opportunities to build the capacity of First Nations to play an active and engaged role in water planning.

- First Nations involved in the development of water resource plans have noted the increasing effort made to consult with First Nations in the development of plans and the improvements in consultation approaches over time.
- The active involvement of First Nations in the decision-making processes, planning and implementation of the Basin Plan is fundamental for its success. The partnerships developed with MLDRIN, NBAN and the Basin Community Committee have been critical to the successes achieved. Under the Basin Plan these partnerships have enabled the development of tailored tools, methods and approaches to capture and incorporate First Nations perspectives, objectives and values in water resource planning.
- While some good progress has been made, there remains the opportunity to revise and improve consultation mechanisms, building on the steps taken to date to increase First Nations involvement in water planning.

Evaluation assessment

Table 3 Performance descriptors for First Nations involvement in water planning.
Evaluation ratings are labelled 1-6, with 1 being the lowest performance rating and 6 being the highest performance rating.
Confidence ratings assess the confidence in the assessment given the available evidence.

Indicator	Evaluation rating	Confidence
The Basin Plan is providing opportunities for First Nations involvement in water planning	4. The implementation is satisfactory	Medium
The Basin Plan provides opportunities to build the capacity of First Nations to play an active and engaged role in water planning. While some good progress has been made, there remain opportunities to build on these steps to increase First Nations involvement in water planning.		

Program logic

The program logic for this theme within the Basin Plan 2020 Evaluation is:

'The implementation of activities related to First Nations involvement is expected to contribute to the achievement of Aboriginal objectives and outcomes specified in water resource plans' (Figure 3).

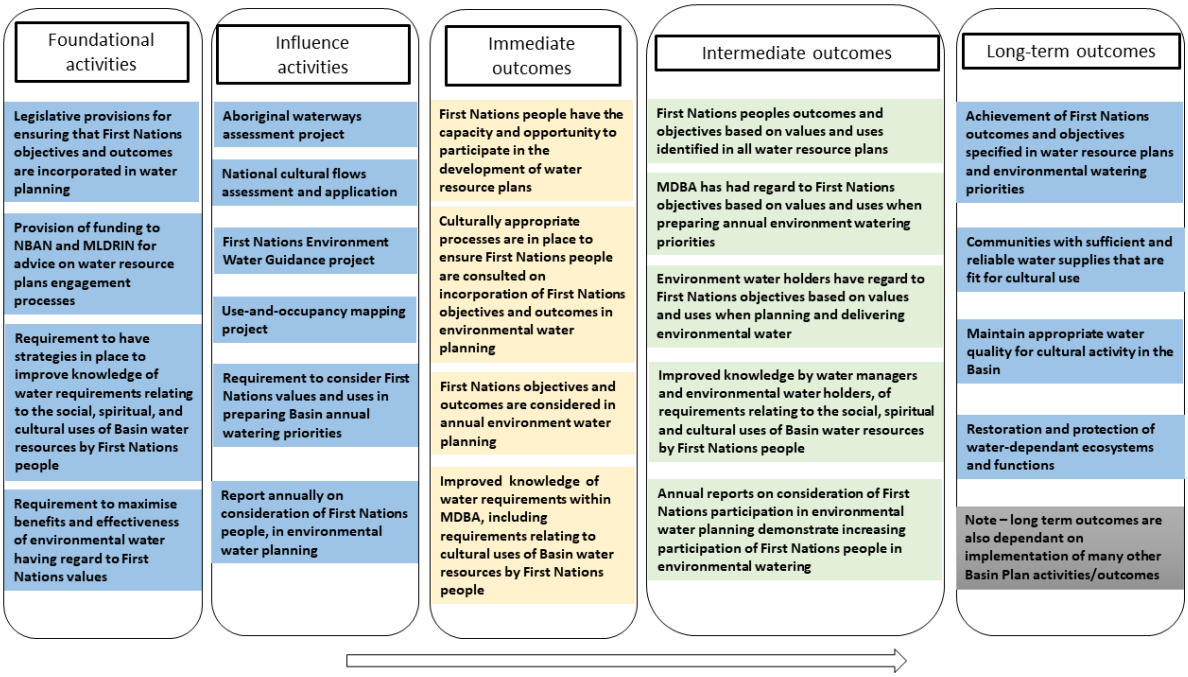

Figure 3 First Nations involvement in water resource planning theme program logic

Evaluation questions

1. Have First Nations objectives and outcomes been identified and specified in water resource plans?
2. What has been the experience of First Nations peoples involved in plan development? Was the process culturally appropriate?
3. What, if any, actions could be taken to improve the experience, and increase the influence, of First Nations peoples in water resource planning?
4. Are there any risks to the implementation of objectives and outcomes specified for First Nations peoples in plans?
5. How have First Nations peoples been involved in planning for environmental watering?

First Nations involvement in water planning findings

Have First Nations objectives and outcomes been identified and specified in water resource plans?

The Basin Plan implementation reports for the 2018–19 water year describe significant efforts towards the inclusion of First Nation objectives and outcomes in plans:

- New South Wales developed an approach in consultation with NBAN and MLDRIN, which is being applied across 32 First Nations and feedback from NBAN and MLDRN is being used in the accreditation process.
- The Victorian Department of Environment, Land, Water and Planning invited 14 First Nations to collaborate over the three-year development period and worked with each group to tailor the most appropriate approach for consultation. Eleven Traditional Owner submissions were

received and included in the comprehensive reports for the Wimmera–Mallee and North and Murray water resource plans.

- The South Australian Department for Environment and Water used significant community consultation and engagement throughout 2018–19 during the drafting of the 2019 River Murray Water Allocation Plan, the key statutory mechanism underpinning the South Australian River Murray water resource plan. Extensive consultation and policy discussion was undertaken with the River Murray Advisory Committee, which includes membership from peak industry bodies and the community.
- Queensland has three accredited water resource plans, all of which involved consultation with First Nations peoples and advice on the proposed plans from NBAN representatives. The key steps taken to enhance and guide consultation with First Nations peoples and the outcomes are described in the report *Water Connections: Aboriginal People's Water Needs in the Queensland Murray–Darling Basin,* which was published in April 2019.

The consultation reports published in 2018-19 for four First Nations in the New South Wales reflected a comprehensive and culturally appropriate approach to consultation that was based on the *Akwe:Kon Guidelines.* The reports cumulatively covered more than 28 plans (some overlap across Nations) and engagement with First Nations peoples representing a broader community of more than 20,300 people. The systematic approach resulted in extensive lists for each First Nation consulted in relation to their objectives, desired outcomes, values and uses as well as identifying areas of concerns and risks to implementation. The lists cover a wide range of common objectives and outcomes under the headings of:

- Healthy country and people
- Cultural continuity and revival
- Custodianship and jurisdiction
- Equity, redress and compensation
- Partnerships and communication.

The reports also identified specific local objectives and outcomes, such as restoration of the *Ngunnhu* (fish traps) near Brewarrina for the Gomeroi Nation.

It should be noted that the proposed New South Wales water resource plans submitted to the MDBA for assessment are yet to be accredited by the Australian Government Minister responsible for water. The assessment process includes NBAN and MLDRIN reviewing the state's process of engagement with First Nations and providing their assessment to the MDBA. The advice is currently being prepared by NBAN and MLRDIN, and will be included in the package of advice that goes to the Australian Government Minister responsible for water.

Objectives — Analysis of the NBAN and MLDRIN advice on the 13 accredited plans shows that, generally, the plans adequately reflect First Nations' objectives. For Queensland, the advice is that the plans reflect these well. For South Australia, input from individual Nation meetings, workshops and combined 'all Nation' workshops contributed to an amalgamated set of objectives and outcomes for all South Australian plans. There was concern that South Australian Nations had not had an adequate opportunity to review, discuss and endorse the amalgamated content. This was a result of the tight timeline that the South Australia Government was working to meet MDBA requirements.

Community follow-up and development of implementation strategies are required to reflect the individual agency and specific outcomes and objectives of each Nation. The advice from the Victorian plans was that the reflection of objectives was good and had been recorded well. It was noted that strategies to implement First Nations' objectives needed to be put in place to ensure implementation.

Outcomes — The advice received in relation to the reflection of First Nations' outcomes was less positive.

An amalgamated set of objectives and outcomes for all South Australian plans have been put together. There was concern, given the timeframe, South Australian Nations had not had an adequate opportunity to review and discuss the content. Further community discussions and development of tailored implementation strategies were put in place to reflect the outcomes and objectives of each Nation. It was also noted that the outcomes need more specific and measurable parameters in order to be properly evaluated. Further, while the language is there in relation to 'having regard to' values and uses, the emphasis was on descriptions of process rather than on the actual values and uses.

For Victoria, the process of identifying objectives and outcomes in the Northern, Goulburn-Murray and Victorian Murray plans had improved since the development of the first Victorian plans (the Wimmera-Mallee plans). The process for identifying outcomes for the Northern, Goulburn-Murray and Victorian Murray plans was assessed as 'good'. The Wimmera-Mallee plan did not always distinguish between the differing objectives and outcomes of Nations. While the Wimmera-Mallee plans attempted to address some reluctance by Traditional Owners to hand over detailed information on cultural values and uses, it was felt that opportunities to strengthen protection had not been identified.

In summary, the data shows extensive efforts were made to consult with First Nations peoples and the plans accredited to date are recording agreed objectives and outcomes. This has sometimes required revisions to plans based on initial NBAN or MLDRIN assessment advice. Approaches have evolved and improved over time, and improvements in processes following development of initial plans have been observed. There are opportunities across the states to improve the process of defining and agreeing objectives and outcomes. Implementation and monitoring and evaluation strategies need to be developed to ensure that objectives and outcomes are realised.

What has been the experience of First Nations peoples involved in water resource plan development? Was the process culturally appropriate?

To assist Basin state governments with their approach MDBA released a Basin Plan water resource plan requirements Position Statement 14A *Aboriginal Values and Uses*. This incorporated advice on best-practice First Nation engagement, including relevant parts of the Convention on Biological Diversity's *Akwe:Kon Guidelines*.

There is evidence that these tools, and other advice, were adopted into state approaches. For example:

- In Queensland *Water Connections: Aboriginal People's Water Needs in the Queensland Murray–Darling Basin,* was published in April 2019. The report covers engagement between water planners and First Nations peoples, in order to incorporate Indigenous values and uses into plans. First Nations feedback is that this is excellent.
- In South Australia the First Peoples Water Coordinator was employed through the River Murray and Mallee Aboriginal Corporation. This arrangement helped with early engagement with the First Nations peoples on water planning matters of relevance to them. The benefits and achievements from the First People's Water Coordinator perspective included: numerous workshops and getting out on Country; time for the community to consider information and requests and a clear engagement process to respond to notifications and requests for input into planning and management plans; greater collaboration between the community and the Department for Environment and Water — leading to a more "equal" relationship which saw a shift from a "them telling us how" approach to now "asking"; development of the First Peoples Program Logic framework to help with the evaluation of water resource plan outcomes. MLDRIN advice on the Eastern Mount Lofty Ranges and River Murray plans noted the investment to build strong relationships between government and First Nations and the willingness of staff to listen and respond to First Nations' views about consultation and plan development.
- Victoria supported engagement activities and broader capacity-building through: employment of Aboriginal water officers; development of water advisory groups within respective Aboriginal Corporations; Aboriginal Waterways Assessments undertaken by Traditional Owners with the support of MLDRIN; cultural, social, economic and environmental values identification and mapping projects; on Country meetings, gatherings, workshops and cultural events; revision of Country plans to add a water focus to support continued involvement in water resource management; training and other capacity-building activities. Policies have been developed to guide engagement including the A *Pathways to Participation: Indigenous Engagement Implementation Plan* guides Victorian Catchment Management Authorities. The Aboriginal Water Policy in Water for Victoria will also continue to be revised and strengthened.
- In New South Wales the overarching Nation-based approach to consultation for water resource plan development supported and assisted by local First Nation organisers reflected a culturally appropriate approach to consultation based on the *Akwe:Kon Guidelines* (Dhirranggal Solutions 2018a, 2018b, 2019, Strategic Small Business Solutions 2019). However, as noted above, the First Nation assessment of the New South Wales Government's engagement process have not been finalised by NBAN and MLDRIN at the time of writing this report.

The plan assessment advice shows that some of the plan consultations, particularly the early ones, took a couple of rounds before the process was considered adequate and culturally appropriate. The first plan accredited, Queensland Warrego-Paroo-Nebine, took three attempts. The NBAN observation was that due process was not always followed and feedback was not always provided. Both the Australian Capital Territory plan and Victoria's Wimmera-Mallee plan also needed to be revised before being accredited.

The processes have improved and a range of positive feedback was recorded in the later assessment advice. In summary the advice noted that: the efforts to engage were appreciated, on Country visits

were useful and welcomed; meetings and yarnings went well, the use of a range of media worked well, use of simple language and pictures was appreciated, representatives felt that they were respected and listened to, allowing First Nations peoples to tell stories was appreciated and important, and good working relationships were forged. In particular, the advice was that delegates had done a good job of identifying the First Nations peoples to be approached and had deployed good approaches. Use of Aboriginal Waterways Assessment tools were generally seen as a positive engagement tool, with First Nations peoples able to adapt the process to ensure cultural appropriate engagement. However, there was concern in the Australian Capital Territory that the use of the Aboriginal Waterways Assessment tool may have resulted in broader values and uses being overlooked.

The Victorian Government received particularly positive feedback on engagement processes. Consultation and plan development demonstrated adaptability and responsiveness to individual Nation protocols and preferences. Assessment of South Australia and Australian Capital Territory plans noted that consultation approaches fell short of best practice at times.

Overall, the approaches were regarded as culturally appropriate, with some observations for improvement noted. These included:

- allowing more time and dedicated resourcing for responses
- consulting consistently across all Nations
- clarifying how sensitive information would be protected
- explaining more clearly how water management works (and providing capacity building)
- providing more staff to take down oral advice
- holding more one-on-one meetings
- allowing email submissions
- providing clear submission dates
- allowing time for informal workshops and on-Country visits
- including decision-makers and executive staff in discussions and negotiations
- clarifying how First Nation views would be taken into account and could achieve influence.

What, if any, actions could be taken to improve the experience, and increase the influence, of First Nations peoples in water resource planning?

The reports reviewed for this evaluation show that significant consultation and engagement had occurred. However there continue to be opportunities to improve the experience, and increase the influence, of First Nations peoples in water resource planning. Opportunities identified by First Nations representations include:

- following proper First Nations protocols at all stages of consultation, noting that this has improved
- providing written reports and feedback to participants no later than 30 days after the finalisation of the first draft of the plan
- consulting First Nations peoples first during all consultation processes
- strongly considering advice given by delegates who represent the First Nations peoples

- providing more resources to support more meaningful participation
- proving more of a partnership level role for First Nations peoples in identifying future opportunities to protect First Nations values and uses
- including a stronger enabling commitment to progressing First Nations peoples' aspirations
- developing a better understanding of cultural flows and their importance
- developing a monitoring and evaluation program to track achievement of objectives and outcomes
- empowering First Nations peoples to manage their own water and land
- developing localised information and explanation about the water management and flow data
- developing better partnerships with government in water management
- increasing involvement in employed water positions
- protecting and mapping cultural sites and getting access to sites
- inclusion of First Nations water rights and interest in state water allocation framework

There is overlap between the identified areas for improvement and perceived risks to the implementation of First Nations objectives and outcomes. The level of engagement to date is generating meaningful participation and encouraging continuous improvement of the approaches and processes.

Are there any risks to the implementation of objectives and outcomes specified for First Nations peoples in water resource plans?

The advice on the accredited plans in Queensland, Victoria and South Australia, and the consultation processes reported to being followed in New South Wales, identified some recurring perceived areas of risk. Many of the risks were identified across multiple jurisdictions. The major risks are summarised below.

Definition of objectives – there is concern that First Nations peoples have not been adequately consulted on the objectives and outcomes in the South Australian plans and may not adequately represent all Nations' objectives and outcomes. Ongoing conversations between Nations and Government is required to address this risk. Implementation strategies need to be developed to reflect the individual agency and specific outcomes and objectives of each Nation.

Cultural flows — More work is needed to understand cultural flows in in Queensland, Victoria and New South Wales. Victoria and South Australian advice also highlighted that strategies and dedicated resourcing were needed to implement the National Cultural Flows Research Project. Risks to Aboriginal uses and values have not been explicitly evaluated in the South Australian Murray Region water resource plan. However, the ongoing Yama Rumi Assessment methodology and ongoing engagement may address some of these risks.

Protection of cultural sites — advice on most plans noted that 'having regard to' was not a strong enough commitment and that the processes for protecting cultural sites was not supported by the identification of specific watering plans and measures (South Australia, Victoria, New South Wales, Australian Capital Territory plans). More work needs to be done in relation to proper, genuine and realistic consideration of Native Title rights, Native Title claims and Indigenous Land Use Agreements

(Victoria, South Australia, New South Wales, Australian Capital Territory). One plan advice noted that future claims and significant heritage sites in the plan area (such as Lake Tyrell) were simply not referred to at all.

Support and resourcing — more support and resourcing is needed for Nation-led planning (South Australian plans). Nations need more time and funding to develop detailed and culturally appropriate methodologies and strategies. There also needs to be more time provided to involve those not on key Aboriginal boards. Ongoing funding needs to be guaranteed for *Water for Victoria* and other initiatives.

Implementation responsibility — the relationship between water resource plans and the various state and regional level plans, instruments and documents that are required to implement the water resource plans needs to be clarified. Implementation plans should be co-designed (South Australia, Victoria). Plans need to include clearly defined roles and responsibilities for implementing actions. Monitoring and evaluation programs also need to be put in place to track achievements towards objectives and outcomes (South Australia, Victoria, Queensland).

Inequitable water allocation — First Nations have noted concerns about inequitable water allocations, especially allocations to large-scale industries such as mining and cotton. A lack of access to the old stock routes and private property bordering waterways was also noted as a major barrier to achieving First Nation objectives and outcomes.

Infrastructure and managed flows — infrastructure and managed flows were also perceived as a risk, resulting in environmental degradation and the drying up of billabongs and creeks required for cultural activities. The Ngemba Nation gave the example that the creation of Brewarrina Weir has compromised the sacred *Ngunnhu* (fish traps) in the Barwon River.

How have First Nations been involved in planning for environmental watering?

The Basin Plan provides opportunities to build the capacity of First Nations to play an active and engaged role in Basin water policy, planning and management. While further work is required, some good progress has been made. Some examples are provided below.

First Nations Environmental Water Guidance Project

The First Nations Environmental Water Guidance Project aims to develop a defined and transparent methodology to enable First Nations' environmental watering objectives to be incorporated in annual environmental water planning.

First Nations assist the MDBA, the Commonwealth Environmental Water Office (CEWO) and other jurisdictions to ensure First Nations values and uses are included in Basin-wide environmental watering strategies. First Nations come together at NBAN and MLDRIN full gatherings and participate in the development of First Nations environmental watering objectives.

MLDRIN and NBAN assist the CEWO and the MDBA in developing a defined and transparent methodology for First Nations environmental watering objectives and outcomes included in annual environmental watering priorities, Basin-wide environmental watering strategies and environmental

water planning. MLDRIN and NBAN also review the Basin-wide environmental watering strategy. Sections of the document relating to First Nations are drafted collaboratively between the MDBA, MLDRIN and NBAN. NBAN, under contract with the CEWO and MLDRIN under contract to the MDBA, have a number of responsibilities, including:

1. conducting First Nations working groups to develop the First Nations environmental watering objectives
2. develop First Nations environmental watering objectives map
3. draft First Nations environmental water guidance
4. coordinating First Nations peoples review and providing feedback
5. coordinate and provide First Nations peoples feedback on MDBA's 2020-21 Basin annual environmental watering priorities.

NBAN plays a significant role in the development of the First Nations Environmental Water Guidance Project in relation to the northern Basin. MLDRIN plays a similar role in facilitating First Nations Environmental Water Guidance projects within the southern Basin.

Basin annual environmental water priorities

MLDRIN and NBAN supported the development of the Basin annual environmental water priorities for 2020-21. MLDRIN and NBAN developed their own guidance using different approaches to reflect the differences in climate, water management and cultural diversity in the northern and southern Basin. This project was the first time that First Nations environmental water objectives have been acknowledged and incorporated into planning and management at a federal level. Ongoing collaboration between First Nations and the Commonwealth Environmental Water Office will further develop and integrate First Nations peoples' knowledge into annual and long-term planning (i.e. the next Basin watering strategy update).

Other activities that have provided opportunities to build the capacity of First Nations people to play an active and engaged role in Basin water policy, planning and management include:

National Cultural Flows Research Project

The National Cultural Flows Research Project, which was a project driven by and for First Nations peoples has, over seven years, sought to establish a national framework for cultural flows. The framework, released in 2018, provides the first guide and method for future planning, delivery, and assessment of cultural flows. This research is thought to be the first robust legislative and policy framework for cultural flows anywhere in the world. The MDBA is responsible for administering the Murray–Darling Basin Cultural Flows Project with NBAN and MLDRIN. The government funded the appointment of two full-time cultural flow officers to work with MLDRIN and NBAN. The positions are funded for three years.

In 2007 MLDRIN articulated the attributes of a cultural flow in the Echuca Declaration as being

> *water entitlements that are legally owned and managed by First Nations to improve the spiritual, cultural, environmental, social and economic conditions of these Nations* (MLDRIN 2008).

The Echuca Declaration is a foundational document which has enabled a fundamental shift from consideration of cultural values on a site by site basis (such as Icon sites) to being an inherent right and consideration across water management systems. Achieving this change, however, will take time. The National Cultural Flows Research Project was a significant first milestone in this journey. It established a national framework to guide planning, delivery, and assessment of cultural flows. The framework enables First Nations cultural water use and values to be described and measured with quantifiable water volumes for the first time.

MLDRIN and NBAN, primarily through their Cultural Flows Project Officers, facilitate the on Country planning Nations undertake in applying the National Cultural Flows Research Project methodology. NBAN and MLDRIN may also provide advice on cultural flows to Nations and clan groups not affiliated with either NBAN or MLDRIN. MLDRIN and NBAN will continue to be instrumental in providing advice and guidance to the MDBA, DAWE and the CEWO on a range of matters relating to cultural flows, environmental watering priorities and the achievement of 'shared benefits'.

The Living Murray – Indigenous Partnerships Program

The Living Murray (TLM) is a joint initiative funded by the Australian and Basin state governments and coordinated by the MDBA. In 2001 the Murray–Darling Basin Ministerial Council adopted a vision for a healthy River Murray system. Through the Ministerial Council, the Living Murray program was set up in April 2002 as a long-term river restoration project with the intention of restoring to a healthy river system.

The Indigenous Partnerships Program is a critical component of the Living Murray program. The Indigenous Partnerships Program aims to bring Indigenous knowledge, cultural values and perspectives to the planning and management of the icon sites. The Living Murray program recognises Indigenous People's spiritual and cultural connection to Country, and their aspirations to be actively involved in managing the environment. Facilitators from First Nations are employed for all the Living Murray icon sites.

The Living Murray program continues to be implemented across the southern Basin. An example of the Living Murray program delivery can be found in 'Rivers, the veins of our country report', in particular case studies two, three and ten.

Aboriginal Weather Watcher Project

The Aboriginal Weather Watchers project which took place between 2016-2019. The project explored the impacts weather has on First Nation peoples. Specifically, the impacts of everyday weather changes, alongside the impact this has on Indigenous values and uses of water-dependent natural resources. The project facilitated engagement and capacity building as well as an opportunity for Aboriginal participants to tell their story about the impact of weather on their lives.

Use and Occupancy mapping

The Use and Occupancy mapping and spatial process has documented the ways in which First Nations peoples use land and water. The process included First Nations highlighting significant sites such as burial sites, repatriation sites, gathering sites and cultural activities undertake on country, including hunting and fishing.

Native Fish Management and Recovery Strategy

The Native Fish Management and Recovery Strategy aims to protect and recover native fish populations and has been developed in collaboration with the Basin state governments, First Nations, aquatic ecology experts and Basin communities. The strategy will be implemented in partnership with First Nations and other relevant stakeholders. The strategy outlines genuine and meaningful participation of First Nations peoples in design, decision-making and implementation phases to recognise contemporary rights and capacity.

Reviews and adjustments

Overview

Northern Basin toolkit measures

The MDBA conducted a four-year review into the northern Basin that resulted in a 70 GL reduction to the 390 GL per year water recovery target in the north. This was possible because the New South Wales and Queensland governments adopted a suite of environmental works and measures (commonly referred to as toolkit measures) with assistance from the Australian Government. The Basin Plan was amended in 2018 and at the time, the Basin Commitments Package was also announced.

The toolkit measures or initiatives complement and support the implementation of the Basin Plan which guides how water is managed and used sustainably in the Basin.

The toolkit, along with other activities in the northern Basin, will protect water for the environment, improve compliance with water laws, and create opportunities for local communities, including First Nations.

The toolkit measures reflect the MDBA's view that the sustainable diversion limits are a necessary, but alone insufficient, step to achieve a sustainable northern river system. The variable climate, combined with the unique geomorphology and water use practices across the northern Basin, prompts more than a long-term average approach to water management, necessitating targeted local management of flows.

Approximately $180 million is available to support implementation of the measures and specific elements of the Basin Commitments Package.

The toolkit measures broadly consist of a mix of:

- policy and management changes such as real time management (also called active management) of flows in the northern basin, protection of environmental water and implementation of a first flush rule
- environmental works that will enhance the environmental outcomes from the water recovered such as fishways, habitat restoration, cold water pollution mitigation and relaxing constraints in the Gwydir River.

New South Wales and Queensland governments are responsible for engaging with communities on the toolkit. This responsibility is set out in the amended *Intergovernmental Agreement on Implementing Water Reform in the Murray Darling Basin* (the IGA) agreed by Ministers in August 2019.

A Northern Basin Project Committee has been established to provide support and advice to the Basin Officials Committee on the implementation of the toolkit measures. The Committee provides a high-level forum for the Department of Agriculture, Water and the Environment, the Commonwealth Environmental Water Office, the MDBA and the New South Wales and Queensland governments to

work together to consider strategic issues that affect the identification, prioritisation, assessment, and implementation of environmental works and measures projects as well as monitoring and reporting on progress of toolkit implementation for all measures.

Sustainable diversion limit adjustment mechanism

To provide flexibility, the Basin Plan includes a mechanism to adjust sustainable diversion limits in the southern Basin. The mechanism requires a suite of projects to be implemented – some projects allow Basin Plan environmental outcomes to be achieved with less water. The adjustment mechanisms applies to the southern connected Murray–Darling Basin and operate as follows:

- **Supply measures** are projects that enable equivalent environmental outcomes to be achieved with less environmental water than the original recovery target set in the Basin Plan. Supply measures reduce the water recovery target needed to achieve the Basin Plan outcomes. This enables an increase in the overall limit on take and leaves more water available for consumptive use. The current agreed package of supply measures allows 605 GL to remain in the consumptive pool. The projects are required to be operational by 2024.
- **Efficiency measures** are projects that improve the efficiency of water management for consumptive purposes and allow for similar (or better) social and economic outcomes with less water. The water saved can then be made available for the environment to improve outcomes. Efficiency measures result in a reduction of the overall limit on take and an increase in the overall volume of water available for the environment. The Basin Plan provides for efficiency projects to adjust the overall limit by recovering up to 450 GL per year of additional water for the environment. At least 62 GL must be recovered through efficiency measures to enable the full 605 GL supply offset to take effect.
- **Prerequisite policy measures** are changes to environmental water delivery and water accounting practices that significantly improve the effectiveness of environmental water management without impacting on other users. The development of the Basin Plan limits on take and water recovery targets assumed that each jurisdiction would implement these measures by 30 June 2019, which has occurred.

A total of 36 supply projects measures have been identified by the jurisdictions, which make up the package that was modelled by the MDBA and formed the basis for an amendment of 605 GL to the limit on water take in the Basin Plan. To date, very few efficiency projects have been locked in, and the total volume available from these measures is less than 2 GL per year.

Constraint measures

The constraints measures are a subset of the 36 projects nominated by the Basin states that contributed to the sustainable diversion limit adjustment mechanism amendment to the Basin Plan, which received bipartisan support from the Australian Parliament in May 2018. To assist in progressing delivery of the Constraints Measures Program, a Constraints Measures Program coordinating work plan (the work plan) was developed by the Constraints Measures Working Group. In December 2018, ministers endorsed the work plan and agreed to progress it.

The delivery of the Constraints Measures Program and the Enhanced Environmental Water Delivery project[4] is important to achieving the full 605 GL supply contribution under the sustainable diversion limit adjustment mechanism. This means there is a significant shortfall risk if these projects are not delivered as notified. Together they provide greater flexibility for river operators and environmental water managers to deliver water for the environment and maximise the environmental outcomes achieved by the Basin Plan

Key theme findings

Northern Basin toolkit measures

- Good progress has made on the implementation of the northern Basin policy and management toolkit projects.
- Progress with infrastructure projects has been slower than anticipated, partly due to COVID-19 impacts and restrictions. Delivering the priority projects by 2024 will be challenging. While significant progress is achievable by June 2024, there is a significant risk that some environmental works and measures projects may not meet the agreed implementation timeframe.
- Coordination between the agencies responsible for environmental watering in the northern Basin is improving, particularly with regard to multi-jurisdiction and multi-catchment co-ordinated watering events targeting outcomes in the Barwon–Darling River.
- The Northern Basin Environmental Watering Group, which comprises officials from the Australian Government, the MDBA, the Commonwealth Environmental Water Office, the Department of Agriculture, Water and the Environment, and the New South Wales and Queensland governments has been established as an enduring forum to coordinate planning and delivery of water for the environment across the northern Basin.
- Community confidence in water management in the northern Basin is low and is unlikely to be restored until the toolkit projects, compliance initiatives, communication and transparency initiatives, and floodplain harvesting accounting arrangements are fully implemented or significantly progressed.

Sustainable diversion limit adjustment mechanism

- Some of the highly complex projects are currently assessed as having a high risk of not being completed by the 2024 target date (MDBA 2020b).
- Progress in the delivery of efficiency projects remains slow. At present, less than 2 GL has been contracted for delivery under this program.
- Delivery of the full sustainable diversion limit adjustment volume appears to be at risk of not being achieved.
- There is room for improvement in engagement both at a program, and individual project level, particularly in relation to Traditional Owners. Jurisdictions have recognised this and are all moving to improve and deepen stakeholder engagement, which is one of the most essential improvements needed to support successful implementation of the sustainable diversion limit adjustment mechanism program.

[4] The Enhanced Environmental Water Delivery project is a sustainable diversion limit adjustment mechanism supply project. The Enhanced Environmental Water Delivery project seeks to deliver a suite of enhancements to how rivers are operated across the Southern Connected Basin, to maximise environmental benefits while minimising impacts on existing water users.

Evaluation assessment

Table 4 Performance descriptors for the reviews and adjustments theme. Evaluation ratings are labelled 1-6, with 1 being the lowest performance rating and 6 being the highest performance rating. Confidence ratings assess the confidence in the assessment given the available evidence.

Indicator	Evaluation rating	Confidence
The extent to which the implementation of the northern Basin toolkit measures and relevant parts of the IGA been delivered on time against agreed milestones, timelines or workplans	5. The implementation is good for the policy and management measures 3. The implementation is just satisfactory for environmental works and measures	Medium
Good progress has made on the implementation of the policy and management measures. Progress with environmental works and measures is behind schedule. There is a significant risk that some environmental works and measures may not meet the agreed June 2024 implementation timeframe.		
The extent to which the implementation of supply and efficiency projects been delivered on time against legislative requirements, agreed milestones, timelines or workplans	2. The implementation is not suitable in its current format	Medium
Some of the highly complex projects are currently assessed as having a high risk of not being completed by the 2024 target date. Progress in the delivery of efficiency projects remains slow. Delivery of the full sustainable diversion limit adjustment volume appears to be at risk of not being achieved.		
The extent to which stakeholders agree that MDBA and Basin state government engagement processes on sustainable diversion limit adjustment mechanism projects and the toolkit measures are providing clear, transparent accessible and comprehensive information about projects and policy objectives and outcomes, risks and progress	2. The implementation is not suitable in its current format – 3. The implementation is just satisfactory	Low
Engagement varies among projects with some projects having been completed with appropriate engagement (these projects score 3). There is room for improvement in engagement for some projects (these projects score 2), particularly those projects that propose changes to river operations and flow patterns. Jurisdictions have recognised this and are all moving to improve and deepen stakeholder engagement. Confidence in this rating is low as there was no direct surveying of stakeholder satisfaction.		

Program logic

The program logic for this theme within the Basin Plan 2020 Evaluation is:

'The implementation of activities related to reviews and adjustments is expected to contribute to a healthy working Basin' (Figure 4).

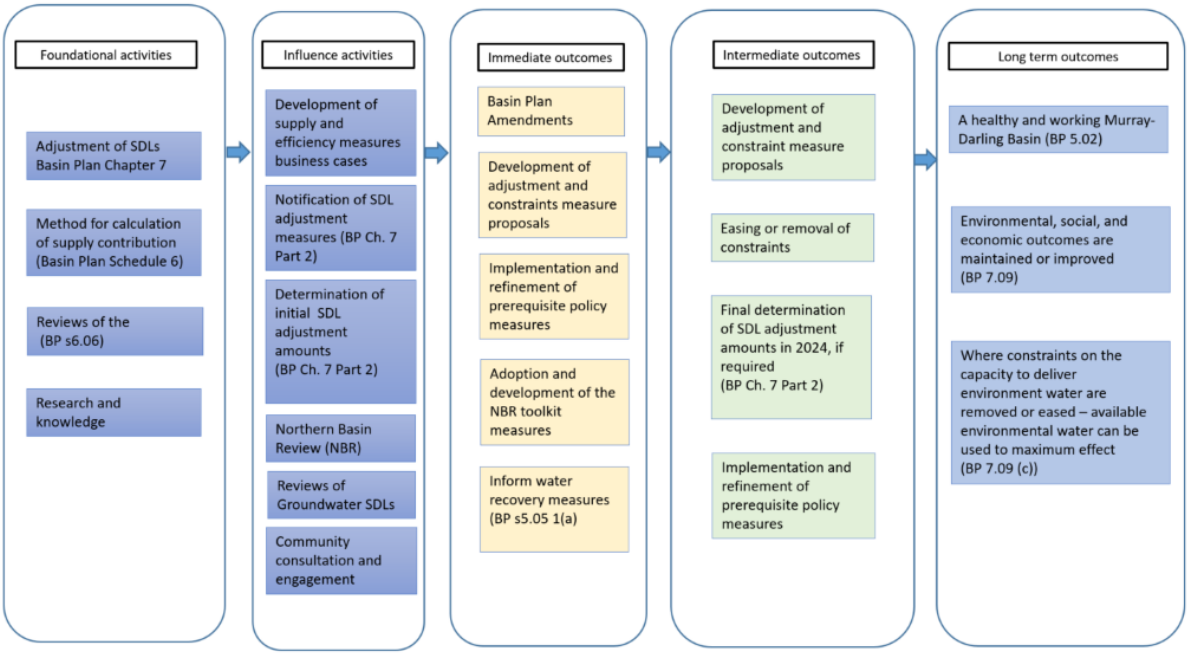

Figure 4 Reviews and adjustment theme program logic

Evaluation questions

1. To what extent has the implementation of the toolkit measures and relevant parts of the *Intergovernmental Agreement on Implementing Water Reform in the Murray Darling Basin* been delivered on time or as expected?
2. What opportunities are there to improve implementation of the toolkit measures?
3. What are the risks to implementing the toolkit measures?
4. To what extent are stakeholders satisfied that MDBA and Basin state government engagement processes on the toolkit measures are effective?
5. To what extent have the supply and constraint projects been delivered on time or as expected?
6. What opportunities are there to improve implementation of the supply and constraint projects?
7. To what extent has the sustainable diversion limit adjustment mechanism determination and the register of measures been delivered?
8. What are the risks to implementing the Basin Plan as intended that relate to the sustainable diversion limit adjustment mechanism?
9. To what extent have prerequisite policy measures been delivered on time or as expected?
10. What opportunities are there to improve implementation of prerequisite policy measures?
11. To what extent are stakeholders satisfied that MDBA and Basin state government engagement processes on sustainable diversion limit adjustment mechanism projects are effective?

Summary of findings

Northern Basin toolkit measures

- Good progress has made on the implementation of the policy and management toolkit projects.
- In Queensland, existing arrangements largely protect water that has been recovered for the environment and new mechanisms to protect that water have been codified in water resource plans. These new mechanisms were gazetted in February 2019. All Queensland plans are now accredited and fully operational.
- The New South Wales Government has implemented interim arrangements to protect water for the environment. Over the last two years, water for the environment through the Barwon–Darling has been protected using temporary water restrictions.
- The New South Wales Government is putting in place arrangements to protect water for the environment that will be implemented through water resource plans. Key aspects of the New South Wales Government reform came into effect in July 2020 through changed New South Wales water sharing plan rules for the Barwon–Darling (protection of first flush flows; daily extraction limits and increases to some A Class access thresholds).
- Following extensive on-ground consultation, an implementation plan for event-based mechanisms in the lower Balonne has been finalised and published.
- The Queensland Government has committed to review accounting and management arrangements, within the seasonal assignment framework, to facilitate the most comprehensive take-up of event-based mechanisms to allow for flow event transfers between entitlement holders and the Commonwealth Environmental Water Office.
- Progress with infrastructure projects is behind schedule. The business case submission timeframe for environmental works projects of December 2020 agreed by Basin governments will not be met. It is likely business cases will now be delivered towards the end of 2021. Delivering the prioritised environmental works infrastructure projects by the agreed June 2024 implementation timeframe will be challenging and there is significant risk of not being met for some projects. Further delays will increase implementation risk.
- Coordination between the agencies responsible for environmental watering is improving, particularly with regard to multi-jurisdiction and multi-catchment co-ordinated watering events targeting outcomes in the Barwon–Darling River.
- The Commonwealth Environmental Water Office and New South Wales government agencies have coordinated joint environmental releases to achieve whole-of-northern Basin connected flows:
    - the Northern Connectivity Event in 2018
    - the Northern Fish Flow in 2019.
- The Northern Basin Environmental Watering Group, which comprises officials from the Australian Government (MDBA, the Commonwealth Environmental Water Office and the Department of Agriculture Water and the Environment), and New South Wales and Queensland governments has been established. It has met on several occasions. The Northern Basin Environmental Watering Group provides a formalised mechanism to coordinate planning and delivery of water for the environment across the northern Basin.

- There remains 30GL of water recovery to achieve the 320GL northern Basin recovery target. Recovery needs to be fast tracked to ensure sustainable diversion limit compliance and conclude the program to provide confidence and certainty to communities. Consistent with the $230 million Murray–Darling Communities Investment Package, the Australian Government is shifting its focus to recovering water for the environment by modernising off-farm water delivery infrastructure.
- Community confidence in water management in the northern Basin is low and is unlikely to be restored until the toolkit projects, compliance initiatives, communication and transparency initiatives, and floodplain harvesting accounting arrangements are fully implemented or significantly progressed.

Sustainable diversion limit adjustment mechanism

- A total of 36 supply measures have been identified by the jurisdictions, which make up the package that was modelled by the MDBA and formed the basis for an amendment of 605 GL to the overall limit in the Basin Plan.
- Some of the highly complex projects which are expected to provide a significant contribution to the overall sustainable diversion limit adjustment volume, are currently assessed as having a high risk of not being completed by the 2024 target date.
- Sixteen projects have made good progress or are on track, being under construction, undertaking operational trials or in operation.
- Fourteen projects have made some progress with project design and implementation, however, could experience potential delays due to stakeholder concerns or regulatory requirements.
- To date, very few efficiency measures have been locked in, and the total volume available from these measures is less than 2 GL per year.
- Based on current progress and varying levels of support, it appears highly unlikely that the full 450 GL of efficiency measures will be achieved by 2024.
- Delivery of the full sustainable diversion limit adjustment volume of 605 GL appears to be at risk of not being achieved.
- Community stakeholders have expressed significant concerns about the delays and lack of engagement, especially for major projects which involve proposed changes to river operations and flow patterns or where they have concerns about unknown possible impacts on future access to water or in relation to inundation of floodplains.
- There is room for improvement in engagement both at a program, and individual project level, particularly in relation to Traditional Owners. Jurisdictions have recognised this and are all moving to improve and deepen stakeholder engagement, which is one of the most essential improvements needed to support successful implementation of the sustainable diversion limit adjustment mechanism program.
- As an ambitious suite of large, complex projects, the program is subject to a range of risks. Despite the delays experienced in initiating some of these projects, the deadline for completion has not changed, and based on an assessment of current progress this is a high risk for a number of projects. There is also risk and uncertainty associated with the question of what will happen if projects can't be completed by the deadline.
- Other risks that that may impact on achievement of the program's objectives include:

    - Insufficient funding available to complete projects, particularly as funding estimates were based on high level business cases developed some time ago.
    - Development of detailed project design and addressing stakeholder impact issues may delay projects and/or reduce the contribution they can provide to the adjustment volume.
    - State governments are independently evolving project assessment methods based on, for example, environmental watering requirements rather than stream flows, however these methods are not being developed within an agreed modelling framework.
    - Lack of effective governance and co-ordination. These are complex projects spread across three jurisdictions with a range of significant interdependencies between a number of the major projects.
- At a more strategic level, a number of independent reports have suggested that there is a need for stronger and clearer leadership from Basin governments around a shared vision for the Basin, coupled with clear alignment and direction on implementation of the Basin Plan. Developing an agreed position on how the final reconciliation of sustainable diversion limit adjustment volumes will be managed if key projects cannot be completed by the current 2024 deadline will also help address and reduce uncertainty. Streamlining and clarification of roles and responsibilities and governance process for implementation of the sustainable diversion limit adjustment mechanism program will help, together with continued improvement in structured co-ordination and collaboration between jurisdictions implementing projects.

Northern Basin toolkit measures findings

To what extent has the implementation of the toolkit measures and relevant parts of the IGA been delivered on time or as expected?

Policy and management measures

Good progress has been made on the implementation of the policy and management toolkit measures.

In Queensland, existing arrangements largely protect water recovered downstream of Beardmore Dam. Since the Northern Basin Review amendment was passed, the Australian Government and Queensland officials have worked together to develop protection mechanisms for water recovered upstream of Beardmore Dam. The resulting revisions made to the Queensland Condamine–Balonne Water Plan and water management protocols were gazetted in February 2019 and the associated water resource plan was accredited by the Australian Government Minister responsible for Water in September 2019. These protection mechanisms are now in effect.

Following the Northern Basin Review, the MDBA recommended that water recovery (up to 10 GL) be explored upstream of Beardmore Dam, subject to the Queensland Government providing measures to protect this water to and through Beardmore Dam. There is also potential for improved social and economic outcomes by recovering water upstream of the Beardmore Dam.

Queensland, in collaboration with New South Wales and the Commonwealth Environmental Water Office, has commenced development of an accounting method for cross-border held environmental water. It is anticipated that improved interim arrangements will be in place by the timeframe agreed by Basin governments of the end of December 2020. Queensland plans to finalise the improved cross-border water accounting arrangements, including formal supporting procedures and protocols, by 30 June 2021.

The New South Wales Government has implemented interim arrangements to protect water for the environment. Over the last three years, water for the environment through the Barwon–Darling has been protected using temporary water restrictions. The New South Wales water resource plans submitted to the MDBA for assessment on 30 June 2020 include:

- rules to protect held water for the environment from extraction in the Barwon–Darling and some unregulated sections of the Gwydir and Macquarie-Bogan rivers
- rules to prevent user extracting to first flush flows after a continuous period of dry or low flow conditions
- limits on daily water take for all unregulated river A, B, and C class licences in the Barwon–Darling.

These restrictions include recent temporary water restrictions imposed by the New South Wales Government to protect first flush flows from the February–April 2020 northern Basin flow event through to Menindee Lakes. Legislation was amended in June 2018 to allow access rules under water sharing plans for the Macquarie Bogan, Gwydir and Barwon–Darling unregulated water sources to be amended to facilitate active management in these areas to protect water for the environment. There has been monitoring of compliance with these arrangements.

An implementation plan for event-based mechanisms has been finalised and published following extensive on-ground consultation. The Commonwealth Environmental Water Office is working with the Queensland Government to clarify conditions under which it would consider temporary or event-based water trading mechanisms to supplement a flow event to enhance environmental outcomes, focussing primarily on the lower Balonne in the first instance. This will facilitate the most comprehensive take-up of event-based mechanisms to allow for flow event transfers between entitlement holders and the Commonwealth Environmental Water Office. This will facilitate the most comprehensive take-up of event-based mechanisms to allow for flow event transfers between entitlement holders and the Commonwealth Environmental Water Office.

A pilot grant scheme was implemented in early 2020. The pilot involved paying a water allocation holder that was legally entitled to pump water from the Narran River not to pump. Lessons learned from monitoring and an independent review of the pilot will support any future implementation of event-based mechanisms. A series of factsheets has been broadly distributed.

Northern Basin infrastructure

Murray–Darling Basin ministers made an in-principle agreement to implement toolkit measures in June 2017. In February 2018, the Australian Government announced funding of up to $180 million to support New South Wales and Queensland. On 9 August 2019, all Basin governments agreed to a revised *Intergovernmental Agreement on Implementing Water Reform in the Murray–Darling Basin*

(the IGA), which outlines how Basin governments will work together to implement the northern Basin toolkit measures. All measures must be operational by 30 June 2024.

Progress with infrastructure projects has been slower than anticipated and delivering the projects by 2024 will be challenging. While delivery is achievable by June 2024, particularly for smaller scale and less complex projects, the likelihood of meeting the agreed implementation timeframe has been steadily decreasing over the past two years — significant action is required to reverse this trend. Good progress by June 2024 is still achievable, but completion of all projects by this time is at risk. The risk of not meeting implementation timeframes is greatest for larger, technically complex projects and those requiring extensive community and stakeholder support.

Delays in developing feasibility proposals, partly due to COVID-19 restrictions and impacts, have meant that the timeframe for submitting business cases in the second half of 2020 will not be met. This timeframe was agreed by Basin First Ministers under Schedule 3 of the IGA. An adjustment to the timeframe will be undertaken through an exchange of letters between Commonwealth, New South Wales and Queensland ministers, as agreed by Ministerial Council in June 2020. There were also delays with the execution of funding agreements. Further delays will increase implementation risk.

The New South Wales and Queensland governments submitted feasibility proposals for environmental works projects to the Australian Government for assessment in July 2020. Proposals are being assessed in terms of value for money and their ability to maximise environmental outcomes in the northern Basin. The assessment includes advice from an independent expert panel on the ecological merits of proposals using an agreed ecological prioritisation framework. Priority projects identified through the Australian Government assessment process will be recommended to the Australian Government Minister responsible for Water. Approved projects will secure business case funding and proceed to business case development.

As at early November 2020, revised business case submission dates are yet to be confirmed between the Australian, Queensland and New South Wales governments. Following an assessment of business cases and subject to decisions by the Australian Government Minister responsible for water, Australian Government funding will be provided to the New South Wales and Queensland governments for approved projects to proceed to implementation. Given it is anticipated that business cases will not be completed until towards the end of 2021 at the earliest, implementation of priority projects is not expected to commence until 2022. A clearer picture of implementation timeframes will emerge during detailed business case development.

Northern Basin coordination and management of water for the environment

The aim of coordinating environmental flows is to maximise the environmental outcomes of water for the environment moving from upper catchments to downstream rivers, such as the Barwon–Darling and the lower Balonne.

Coordination between the agencies responsible for environmental watering is improving.

The Commonwealth Environmental Water Office and the New South Wales Office of Environment and Heritage (OEH)[5] made joint releases from the Border Rivers and Gwydir catchments to deliver water for environmental outcomes in the Barwon–Darling: the northern connectivity event (April–June 2018) and the northern fish flow (commenced in Apr 2019, with water arriving at Brewarrina in early July).

These were the first such multi-catchment coordinated events in the northern Basin and required careful planning and collaboration by the Commonwealth Environmental Water Office across government agencies in New South Wales and Queensland, including the introduction of temporary flow restrictions and associated monitoring to ensure the water was protected from extraction.

In line with the northern Basin toolkit measures and subsequent recommendations (including from the Vertessy Panel and the Productivity Commission), a forum to coordinate planning and delivery of northern Basin environmental water has been established - the Northern Basin Environmental Watering Group. The Northern Basin Environmental Watering Group terms of reference were finalised in early 2020. This will be a forum between officials from the MDBA, Commonwealth Environmental Water Office, the Department of Agriculture Water and the Environment and New South Wales and Queensland governments, and will formally embed the temporary coordination arrangements that were developed between these agencies in 2018–19.

The Northern Basin Environmental Watering Group met on multiple occasions in early 2020 to support cross-government management of the March–April 2020 northern Basin flow event to ensure there was a joint government response to the rainfall events. Partly because of this forum, the MDBA had a large volume of material to access when responding to community requests for information. This flow event and the New South Wales commissioned Independent Assessment into the Management of the 2020 NSW northern Basin First Flush event highlighted that there are opportunities for co-ordinated and more proactive communication of information, including shared Basin government key messages (Craik and Claydon 2020).

Northern Basin Commissioner

Appointed as Northern Basin Commissioner for three years from August 2018, Mick Keelty was engaged by the Australian Government to improve compliance in the northern Basin and worked with governments on ways to help achieve this. The Commissioner released his first-year report on 5 December 2019. The Northern Basin Commissioner role was subsumed by the Interim Inspector-General role from 1 October 2019. In September 2020, the Australian Government announced it would establish a statutory and independent Inspector General of Water Compliance. This will bring together the water compliance role of the Murray–Darling Basin Authority with the assurance role of the Interim Inspector-General.

Northern Basin water recovery

As at 30 June 2020, the total amount of water recovered for the environment across the Basin is 2,106 GL/y. While the total amount of water recovered across the Basin is higher than the overall

[5] OEH is now Environment, Energy and Science within the NSW Department of Planning, Industry and Environment.

target of 2,075 GL/y, there remain some sustainable diversion limit resource units with local and shared water recovery targets that have not yet been met.

A further 29.5 GL of recovery is required to meet local water recovery targets in the northern Basin. Water recovery remaining for specific catchments as at 30 June 2020 are:

- 12.6 GL in the Condamine–Balonne
- 0.7 GL in the Queensland Border rivers
- 1.6 GL in the Barwon–Darling
- 9.5 GL in the Namoi
- 5.1 GL in the New South Wales Border rivers.

Recovery needs to be fast tracked to ensure compliance with sustainable diversion limits and conclude the Bridging the Gap program. Consistent with recent announcements by the Minister responsible for water, the Australian Government will continue to recover water through targeted investments in water-saving infrastructure to meet recovery targets in ways that improve environmental outcomes whilst minimising or avoiding any adverse socio-economic impacts. In particular, the Australian Government is shifting its focus to recovering water for the environment by modernising off-farm water delivery infrastructure. A plan and timeframe for achieving the remaining northern Basin water recovery is needed and should be transparently communicated to provide confidence and certainty to communities.

What are the risks to implementing the toolkit measures?

The environmental outcomes the suite of infrastructure toolkit measures will deliver will be defined as part of business case development in 2020–21. These outcomes will inform the prioritisation process by which funding will be allocated to projects.

All toolkit measures must be in operation by 30 June 2024. Whilst significant progress is achievable by June 2024, there is a risk that some environmental works and measures projects may not meet the agreed implementation timeframe. There have been delays with development of feasibility proposals, and further delays during the business case phase will increase the risk implementation timeframes are not met.

To what extent are community stakeholders satisfied that MDBA and Basin state government engagement processes on the toolkit measures are effective?

During the Northern Basin Review there was effective community engagement. The need for measures beyond changes to sustainable diversion limits was initially identified through the Northern Basin Advisory Committee. The Northern Basin Advisory Committee was a community-based group established by the MDBA to provide community insights and advice into the Northern Basin Review process. This committee concluded operations after the completion of the Northern Basin Review in 2017–18. At the time, there was a high degree of community ownership of the toolkit process and projects.

In the last three years, however, there has been little community engagement specifically related to the infrastructure-associated toolkit measures. Stakeholders have indicated they want to be involved in the development and implementation of the infrastructure projects. They have also expressed concern about the level and accessibility of information, transparency and engagement related to infrastructure projects (MDBA 2019d). The New South Wales and Queensland governments are responsible for facilitating stakeholder engagement and consultation in the development and implementation of projects, including consultation with the South Australia and Victoria governments regarding any downstream impacts.

Public consultation has been undertaken for proposed amendments to water sharing plans. These new arrangements include new rules to implement active management in selected water sources. It is worth noting that community members may not see the link between the policy and management changes in water resource plans and those identified in the toolkit.

The Australian, Queensland and New South Wales governments have executed agreements to fund feasibility activities for proposed environmental works and measures projects, including community consultation. Funding for community consultation will also be provided to projects that proceed to business case development.

The Northern Basin Project Committee agreed in February 2020 that the MDBA website become the digital home for northern Basin content, including toolkit measures. This website is providing public access to updated information on toolkit progress, including a toolkit workplan and information on priority infrastructure projects.

What opportunities are there to improve implementation of the toolkit measures?

Opportunities to improve implementation of the toolkit include:

- Improved community engagement (particularly on infrastructure projects) and access to information about the projects and progress, including the communication of roles and responsibilities. Consistent with commitments in the IGA, New South Wales and Queensland are responsible for facilitating stakeholder engagement and communication in the development and implementation of toolkit projects.
- Coordinated communication and engagement efforts by government agencies involved in water management in the northern Basin could reduce duplication.
- All government agencies involved in coordinating the Northern Basin First Flush event in 2020 agreed that a more structured approach to communications would be beneficial.

It should be noted that community confidence in water management arrangements in parts of the northern Basin is low and is unlikely to be restored until the toolkit projects, compliance initiatives, communication and transparency initiatives, and floodplain harvesting accounting arrangements are fully implemented or significantly progressed.

Sustainable diversion limit adjustment mechanism findings

To what extent have the supply and constraint projects been delivered on time, or as expected?

A total of 36 supply measures have been identified by the jurisdictions, which make up the package that was modelled by the MDBA and formed the basis for an amendment of 605 GL to the overall limit on take in the Basin Plan. This amendment was approved by the federal parliament in May 2018.

Sustainable diversion limit adjustment mechanism projects range from straight-forward to highly complex. Straight-forward projects could involve the construction of a new regulator and minor levees to enable supply to a wetland at normal regulated river flows, rather than needing overbank events. Complex projects, like the relaxation of constraints to environmental watering between Hume and Yarrawonga, aim to enable managed overbank flow events. Implementation will involve addressing potential impacts on public and private infrastructure and land along hundreds of kilometres of river channel.

When the Basin Plan was first approved in 2012, there were no confirmed sustainable diversion limit adjustment mechanism projects. It was expected that the package of supply and constraints projects would be identified and confirmed by mid-2016, however this didn't occur until mid-2018. Funding agreements to cover the costs to further develop detailed concepts/designs and implement each project then had to be negotiated with the Australian Government. One of the more complex projects, Enhanced Environmental Water Delivery, which involves New South Wales, Victoria, South Australia and the MDBA, does not yet have a finalised funding agreement to enable work to start.

Some of the highly complex projects are currently assessed as having a high risk of not being completed by the 2024 target date. The six projects in this category include the four New South Wales and Victorian constraints projects, the structural and operational changes to Menindee Lakes and the Enhanced Environmental Water Delivery project. These projects are expected to provide a significant contribution to the overall sustainable diversion limit adjustment volume.

The initial feasibility level business cases for most supply and constraints projects were prepared in 2015. Due to the delays experienced in finalising the sustainable diversion limit adjustment mechanism package and funding arrangements, to date there has only been quite limited information available on the detail of what each project will involve, what the potential impacts and risks might be, and how these might be mitigated. For a number of the more contentious and complex projects, this delay/lack of information and absence of detailed community engagement has created uncertainty in the community.

Stakeholders have expressed significant concerns about the delays and lack of engagement, especially for major projects which involve proposed changes to river operations and flow patterns or where they have concerns about unknown possible impacts on future access to water or in relation to inundation of floodplains. Projects in this category include the New South Wales and Victorian constraints projects, the structural and operational changes to Menindee Lakes (see Case

study: Menindee Lakes water savings project) and the Improved Flow management Works at Murrumbidgee River (Yanco Creek Offtake project).

Case study: Menindee Lakes water savings project

The Menindee Lakes Water Saving project (the project) is one of 36 sustainable diversion limit adjustment mechanism projects. It is anticipated to deliver between 71 GL and 106 GL of water savings through more efficient infrastructure and operation of the Menindee Lakes system to reduce evaporation. The project aims to improve water managers' ability to achieve ecological outcomes in the Lower Darling, the Anabranch and the Lower Murray. The project is complex and has a long history of over twenty years. It requires inherent trade-offs to be made between local environmental outcomes, broader Basin environmental outcomes, and overall system efficiency.

The New South Wales Department of Planning, Industry and Environment is leading the delivery of the project. It does so with the involvement of a Technical Inter Agency Working Group, a Stakeholder Advisory Group and an Interjurisdictional Working Group.

The project is currently in the scoping and design phase. It proposes to include a series of works and operational changes including new regulators, fish-ways, outlets structures, revised storage management trigger levels and operational rules.

The project has the potential to make an important contribution to the sustainable diversion limit adjustment (returning up to 17% of the total 605 GL estimated to be achieved through supply projects). Delivery of the project has been delayed due to complexity and contention around project outcomes. It must find an acceptable balance between competing objectives of improving overall system efficiency and environmental protection in the Lower Darling. The fish deaths in 2019 and recent drought sequences have highlighted the challenges involved in this project.

The SDL Adjustment Mechanism 2020 Annual Progress Report assessed the project at high risk of not being delivered by June 2024.

To work through options analysis the Department has formed and supports the abovementioned Technical Inter Agency Working Group, a Menindee Lower Darling Stakeholder Advisory Group and an Interjurisdictional Working Group. The format for the project options analysis is an options evaluation framework linked to its work plan workflow and planning milestones.

The stakeholder advisory group has an independent Chairperson and represents a wide range of interest groups from across the project area. Engagement with the group has emphasised options analysis and stakeholder input into a co-design approach that considers existing ecological, cultural heritage and socio-economic values of the Menindee Lakes, Lower Darling and Great Darling Anabranch. The engagement approach aims to maintain extensive consultation

throughout the design and implementation processes to ensure communities have a chance to contribute local knowledge to the project's design and delivery options as the New South Wales Government delivers its Basin Plan obligations.

Inter-agency partners MDBA, CEWO, Department of Planning, Industry and Environment-Environment Energy and Science, NSW National Parks and Wildlife Service and WaterNSW regularly attend the stakeholder advisory group meetings and workshops as observers. COVID-19 restrictions in travel and gatherings in 2020 have hindered face to face engagement, however, a range of digital methods for engagement have been used. The Department of Planning, Industry and Environment has established a dedicated microsite for key stakeholders to access. In addition, a suite of fact sheets, regular updates, collateral, social media and video content has been developed as well as a dedicated email and SMS channel for the dissemination of information.

An Aboriginal Engagement Strategy has been developed and is underway.

In addition to community and governance group activities, the project team regularly engage with local Councils, agencies and other key stakeholder groups.

While the Menindee Lakes sustainable diversion limit adjustment mechanism project was on track with the funding agreement milestones on 31 March 2020, the complexity of the stakeholder environment and concerns from community and First Nations people mean that the project may require significant modification from the original business case. Regular investigation of risk continues as the project evolves.

Menindee Lakes – regulated storage system

The Menindee Lakes are a naturally occurring series of shallow, ephemeral wetlands located along the Lower Darling River, around 200 kilometres upstream of the junction with the Murray River at Wentworth. During the 1950-1960s the Menindee Lakes were modified to provide water storage to Broken Hill and other users in the Murray–Darling system.

The regulated storage system at Menindee consists of four main interconnected lakes – Lakes Pamamaroo, Menindee, Cawndilla and Wetherell. There are seven main regulating structures in the Menindee Lakes system

The Menindee Lakes are a critical storage in the southern Basin. When there is sufficient supply in the Menindee Lakes, water can be delivered to South Australia. This reduces the amount of water that needs to be released from the Hume and Dartmouth storages to meet South Australia's allocation, and enables that water to be supplied to the mid-Murray users in New South Wales and Victoria.

The Menindee Lakes are also an important source of water for local towns and users. They provide recreational, tourism, and economic benefits for the towns and surrounding region. The Menindee Lakes, Lower Darling and Great Darling Anabranch are culturally significant to the Barkindji people and the local First

Nations people. The Menindee Lakes are also home to threatened species and contain nationally important wetlands. They are important for breeding, spawning, and dispersal of native fish such as the golden perch.

The Menindee Lakes storage system was designed and built based on water supply during wet years. The shallow nature of the Menindee Lakes and the local climate means they have high levels of evaporation. It is estimated that in average years over 400 GL of water is lost to evaporation (and up to 700 GL per year when the lakes are full). The flow regime (including timing and average flows) in the lower Darling River has changed significantly since the construction of the Menindee Lakes system. Upstream extractions have reduced mean annual flow by more than 40%. Prolonged dry periods over the last 20 years have also made the Menindee Lakes increasingly unreliable. In an extended period of low inflows, the water can be unsuitable for irrigation or town water supply regardless of availability. During these low flows, however, the Menindee Lakes remain an important refuge habitat for aquatic and terrestrial fauna.

Challenges managing competing objectives

Since the early 2000s a number of studies and proposals have sought to improve the Menindee Lakes operations, structures and environmental and cultural heritage management. However, this has been more challenging than anticipated to achieve.

While the Menindee Lakes sustainable diversion limit adjustment mechanism project was on track with the funding agreement milestones on 31 March 2020, the complexity of the stakeholder environment and concerns from community and First Nations people mean that the project may require significant modification from the original business case.

There is ongoing community concern about the operation of the Menindee Lakes, the implications on the environmental health of the Lower Darling, and concern from the Barkindji people of further disruption to Aboriginal cultural heritage from the project.

The Independent assessment of the 2018-19 fish deaths in the lower Darling (Vertessy et al. 2019) identified that the community did not feel they had been adequately or meaningfully engaged in the operation and management of the lakes. The report highlighted the need to balance the competing objectives between local outcomes and broader Basin environmental outcomes and recommended that:

'*Basin governments work collaboratively to review and adjust the operating procedures for the Menindee lakes to strike a new balance between the competing objectives of maintaining overall system efficiency and improving environmental protection in the lower Darling.*' (Vertessy et al. 2019:73).

Implementing this recommendation and making these modifications is likely to lead to further delays in the project and may alter the contribution of the project to the sustainable diversion limit adjustment.

The project also operates within a complex authorising environment with various legislative approvals and assessments. This creates additional complexities and takes time to navigate.

Insights

The Menindee Lakes project is extremely important to the local community and the delivery of the Basin Plan. Delivering this complex project has provided insights into how to improve future delivery of such important and complex projects, including:

Community engagement takes time and requires considerable investment

Given the history and legacy of previous projects in the region, there is a need for more consistent and long-term consultation and engagement with communities in the region, particularly with the Barkindji people. This is important for ensuring local knowledge is incorporated into the project design and outcomes.

Community engagement takes time and requires considerable investment

Given the history and legacy of previous projects in the region, there is a need for more consistent and long-term consultation and engagement with communities in the region, particularly with the Barkindji people. This is important for ensuring local knowledge is incorporated into the project design and outcomes.

Benefits for the community need to be clearly demonstrated and communicated

The Basin Plan project descriptions and sustainable diversion limit adjustment mechanism business cases did not describe the local environmental (and other) benefits that the projects could provide. Local benefits from the Menindee Lakes project need to be clearly assessed and demonstrated. This is a crucial step to achieving community support for the project.

Project governance needs to be clear and agreed

The authorising environment for the Menindee Lakes project is complex and, at times, uncertain. State government agencies, as well as the MDBA, need to work together collaboratively to achieve mutual outcomes.

Trade-off framework needs to be developed

There is a need to develop a trade-off framework that operates at both the project and Basin scale to support transparent decision making

As an ambitious suite of large, complex projects, the sustainable diversion limit adjustment program is subject to a range of risks. These have been mapped and analysed and in addition to the stakeholder support and alignment risks noted above, some of the other major risks that may impact on achievement of the program's objectives include:

- It is unlikely all the projects will be completed by the 2024 deadline. Despite the delays experienced in initiating some of these projects, the deadline for completion has not changed, and based on an assessment of current progress this is a high risk for a number of projects. There is also risk and uncertainty associated with the question of what will happen if projects can't be completed by the deadline.
- Insufficient funding available to complete projects, particularly as funding estimates were based on high level business cases developed some time ago.
- Development of detailed project design and addressing stakeholder impact issues may delay projects and/or reduce the contribution they can provide to the sustainable diversion limit adjustment volume.
- Lack of effective governance and co-ordination. These are complex projects spread across three jurisdictions with a range of significant interdependencies among the major projects. Effectively managing and co-ordinating within and between projects is challenging.

Underlying and complicating these program specific risks is the challenging environment in which these projects are being delivered. The affected communities have faced extended drought and low water availability plus extensive water reform associated with implementation of other elements of the Basin Plan. In addition, overall water availability for traditional agricultural industries has been affected by water recovery for the environmental and more recently by market-based movement of water to higher value crops including horticulture and cotton. There are widespread concerns over the cumulative social and economic impacts that this extended period of continual change has had on Basin communities. This last issue is also driving significant community concern over the impacts that additional water recovery through efficiency measures may have.

All risks bring with them opportunities, and there are a number of opportunities to improve the implementation of sustainable diversion limit adjustment mechanism projects. Implementing identified mitigations for key risks will clearly assist, and jurisdictions are moving to do this. There are also a range of specific project management improvements that will be of significant assistance. At a more strategic level, a number of independent reports have suggested that there is a need for stronger and clearer leadership from governments across the Basin around a shared vision for the Basin, coupled with clear alignment and direction on implementation of the Plan.

Developing an agreed position on how the final reconciliation of sustainable diversion limit adjustment volumes, which is currently due in 2024, will be managed if key projects cannot be completed by this time will also help address and reduce uncertainty. Streamlining and clarification of roles and responsibilities and governance process for implementation of the sustainable diversion limit adjustment program will help, together with continued improvement in structured co-ordination and collaboration between jurisdictions implementing projects. Jurisdictions are all moving to improve and deepen stakeholder engagement, which is one of the most essential improvements needed to support successful implementation of the sustainable diversion limit adjustment program.

Constraint measures

The delivery of the Constraints Measures Program is guided by the coordinating work plan (work plan) as endorsed by Ministerial Council in December 2018. The establishment activities of the work plan are largely complete.

Phase 1 funding agreements enabling design and initial stakeholder engagement are now in place for the Yarrawonga to Wakool (except the Victorian component), Murrumbidgee, lower Darling and South Australian lower Murray projects. Progress has been made on joint Stage 1 funding proposals for the remaining constraint measure projects (Hume to Yarrawonga, New Goulburn).

Progress reporting on delivery of the work plan in June 2019 showed that implementation of the Constraints Measures Program was slower than anticipated against the identified milestones. Initial efforts have focused on establishing funding arrangements, resourcing agencies and project governance frameworks.

South Australia has begun its Constraints Murray Key Focus Area project. To date the New South Wales and Victorian governments have focused on establishing funding arrangements with the Australian Government. The New South Wales and Victorian governments have concentrated on their non-Constraints Measures Program project delivery frameworks which will eventually translate to the constraint projects. Current delays resulting from lengthy funding agreement negotiations and subsequent project implementation may delay program milestones and impact the subsequent Basin Plan reconciliation.

Jurisdictions and the Constraints Measures Working Group will need to expedite key tasks of the work plan to enable meaningful progress on these projects. This will enable the implementation of risk treatments in accordance with the program risk management strategy and progress the resolution of identified priority policy issues.

It would be useful to establish functional links between the Constraints Measures Program and the implementation of the Enhanced Environmental Water Delivery project. There are also strong interdependencies between the lower Darling constraints and the Menindee lakes supply projects, and potential for delays in the supply measures project may also affect the timing for the constraints project.

Constraints projects will interact directly with private landholdings adjacent to significant lengths of major rivers in the southern Basin. Effective engagement with these landholders who are directly affected, and with stakeholders from the wider community, will be a lengthy process. The New South Wales and Victorian governments have proposed a co-design process to involve stakeholders in the project. Given the delays experienced to date and the proposed approach to project design and implementation, there is a high risk that the five New South Wales and Victorian constraints projects will not be completed by the 2024 target date.

What opportunities are there to improve implementation of the supply and constraint projects?

The Productivity Commission's five-year assessment and the independent assessment of social and economic conditions in the Basin both call for several more strategic reforms.

The Productivity Commission's five-year assessment and the independent assessment of social and economic conditions in the Basin both call for several more strategic reforms:

- **The Ministerial Council should provide a shared vision and clear objectives for Plan implementation. The Productivity Commission suggested 'a clearer tone of firm commitment to the Basin itself, with unmistakable collective direction for delivering on that commitment'.**
- **Roles and responsibilities for implementation of the sustainable diversion limit adjustment program should be streamlined and clarified.**
- **The MDBA should continue and expand initiatives for improved co-ordination and collaboration between jurisdictions implementing projects.**
- **An agreed, shared government approach in response to ongoing implementation of the sustainable diversion limit adjustment mechanism (and sustainable diversion limit adjustment reconciliation) should be developed, as it is likely that a number of major projects may not be completed by 2024. This may be necessary to provide certainty to stakeholders concerned about impacts of projects if insufficient time is available to identify risks and develop appropriate mitigations.**

At the procedural and project management level, Basin jurisdictions recognise that the progress of all supply and constraint projects must be carefully monitored in the lead-up to the 2024 deadline, especially for the more complex and challenging projects.

Strong governance and project management arrangements will need to be put in place by each of the states to enable progress review and early identification of risks to project delivery. Additional oversight and monitoring will be provided by Basin committees.

The sustainable diversion limit adjustment mechanism is an ambitious program, as is often the case for reforms, with the potential for substantial outcomes and benefits. Completing all projects by 2024 will be challenging, and there are difficult policy and legislative issues to be resolved. With four years remaining for program implementation, the focus should be on accelerating program delivery, including increased community engagement and consultation.

Opportunities for implementing the Constraints Measures Program rely on coordination between the Basin governments and key agencies on risk management, reporting and strategic communications and engagement.

Concerted effort and increased resourcing to facilitate stakeholder engagement is critical to accelerating progress. In line with the work plan, the Constraints Measures Working Group is developing a coordinated stakeholder engagement strategy. This document includes an integrated communications strategy and an integrated community engagement strategy.

While co-design of the constraints program with communities is planned and will be a powerful tool in establishing trust and support, ensuring there is an appropriate baseline of information available in the early stages of community engagement is also important. Once all funding and governance arrangements are finalised, the focus will move to collating information to support initial engagement, with an emphasis on describing the beneficial outcomes to be achieved by relaxing constraints.

Case study: Enhanced Environment Water Delivery Project

The Enhanced Environmental Water Delivery project is a sustainable diversion limit adjustment mechanism supply project. Supply projects aim to improve the way we manage the Basin's rivers more efficiently to deliver water for the environment.

The Enhanced Environmental Water Delivery project seeks to deliver a suite of enhancements to how rivers are operated across the Southern Connected Basin, to maximise environmental benefits while minimising impacts on existing water users. Proponent states South Australia, Victoria and New South Wales have proposed the project be delivered in stages and the MDBA has agreed to be the delivery partner leading the first stage over an 18-month period in close consultation with proponent states.

The Enhanced Environmental Water Delivery project aims to develop new forecasting and planning tools and streamlined processes for coordinated system wide river operations in the Southern Connected Basin. This would maximise downstream and system-wide connectivity and enhance environmental outcomes. Specifically, the Enhanced Environmental Water Delivery project will:

a. Coordinate environmental water releases across tributaries of the River Murray system to maximise downstream and system-wide connectivity outcomes

b. Align the release of held water for the environment with regulated and unregulated flows to achieve a desired peak and/or duration for a flow event, to create a stronger biological stimulus in sync with environmental water requirements and climate signals

c. Efficiently use increased delivery capacity (created via the implementation of constraints measures) to improve in-channel, floodplain/wetland connectivity and end-of-system outcomes

d. Develop a multi-year, multi-location planning framework including low flows, regulated flow, unregulated flows, as well as the use of works and measures to maximise long-term environmental outcomes.

To achieve the maximum possible supply offset under the proposed Sustainable Diversion Limit adjustment package, the Enhanced Environmental Water Delivery project needs to be delivered in conjunction with projects to relax physical constraints to water delivery.

The MDBA, along with the proponent states, will work closely with environmental water holders and managers, catchment management organisations, and scientists, water authorities, river operators, traditional owners and affected communities to identify innovative approaches and improvements to current processes, policies, legislative and governance structures for managing water for the environment.

The SDLAM 2020 Annual Progress Report assessed the Enhanced Environmental Water Delivery project at high risk of not being delivered by June 2024.

Challenges and issues

The Enhanced Environmental Water Delivery project is complex, with multiple jurisdictions and stakeholders involved. Delivery is planned over three stages, with multiple workstreams. The project is currently in Stage 1A which is funded by the Commonwealth and includes project establishment, stakeholder and community engagement planning and initial implementation.

The negotiation of funding agreements between project proponents and the Commonwealth represented by the Department of Agriculture, Water and the Environment have taken longer than expected due to intellectual property and data sharing issues and this has delayed project commencement. The MDBA and proponent states agreed to commence project activities in late September 2020, in parallel to the finalisation of funding agreements.

Lessons for future project delivery

Funding arrangements for Stage 1A of the Enhanced Environmental Water Delivery project took longer than expected due to intellectual property and data sharing issues. These issues remain unresolved, and an additional workstream (intellectual property and data sharing arrangements and protocols for modelling and other data resources) has been added to Stage 1A project delivery at a cost to budget and capacity, highlighting the need for increased certainty and inter-jurisdictional arrangements in this area.

The successful delivery of the Enhanced Environmental Water Delivery project will require streamlined processes for coordinated system wide river operations. This process is expected to take time. Coordination and collaboration between all parties will remain critical for the success of the Enhanced Environmental Water Delivery project.

Lessons from the initial challenges and complexities encountered during funding arrangement negotiations provide several insights into how coordination and collaboration can be maximised:

Clear and agreed outcomes need to be developed

Clear and agreed outcomes need to be in place to facilitate ongoing and effective collaboration between all parties. This is particularly important given the number of jurisdictions, legislative frameworks and complementary activities that need to be considered to achieve project objectives.

Stakeholder engagement and planning need to occur early on

The project will require consultation with a wide range of stakeholders. Clear and well documented strategies to engage and involve stakeholders and communities are required early in the scoping and planning of such complex projects. A detailed stakeholder and community strategy will be developed as part of Stage 1A of the Enhanced Environmental Water Delivery project.

Collaborative project, risk and adaptive management arrangements need to be in place

Large, complex, collaborative projects, such as Enhanced Environmental Water Delivery, inevitably test project and risk management capabilities. Given the importance of these types of projects to the successful implementation of the Basin Plan, they should be undertaken within an adaptive management framework that helps identify improved methods for identifying and managing risks, as well as governance arrangements that focus on problem and conflict resolution and addressing cultural issues that may constrain collaboration.

To what extent have efficiency projects been delivered on time, or as expected?

At least 62 GL must be recovered through Efficiency Measures to enable the full 605 GL supply offset to take effect (605 GL supply offset minus five per cent limit of 543 GL).

Progress in the delivery of efficiency projects remains slow. At present, less than 2 GL has been contracted for delivery under this program. A review of the Water for the Environment Special Account (the Special Account)[6] (Australian Government 2020) observed:

> *The arrangements for the current efficiency measures program (the Water Efficiency Program) have tighter project scope requirements and more onerous project application, public scrutiny and approval processes than many previous initiatives. These are, at least in part, driven by the socio-economic impact test requirements, and the delivery partner model. While these arrangements were conscious decisions, the Australian Government, in collaboration with other Basin governments, has the option to introduce other delivery arrangements and include additional measures to improve the chances of achieving the Special Account's objectives by 30 June 2024.*

What are the risks to implementing the Basin Plan as intended that relate to the sustainable diversion limit adjustment mechanism?

The key risks for the sustainable diversion limit adjustment mechanism program are:

[6] The Special Account sets aside $1.775 billion of Commonwealth funding to pay for efficiency measures and constraint projects over the period 1 July 2014 to 30 June 2024

- Basin Plan delivery progress - risk that all projects may not be completed by the 2024 deadline.
- insufficient funding available to complete projects - risks that project cost estimates could escalate during implementation and insufficient funds would be available to complete project
- links and interdependencies between projects - projects operate as a package and are linked/dependent on each other and existing water management arrangements. Strong governance, coordination and risk management across the program and between projects is paramount to success.
- uncertainty in reconciliation approach - uncertainty in how projects will be assessed by 2024 can impact individual project design and offset calculations. Early certainty in reconciliation approach is needed to allow project optimisation.
- lack of stakeholder support and alignment – community, agency and ministerial
    - Community support is vital for success of many of the projects that directly impact individuals/communities for example constraints projects, Menindee Lakes, and Murrumbidgee River -Yanco Creek Offtake projects.
    - Interagency support is required to deliver projects, coordinate interdependencies and manage risks.
    - Ministerial support is required for jurisdictions to continue to progress the program.
- Volatility and uncertainty in the external environment.

The key risks identified at this stage of the Constraints Measures Program fall into three main areas: stakeholder support; data and information; and coordination and management (Table 3).

Table 3 Key risks identified at this stage of the Constraints Measures Program

Stakeholder support	Data and information	Coordination and management
• Reluctance to participate • Lack of community support • Perception of inequitable mitigation activities • Inconsistent ministerial commitment and support • Incomplete understanding of the program benefits • Volatility and uncertainty in the external environment	• Lack of confidence in models • Uncertainty over program success • Reliance on outdated business cases • Discrepancies in costing information	• Inability to meet the program timeframe • Lack of program governance and coordination • Lack of effective project and portfolio coordination • Operational failure post-2024 • Inconsistent state and national policy and its application • Fluxes in availability of technical capability

To what extent have prerequisite policy measures been delivered on time or as expected?

The Basin Plan outlines prerequisite policy measures (which are referred to as ‘unimplemented policy measures’ in the Plan) and requires them to be implemented by 30 June 2019.

Prerequisite policy measures are part of the new management framework that has been established to manage water in the Basin. These measures are required under the Basin Plan to maximise the outcomes available from water recovered for the environment without impacting on other water users. The measures are legislative, operational and highly technical, and are vital because they help to ensure effective use of water for the environment. These measures are intended to be adaptable, and appropriate reviews will inform their refinement and improvement over time. They are one of many critical mechanisms in the Basin Plan that adapt water management arrangements to accommodate for the efficient and effective use of water for the environment.

These measures are enabled by states through:

- state legislative changes
- amendments to local water sharing plans
- changes to regulations and operational manuals
- the new water resource plans.

The MDBA has conducted an assessment process to ensure that these measures have been appropriately implemented in state water management frameworks. A set of criteria was used to assess evidence that held water for the environment can be called from storage to supplement an unregulated event and be re-credited for use downstream at environmental sites.

The criteria developed by the MDBA ensures that implementation arrangements are secure, fully operable, and transparent. The assessment provides important assurance for environmental water holders in the management of their entitlements, without adversely affecting the reliability of other water entitlements.

The Independent River Operators Reference Group conducted a review of the MDBA's assessment to ensure that the criteria were consistently applied, and robust and evidence-based conclusions were reached (Independent River Operators Reference Group 2019). The findings support the MDBA's comprehensive assessment process and the conclusions that the measures are in effect in all relevant jurisdictions.

At its meeting on 28 June 2019, the MDBA considered the submitted prerequisite policy measures for each jurisdiction and the River Murray and determined that prerequisite policy measures across all jurisdictions were in effect. The MDBA noted that each jurisdiction needs to commit to further work to refine and improve implementation of prerequisite policy measures over time. The MDBA will be undertaking an audit of implementation of prerequisite policy measures in 2020-21. The findings of the audit are expected to be incorporated into future environmental water protections work plans.

Measures need to be operationalised, and knowledge and expertise built across the Basin. There is an opportunity for governments to work together to understand the implementation approach to prerequisite policy measures across different states, and the different opportunities and challenges that each state is experiencing.

In November 2019, the Basin Officials Committee agreed that in the southern Basin it is desirable and appropriate to continue to review and improve operating arrangements for water for the environment to build upon existing protections. The Basin Officials Committee agreed that an

Environmental Water Protections work plan be developed by the MDBA and Basin state governments with a focus on strengthening collaboration and the ongoing adaptive management regarding operating arrangements for water for the environment.

The work plan may include tools, procedures and guidance to support the accurate measurement, accounting and reporting of water for the environment use, consistent with key principles of transparency and adaptive management, and an agreed approach for the assessment of potential risk. A draft of the work plan is being prepared and is expected to be submitted to the Basin Officials Committee for endorsement in late 2020.

The MDBA also produced a draft report in July 2019 titled *Priorities for Improving Prerequisite Policy Measures*. The draft report documented the existing commitments from jurisdictions in relation to prerequisite policy measures improvements and provided a range of recommended priority actions for further improvements. The report also noted that at the time, the Basin Officials Committee was in the process of developing the scope and governance arrangements of a forward-work program to refine and improve environmental water protections across the Basin (including PPMs and northern Basin environmental water protections. This workplan is expected to be finalised in early 2021.The proposed Environmental Water Protections work plan is the means to do this.

The report provided seven recommendations relevant to all jurisdictions to improve prerequisite policy measures implementation, plus a range of jurisdiction specific recommendations. The Independent River Operators Reference Group also reviewed and commented on this report.

The MDBA report also indicated that the MDBA Office of Compliance will monitor the implementation of prerequisite policy measures arrangements through an auditing program of environmental water events. This work is to ensure that prerequisite policy measures arrangements are appropriately embedded in water management arrangements across the southern Basin. The audit program is intended to be informed by the commitments made by jurisdictions to finalise prerequisite policy measures implementation pathways outlined in this report. This auditing program will also enhance transparency and improve prerequisite policy measures.

To what extent are community stakeholders satisfied that MDBA and Basin state government engagement processes on sustainable diversion limit adjustment mechanism projects are effective?

In the absence of broad-based surveying of stakeholders to ascertain satisfaction this answer is based on the findings of external reviews including the Ernst and Young (2018), Productivity Commission (2018) and Sefton (2018, 2020) reviews.

Community involvement in design and delivery of all sustainable diversion limit adjustment mechanism projects is vital. States are responsible for community consultation for each individual supply and constraints project.

Stakeholders have, for some projects, reported that progress has been slow to date, and there may not be sufficient time to complete all projects.

There are particular concerns in some sections of the community about key projects, particularly Menindee Lakes, constraints projects and the improved flow management works at the Murrumbidgee River (Yanco Creek Offtake) project.

'Community angst has been compounded by a lack of detailed information on the benefits, costs and impacts of some individual projects (including not publishing the business cases) and tokenistic community consultation' (Productivity Commission 2018)

Traditional Owners have previously voiced strong concern that implementation of the supply package carries significant risks to cultural values, and that 'there has been no adequate process of free, prior and informed consent in the development and implementation of [supply measures] (Productivity Commission 2018).

The *SDLAM technical workshop March 20 Communique* (MDBA 2020c:2-3) attended by Basin state governments and experts stated

> *Participants felt that there was room for significant improvement in stakeholder engagement both at a program, and individual project level, particularly in relation to Traditional Owners. Traditional Owners expect to be involved in how the SDLAM projects are designed, implemented and monitored. Stakeholders expressed a desire to participate in regular and coordinated updates on project and program progress, to increase transparency. Future forums should consider a consistent reporting approach across all projects (i.e. cultural, social, economic impacts, and project and over overall program progress).*

States have received inception funding for most supply and constraints measure projects and have developed or are developing communication and engagement strategies for relevant projects. Stakeholder engagement for the Menindee Lakes Water Saving Project has re-commenced and a forward work program has been developed.

The Constraints Measures Program communications and engagement strategy is considered a working draft. The focus of this work is to ensure agencies provide a level of coordination for community engagement, share lessons learned, and to maintain key message consistency and common program engagement approaches where appropriate. The strategy includes individual-reach level and cross-program activities and the development of communications products to support the engagement strategy.

Concerted effort and allocation of adequate resourcing and assigning sufficient priority to stakeholder engagement activities is critical to accelerating progress.

Governments need to continue to cooperate to lift the level of engagement and transparency and to provide access for all stakeholders to input to the projects that are still under development.

The *2018 Murray–Darling Basin Water Infrastructure Program – Consultation for additional criteria* report (Sefton 2018) noted that stakeholders perceived the current round of consultations is a just a 'tick-the-box' strategy and this has not improved community confidence or trust; participants have been asking for a consultation that works for their timing, the seasons they're experiencing, their

geographical locations; their industries; their communities and local businesses; stakeholders want a well-designed two-way process; and they want all parties to work towards achieving agreed aims.

Evidence in the report *Analysis of efficiency measures in the Murray Darling Basin Jan 2018* (Ernst and Young 2018) of extensive stakeholder concern at that time, and extensive media coverage of community concerns point to a lack of lack of effective engagement.

Water quality and salinity management

Overview

Good-quality water is critical for people and the environment. Recognising this, the Basin Plan sets objectives and targets for ensuring water quality is fit for a range of purposes. These targets include site specific salinity targets as well as cyanobacteria (blue-green algae) targets for recreation and dissolved oxygen targets. The Basin Plan also includes a salt export objective, which provides an indicative figure against which the MDBA must assess the discharge of salt from the system into the Southern Ocean[7].

A separate review of water quality targets under the Basin Plan is expected to be released before the end of 2020. That review deals with the appropriateness and effectiveness of the targets and should be referred to for more detail where appropriate.

The Basin Plan targets aim to be fit-for-purpose, that is, they are designed to complement, rather than duplicate, State and local management arrangements to manage water quality and salinity in the Basin. Entities 'have regard' to targets by undertaking a suite of management actions, not only those introduced at the Basin scale, but also by drawing on essential efforts at the State and local level, including building on pre-existing arrangements.

Entities report on their having regard to targets through annual Basin Plan Schedule 12 implementation reporting. In addition, the Independent River Operators Reference Group reports on the MDBA's compliance with this requirement. These reports provide descriptive examples of the large number of activities undertaken to support this requirement.

Water resource plans must also include water quality targets under Chapter 9 of the Basin Plan. However, given most plans are either accredited only recently or not yet accredited, it is too early to evaluate implementation against these targets. This means the effectiveness of management relating to these targets is not a focus of this evaluation. However, the effectiveness of the plans will be a focus of future evaluations of the Basin Plan.

Key theme findings

- Salinity targets for four of the five Basin Plan reporting sites were met for the 2014–19 reporting period.
- The Basin Salinity target at Morgan was met over the period since 2012, and salinity at this site shows an ongoing decreasing trend as a result of salinity management efforts over the last 30 years.

[7] The Authority must assess, on an annual basis, achievement of the salt export objective by comparing the estimated number of tonnes of salt exported per year averaged over the preceding 3 years against the indicative figure of 2 million tonnes of salt per year (s 9.09(5)).

- Additional environmental water passing through the river system as a result of the Basin Plan continues to contribute to reducing salinity levels and flushing salt into the Southern Ocean
- The salt export objective indicative figure of two million tonnes per year has not been met, with the exception of 2012–13. Extended periods of below average inflows into the River Murray system make it difficult to flush annual average of two million tonnes of salt out of the Basin, while maintaining low salinity levels at target sites, over the long term.
- The period between 2014 and 2019 was particularly challenging for the management of algal blooms and low dissolved oxygen in the Murray–Darling Basin.
- The water quality challenges faced over the 2012–19 period, including a number of significant water quality events, highlight the need to continue to improve the capacity of Basin state governments and the MDBA to manage water quality and salinity, particularly in the context of low- or no-flow conditions.
- Action to address these water quality challenges is underway in conjunction with the broader program of Basin Plan implementation. It is important that this work continues given the likelihood of drier and warmer conditions, which will increase water quality threats faced by the Basin in the future.

Evaluation assessment

Table 4 Performance descriptors for water quality implementation theme.
Evaluation ratings are labelled 1-6, with 1 being the lowest performance rating and 6 being the highest performance rating.
Confidence ratings assess the confidence in the assessment given the available evidence.

Indicator	Evaluation rating	Confidence
Salinity levels	5. The implementation is good	High
Salinity targets for four of the five Basin Plan reporting sites were met for the 2014–19 reporting period. The Basin Salinity target at Morgan was met over the period since 2012.		
Salt export	2. The implementation is not suitable in its current format	High
The salt export objective indicative figure of 2 million tonnes per year has not been met, with the exception of 2012–13. Meeting the site-specific salinity targets by maintaining low salinity makes it harder to meet the salt export objective. During periods of low flow, managing the river to meet the salt export objective can lead to higher salinity levels in the river. From an operational perspective, maintaining water quality that is fit for purpose is prioritised over meeting the salt export objective. The review of the Basin Plan Water Quality Management Plan targets, due to be released in December 2020, will examine the appropriateness of the salt export objective, during low flow periods.		
The extent to which reporting demonstrates that MDBA, Basin state governments and the CEWH have had regard to targets for salinity, dissolved oxygen and blue-green algae	3. The implementation is just satisfactory	Medium

Indicator	Evaluation rating	Confidence
outbreaks when making flow management decisions		
In general, the requirement to 'have regard to' water quality when making flow management decisions has been demonstrated. However, more could be done to document how the 'have regard' provision is considered in operational procedures and plans.		
The extent of monitoring and reporting on dissolved oxygen levels and blue-green algae outbreaks	3. The implementation is just satisfactory	Medium
In the southern Basin, well-established cooperative arrangements exist to monitor and report blue-green algae outbreaks. Reporting on dissolved oxygen levels against water quality targets for the period has been inconsistent and monitoring capacity continues to be developed.		

Program logic

The program logic for water quality and salinity management implementation theme within the Basin Plan 2020 Evaluation is:

'The implementation of activities related to water quality and salinity management is expected to contribute to water that is fit for purpose and healthy, diverse and resilient water dependent ecosystems' (Figure 5).

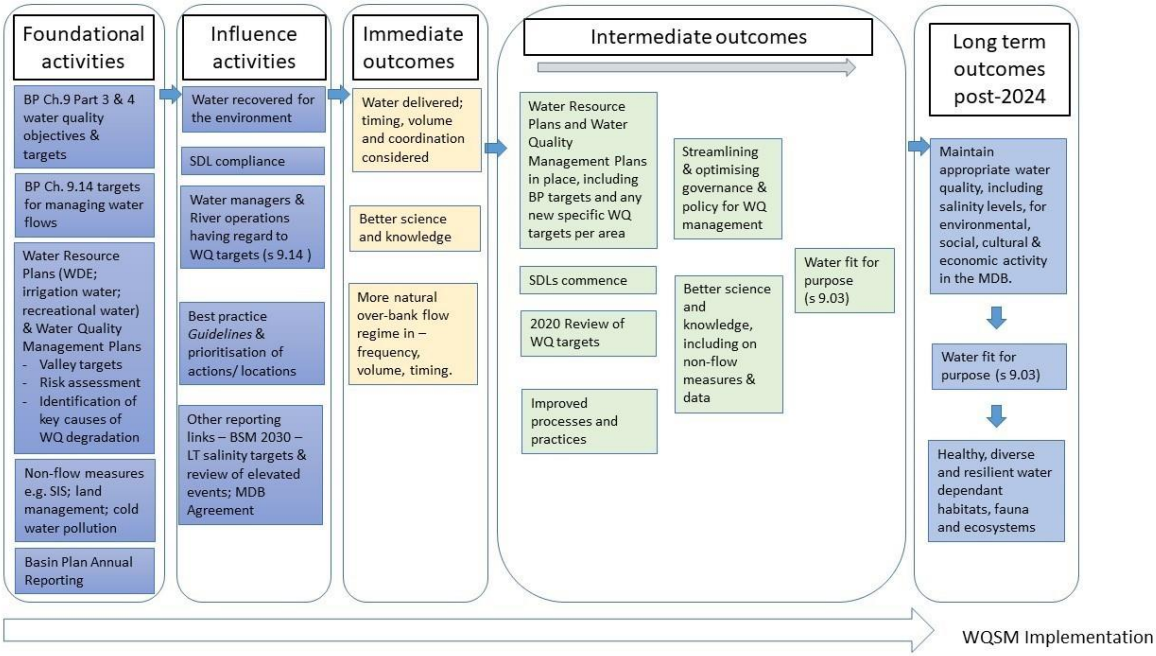

Figure 5 Water quality and salinity management theme program logic

Evaluation questions

1. To what extent have the Basin Plan salinity targets for the 2014–19 reporting period been met?
2. To what extent has there been adequate flushing of salt from the River Murray into the Southern Ocean since the implementation of the Basin Plan?
3. What are the key events and developments relating to water quality and salinity since 2012?
4. To what extent have the MDBA, Basin state governments and the Commonwealth Environmental Water Holder had regard to targets for salinity, dissolved oxygen and blue-green algae when making flow management decisions?
5. What actions are underway to monitor and report on dissolved oxygen levels and blue-green algae outbreaks? How is this information used in water quality and salinity management?
6. What actions are underway to mitigate the negative water quality impacts from natural flooding, or extreme low flow or cease-to-flow events?
7. What have been the key achievements and learnings in salinity and water quality management under the Basin Plan and related instruments?
8. What else needs to be done to improve the water quality and salinity management in the Basin?
9. Are there opportunities to improve governance arrangements for water quality and salinity?

Summary of findings

Salinity and salt export

Salinity targets for four of the five Basin Plan reporting sites were met for the 2014–19 reporting period (BSM 2030; 2018–19 Status report). The Basin Salinity target at Morgan was met over the period since 2012, and salinity at this site shows an ongoing decreasing trend as a result of salinity management efforts over the last 30 years (efforts under the Salinity and Drainage Strategy, the Basin Salinity Management Strategy 2001-2015, and the Basin Salinity Management 2030 strategy). Salt interception schemes play an important role during dry periods, and since 2012 have diverted on average 0.43 million tonnes/year of salt out of the system.

Additional environmental water passing through the river system as a result of the Basin Plan continues to contribute to reducing salinity levels and flushing salt into the Southern Ocean.

However, challenges include:

- extremely dry conditions, particularly in the northern Basin, limited the ability of water managers to meet some targets
- extended periods of below average inflows into the River Murray system make it difficult to flush annual average of two million tonnes of salt out of the Basin, while maintaining low salinity levels at target sites, over the long term.

Since the implementation of the Basin Plan in 2012:

- the five-yearly reporting period target at Burtundy (lower Darling River) has not been met with the exception of 2013–14
- salinity at Milang showed an increasing trend in 2019 due to ongoing dry conditions and is at risk of exceeding target levels in the next reporting period
- the salt export objective indicative figure of 2 million tonnes per year has not been met, with the exception of 2012–13.

Algal blooms and dissolved oxygen

The presence of algal blooms can lower dissolved oxygen, so the two water quality issues can be related. However, dissolved oxygen conditions can also develop from destratification, blackwater events and a number of other factors. Both low-flow conditions and returning flows from floodplains after high-flow events can lead to low dissolved oxygen conditions so management responses are varied and tailored to circumstances.

The period between 2014 and 2019 was particularly challenging for the management of algal blooms and dissolved oxygen in the Murray–Darling Basin. Extreme drought conditions persisted throughout the northern Basin and caused an extended cease-to-flow event in the lower Darling River in early 2019. Water managers have very limited capacity to use regulated flow releases to manage these events in the Barwon–Darling system. The lack of flow management options highlights the importance of preventative measures, such as cease to pump/commence to pump rules, extraction limits and land management to mitigate water quality impacts in the northern Basin.

Since the implementation of the Basin Plan in 2012, blue-green algae red alerts (exceedance of the recreation water quality target in the Basin Plan) were reported by the MDBA in:

- 2014–15—two sites on the lower Darling River
- 2015–16—widespread at multiple locations on the River Murray (including South Australian River Murray) and the lower Darling
- 2016–17—continuation of the 2015–16 event
- 2017–18—widespread, especially in the lower Darling River
- 2018–19 across many sites.

Reporting on dissolved oxygen levels against water quality targets for the period has been inconsistent since the implementation of the Basin Plan, while monitoring capacity continues to be developed.

A particular barrier is that natural diurnal and spatial variations in dissolved oxygen across the Basin, combined with difference in units of measurement of target and observed dissolved oxygen (% saturation versus mg/L), mean it is impractical to expect that dissolved oxygen could be maintained above 50% saturation as expressed in the Basin Plan.

Regardless, two events relating to low dissolved oxygen in particular had important consequences:

- in 2016–17, dissolved oxygen concentrations over 2 mg/L were reported in multiple sections of the Murray River and tributaries in the southern connected Basin. These conditions were the result of very high rainfall and extensive floodplain inundation in the south-eastern catchment, which was followed by a warmer summer than usual. Hypoxic (low dissolved oxygen) blackwater was also reported crossing the South Australian border and impacts downstream were mitigated using releases from Lake Victoria to create a dilution flow.
- two catastrophic fish kill events in December 2018 and February 2019 have been attributed to hypoxic conditions due to low or no flow in the lower Darling River. Water managers had few tools other than mechanical interventions (aerators) to respond.

These water quality issues present a major challenge for the MDBA and Basin state governments. Details of recommendations arising from these events are provided later in this report.

Management actions

River operators manage flows to meet water quality requirements. For example, dilution flows may be used to create turbulence to break up algal blooms or to flush salt from the river. However, river operators can be limited in their ability to mitigate events. For example, the efficient delivery of entitlements can be in conflict with actions for water quality purposes. A lack of options for flow management is particularly evident in the less developed northern Basin during extended periods of low flow or limited water availability.

The Basin Plan does not guide joint government action in the day-to-day management of water quality, but it is the mechanism by which governments collaborate on water quality and salinity management. This includes coordination of supporting actions, monitoring, early-warning systems, inter-jurisdictional collaboration and research essential to avoid and mitigate against the worst impacts of poor water quality.

The water quality actions taken since the implementation of the Basin Plan in 2012 have included:

- flow management strategies
- critical actions to support flow management strategies
- Basin salinity managed in accordance with long-term salinity management arrangements (Basin Salinity Management 2030 strategy and Schedule B of the Murray–Darling Basin Agreement).

Flow management strategies

Flow management strategies include:

- blue-green algae outbreaks managed in accordance with emergency management protocols guided by national guidelines
- ongoing regard to water quality when planning for and delivering water for the environment —including risk assessment and contingency planning
- specific and local management of water quality events using tools such as dilution flows, targeted storage releases or withholding releases, managing flow rates and system transfers
- ongoing regard to water quality when managing flows including:
    - sustaining minimum flows at key locations
    - avoiding delivery of overbank flows during warmer months
    - maintaining reserves for water quality management where practicable (e.g. the Goulburn reserve)
    - operating salt interception schemes, especially during dry years.

Actions to support flow management strategies

Actions to support flow management strategies include:

- local, State and Basin-wide monitoring programs and early-warning surveillance tools
- public notifications of algal blooms from state agencies, and alert maps consistent with the *Australian Guidelines for Managing Risks in Recreational Water*
- improved inter-jurisdictional collaboration via key forums and regular communication channels including:
    - regional algal coordinating committees (New South Wales), SA Water (South Australia) and Goulburn-Murray Water (Victoria) and communication between state government and MDBA algal coordinators
    - operations advisory or real-time management groups for environmental watering events
    - Basin Salinity Management Advisory Panel
    - Water Quality Advisory Panel
    - Southern Connected Basin Environmental Watering Committee
- dissemination of information at a local, State and Basin-wide level, including for public information, monitoring of trends and early warnings, and for the purposes of reporting and research
- documentation of how entities have had regard to water quality targets in annual reports and review cycles

- emergency response plans prepared as a central tool for directing actions during events
- addressing knowledge gaps, with a focus on improving understanding of dissolved oxygen and blackwater events—especially as a result of low flows and management return flows from floodplain inundation

The challenges faced across the Murray–Darling Basin since the implementation of the Basin Plan in 2012 have mainly related to flow management under low-flow conditions. As such, few reports have focused on examples of actions undertaken to mitigate against water quality impacts of floods. Water quality investigations into blackwater and elevated salinity events have progressed over the period since 2012, particularly in response to the events of 2016. These contribute to the ability of Basin governments to predict and respond effectively to some water quality issues due to flooding.

Opportunities

The water quality challenges faced over the 2012–19 period, including a number of significant water quality events, highlight the need to continue to improve the capacity of Basin governments and the MDBA to manage water quality and salinity, particularly in the context of low- or no-flow conditions. Given the severity of events in the past few years, this will also include ensuring critical water needs of local communities can continue to be met.

Recent reviews provide clear recommendations for improvement in the management of water quality and salinity. These reviews include:

- 2017 Basin Plan Evaluation
- 2018 Productivity Commission five-year assessment of the Basin Plan (Productivity Commission 2018)
- Independent assessment of the 2018-19 fish death events in the lower Darling (Vertessy et al. 2019)
- Independent report on stratification, mixing and fish deaths in the lower Darling (Baldwin 2019)
- Independent River Operators Reference Group reports (2013–19)
- Published article: 'Blue-green algae in the Murray Darling Basin: A case for Commonwealth leadership' (Clune and Eburn 2017).

Salinity and salt export

The 2017 Basin Plan Evaluation and 2018 Productivity Commission five-year assessment recommended both the Burtundy target on the Darling River, downstream of Menindee Lakes, and salt export objective indicative figure be a focus of the 2020 review of targets in the Basin Plan. This includes consideration of the causes of low flows in the Darling River, the appropriateness of the salinity targets, and the salt export objective as measures of success, including whether the salinity targets and salt export objective are in conflict. This review is expected to be finalised in late 2020.

Water quality

The focus of water quality related recommendations arising from recent reviews are summarised in Table 5.

Table 5 Summary of recommendations relating to water quality arising from recent reviews

Recommendation	Reference
Hasten and refine implementation of key elements of the Basin Plan with consideration to water quality	
Ensure protection of water for the environment in the northern Basin as per the Northern Basin Review findings.	MDBA 2017a; Vertessy et al. 2019
Finalise the accreditation of water resource plans as soon as possible.	Productivity Commission 2018
Improve the operation of Menindee Lakes under the sustainable diversion limit adjustment mechanism to mitigate water quality impacts.	Vertessy et al. 2019
Refine water quality monitoring programs and responses, particularly for times and sites of high risk	
Refine existing monitoring program prior to 2019–20 summer: • specifically addressing key responsibilities for future monitoring program in lower Darling River • addressing gaps in water quality monitoring sites and methods with an emphasis on target sites and spring-to-autumn monitoring during low-flow years.	Baldwin 2019
Add monitoring, analysis and reporting of water and air temperature to Basin monitoring programs	Baldwin 2019; Clune and Eburn 2017
Ensure the dissolved oxygen monitoring program provides a fit-for-purpose, meaningful and reliable assessment of dissolved oxygen levels against targets	Independent River Operators Reference Group 2018
Further research on key knowledge gaps for better prediction and prevention	
Address knowledge gaps relating to the drivers of sediment oxygen demand and native fish physiology and behaviour, and undertake mapping of bathymetry and monitoring of habitats	Baldwin 2019
Determine how to best manage water for the environment during prolonged dry spells	Vertessy et al. 2019
Increase use of modelling and risk assessment to identify specific risk areas to prioritise water quality and salinity improvements	Vertessy et al. 2019
Strengthen governance arrangements for management of water quality and salinity under the Basin Plan	
Consider governance arrangements for water quality and salinity in the context of MDBA's compliance and enforcement responsibilities once water resource plans come into effect	Productivity Commission 2018

Conclusion

The Basin salinity target at Morgan was met over the period since 2012 and salinity at this site continues to decrease. Salinity targets for four of the five Basin Plan reporting sites were also met for the 2014–19 reporting period. These achievements are the result of long-standing collaborative efforts, including ongoing diversion and export of salt from the river by salt interception schemes and river operations.

Jointly held water for the environment has now delivered benefits—including for the purpose of water quality management—to the river system for over 10 years. Environmental watering events have helped mitigate the effects of elevated salinity. Recently, environmental flows were also delivered to addressed connectivity issues in the northern Basin during periods of drought. However, on a number of occasions since the implementation of the Basin Plan, there were significant events of poor water quality during periods of low flows with Basin-wide impacts. These issues have highlighted the challenges faced by water managers to manage water quality and salinity in accordance with the targets under extreme conditions. These issues have also highlighted the need for water quality and salinity to be managed as part of the broader program of Basin Plan implementation, including through water resource plans.

In general, the requirement to 'have regard to' water quality when making flow management decisions appears to have been demonstrated. However, more could be done to document how the 'have regard' provision is considered in operational procedures and plans. In addition, Schedule 12 reporting does not illustrate in detail how flow management can be used in general to also manage water quality issues.

A number of important opportunities to improve water quality outcomes in the Basin have been identified in reviews and investigations between 2017 and 2019, and in this report. Action to address these issues is underway in conjunction with the broader program of Basin Plan implementation. It is important that this work continues given the likelihood of drier and warmer conditions, which will increase water quality threats faced by the Basin in the future.

Water quality and salinity management findings

To what extent have the Basin Plan salinity targets for the 2014–19 reporting period been met?

Salinity targets for flow management

There are five Basin Plan reporting sites (**Error! Reference source not found.**), where salinity should n ot exceed the following values 95% of the time during a water year (July to June). This information, together with flow information, is required to be collected continuously and reported annually.

Salinity targets for four of the five Basin Plan reporting sites were met for the 2014–19 reporting period.

The salinity target at Darling River downstream of Menindee Lakes at Burtundy was not met over the reporting period. Over the five-year reporting period ending in June 2019, recorded salinity at the Burtundy site was above the target for 46% of the time.

Table 6 Salinity levels at the reporting sites over the five-year period from 1 July 2014 to 30 June 2019, compared to the target values in Basin Plan (section 9.14)

Reporting site	Target value (EC*) (µS/cm)	Non-exceedance salinity at 95% of the time (µS/cm)**	% of days above the target value	Achievement of target
River Murray at Murray Bridge	830	540	0	✓
River Murray at Morgan	800	471	0	✓
River Murray at Lock 6	580	287	0	✓
Darling River downstream of Menindee Lakes at Burtundy	830	1,621	46	✗
Lower Lakes at Milang	1,000	996	4.6	✓

*EC is an electrical conductivity unit commonly used to indicate salt concentration or the salinity of water.
As a guide, EC > 800 µS/cm is marginal for drinking, EC > 1,600 µS/cm is brackish, EC > 4,800 µS/cm is saline.
** Salinity values are compiled from best available data (daily mean values derived from continuously logged data)

For the previous five-year reporting period of 2013–18, salinity at Burtundy was above the target value for 36% of days with a peak salinity of 3,406 EC in August 2016 (MDBA 2020d).

The August 2016 spike in salinity was suggested to be the result of record dry conditions in the Darling system in 2015–16 water year (MDBA 2020d). The lower Darling River downstream of Menindee Lakes experienced eight consecutive months of no flow, the longest no-flow period since the construction of the Menindee Lakes scheme. Hence it was not possible to draw on water from Menindee Lakes for dilution purposes to mitigate the high salinity in the lower Darling River during that time.

Exceedance of the target of salinity at Burtundy has been consistent over a longer period in particular during periods of low flows.

Similarly, salinity levels at Milang showed a slightly increasing trend through time and the suggests that if this trend continues and current conditions persist, there is a risk that the Milang target may not be achieved in the next reporting period (MDBA 2020d).

Under the Basin Plan, the MDBA is required to review the water quality targets in the water quality and salinity management plan by 2020. This review will need to consider a number of factors related to the evolution of the Basin Plan over time and under changing conditions.

The Assessment of the salt export objective and salinity targets for flow management 2018–19 report (MDBA 2020d) report identifies the following for consideration:

- the future flow regime in the northern Basin and lower Darling River following the changes made to the Basin Plan arising from the Northern Basin Review.
- the future effect of enhanced protection of environmental flows, which is one of the northern Basin toolkit measures, and the future management arrangements for Menindee Lakes linked to the implementation of a sustainable diversion limit adjustment mechanism project.

The Basin Salinity Target modelled for Morgan was met for the 2014-2019 reporting period continuing the decreasing trend in salinity at this site over the last 35 years (Figure 6).

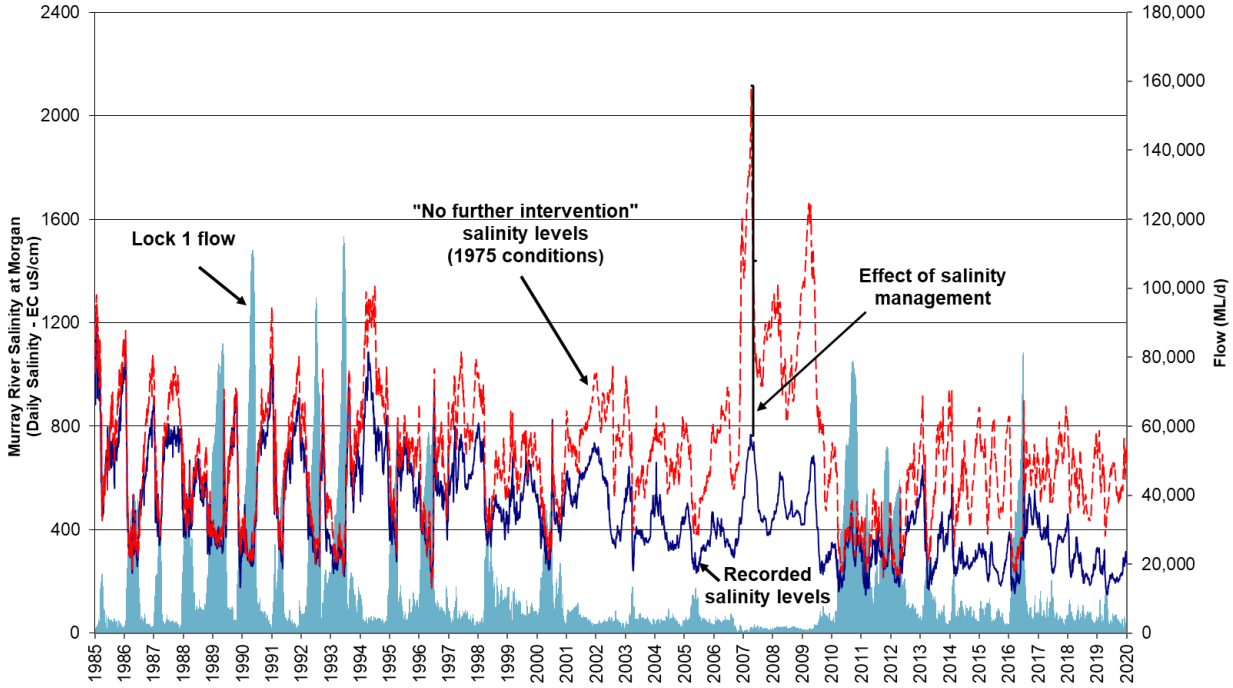

Figure 6 Decreasing salinity in the River Murray.

Long-term salinity planning

For long-term salinity planning under the Basin Salinity Management 2030 strategy, salinity values are modelled for the Murray River at Morgan, to demonstrate that the average daily salinity here is maintained at a level below 800 EC for at least 95% of the time (the Basin salinity target). The modelling uses a 1975–2000 benchmark period of hydrologic conditions to encompass the expected long-term range of climate variability.

The Murray–Darling Basin Agreement also provides end-of-valley targets in Appendix 1, Schedule B, which must be applied in long-term salinity planning and management. Under the current BSM 2030 strategy, the role of end-of-valley targets is to provide a valley scale context to the identification and management of salinity risks to the shared water resources. End-of-valley targets must be monitored daily and reported, together with stream flow, annually.

To what extent has there been adequate flushing of salt from the River Murray into the Southern Ocean since the implementation of the Basin Plan?

The Basin Plan includes a salt export objective to ensure salt is flushed at a sufficient rate into the Southern Ocean from the River Murray system. The objective is expected to be achieved if more than 2 million tonnes of salt per year (averaged over three preceding years prior to and including the reporting year) are exported to the Southern Ocean from the River Murray system.

Even though flow and salinity information over the barrages is available, the salinity and flows required to calculate the amount of salt exported to the Southern Ocean cannot be measured with any accuracy at the mouth of the Murray River. This is due to tides, shifting sands and water exchanges at the mouth from areas other than the River Murray (e.g. the North Coorong).

A technical report in 2013 recommended that River Murray flow estimates over the barrages and observed average salinity in Lake Alexandrina were used as surrogates to estimate salt export in the short term.

The report also recommended that the accuracy of flow estimates over the barrages and Lake Alexandrina salinity be improved over time by reviewing data collection programs and refining the methodology.

For the 2012–13 to the 2017–18 years, the salt export objective of over 2 million tonnes per year from the River Murray system to the Southern Ocean has only been met once, in the first year of the Basin Plan, 2012–13 (Table 7). All other years the export ranged from 0.56 to 1.5 million tonnes per year[8]. However, information on the wider context of overall salinity management in the Basin, including estimates of salt diverted away from the river by salt interception schemes and salt loads at other key locations in the Basin suggest that overall salinity management in the Basin has been successful.

Table 7 Estimated salt export

Reporting	3-year period for averaging	Estimated salt export during the 3-year period
2018–19	Annual average July 2016 to June 2019	0.94 million tonnes per year
2017–18	Annual average July 2015 to June 2018	0.86 million tonnes per year
2016–17	Annual average July 2014 to June 2017	0.87 million tonnes per year
2015–16	Annual average July 2013 to June 2016	0.56 million tonnes per year
2014–15	Annual average July 2012 to June 2015	0.9 million tonnes per year
2013–14	Annual average July 2011 to June 2014	1.5 million tonnes per year
2012–13	Annual average July 2010 to June 2013	2.9 million tonnes per year

The salt export objective of flushing 2 million tonnes of salt per year from the River Murray into the Southern Ocean, as defined in the Basin Plan, has not been met since the implementation of the Basin Plan, except for the first year of the Plan, 2012–13.

[8] Salt export is averaged over 3 years prior to and including the reporting year

There can be an inherent conflict for management to meet site-specific salinity targets, while meeting the salt export objective in periods of low flows. During periods of low flow, managing the river to meet the salt export objective can lead to higher salinity levels in the river. A 2017 report by the MDBA (MDBA 2017b) recommended that maintaining water quality that is fit for purpose by meeting salinity targets should be prioritised over meeting the salt export objective.

What are the key events and developments relating to water quality and salinity since 2012?

The key events and devleopment related to water quality and salinity since 2012 are descrribed in Table 8.

Table 8 Key events and developments relating to salinity and water quality since 2012

Year	Salinity and water quality events	Key developments
2012–13	Fish kills in the lower Darling due to low dissolved oxygen and moderate algal blooms in mid-February, resolved with Menindee Lakes releases. Burtundy salinity target exceeded in March 2013 but salinity spike avoided with releases from Menindee Lakes. Salt export indicative figure met.	Basin Plan 2012 came into effect. The Independent River Operators Reference Group recommended review of diffuse monitoring programs for cyanobacteria (blue-green algae). Salinity export assessment approach developed by MDBA.
2013–14	Menindee Lakes operated to balance risk of lowering water quality in the lower Darling River. Salt export indicative figure not met.	River Murray Operations expanded dissolved oxygen monitoring capability and collation of existing dissolved oxygen data collections. River Murray Operations developed collated onscreen cyanobacteria status map.
2014–15	Hume Dam levels kept above 20% to mitigate against algal bloom risk. Cyanobacteria red alert at 2 sites outside of RMO control. Burtundy and Milang salinity targets not met. Salt export indicative figure not met.	River Murray Operations continued to expand collation of existing dissolved oxygen data collection. River Murray Operations enhanced capacity to detect risks of low dissolved oxygen due to oxygen depletion in floodplain return water. Introduction of ROWS system allows for enhanced real-time salinity data collection. The Independent River Operators Reference Group recommended that the MDBA define key locations and methods of assessment of dissolved oxygen levels for comparison against dissolved oxygen Basin Plan targets.
2015–16	Widespread exceedance of cyanobacteria red alert along the River Murray, lower Darling River and South Australian River Murray in Autumn 2016. MDBA used dilution flows, fluctuations and exchanged River Murray and Lake Victoria water to mitigate impacts.	The Independent River Operators Reference Group advised the MDBA had limited capacity to mitigate the risks of water quality targets being threatened or at risk, given limited tools and operational constraints. River Murray Operations continued to automate and extend dissolved oxygen and water quality monitoring for times and sites of increased risk.

Year	Salinity and water quality events	Key developments
	Burtundy salinity targets not met. Peak salinity at Burtundy of 1,764 EC in May 2016 due to low flows for three years in a row. Salt export indicative figure not met.	Salinity trigger values were incorporated to provide salinity warnings and improve capacity to manage salt interception schemes in line with salinity risk outlook.
2016–17	Widespread cyanobacteria red alert continues until spring 2016. Dissolved oxygen above 2 mg/L in December and January in multiple locations in the Murray, lower Goulburn and lower Murrumbidgee rivers. Hypoxic blackwater crossing South Australia border in November 2016 led the MDBA and the South Australia Department of Environment, Water and Natural Resources to use releases from Lake Victoria to create dilution flow which kept dissolved oxygen levels above 4mg/L. Burtundy salinity target not met with major peak salinity of 3,406 EC in August 2016. Salinity trigger level above 1,400 EC on the River Murray was reached for 2.5 months of the water year. 'Salt slug' followed recession of high flows in December and January and the MDBA worked with stakeholders to manage weirs and speed up the draining of the salt slug. Salt export indicative figure not met.	The Independent River Operators Reference Group identified opportunities to develop multi-disciplinary and multi-jurisdictional blackwater management strategies.
2017–18	Widespread cyanobacteria red alerts issued for the lower Darling and Edward-Wakool rivers and at Lake Victoria, where releases were held to prevent impacts on water quality downstream. The dissolved oxygen target was not met at monitoring sites on the Goulburn, Darling and Murray, but dissolved oxygen was above 30% and no evidence of blackwater or biological effects of low dissolved oxygen was observed. Burtundy salinity target not met.	The Northern Connectivity Flow Event (April 2018) built on natural inflows and provided for connectivity between waterholes across multiple river systems to protect and support native fish. The MDBA (River Operations Improvement Team) reviewed potential responses to extreme dry conditions.

Year	Salinity and water quality events	Key developments
	Salt export indicative figure not met.	
2018–19	Catastrophic fish deaths in December 2018 and February 2019 in the lower Darling and Murrumbidgee, two counts found to be due to hypoxia. Many cyanobacteria red alerts from December 2018 to February 2019. MDBA did not have operational control of Menindee and had few tools available to respond to events, other than mechanical interventions (aerators). Burtundy salinity target not met with the non-exceedance value[9] over 1,600 EC for the fourth year in a row. Flows dropping to zero caused salinity measurement at Burtundy to stop. Milang salinity approached but did not exceed target levels. Salt export indicative figure not met.	MDBA action plan released (January 2019) in response to fish death events in December 2018 released outlining catchments at immediate risk, information about what is being done and recommending short-, medium- and long-term needs for consideration by the Australian Government. An environmental flow (January to April 2019) provided refuge flows to the lower Murrumbidgee River was successful in improving dissolved oxygen levels with no further fish deaths reported. The Northern Fish Flow event (April and May 2019) provided for connectivity between waterholes across multiple river systems to protect and support native fish Independent assessment of the 2018–19 fish deaths in the lower Darling River was conducted in March 2019 and made 27 recommendations for further action (Vertessy et al. 2019). Report and monitoring program commissioned by MDBA to examine issues of stratification, mixing and dissolved oxygen concentrations relating to the 2018–19 fish deaths and made nine recommendations for further action (Baldwin 2019).
2019–20	Water year and reporting for the period not yet complete.	Basin governments prepared a native fish emergency response Plan for the 2019–20 summer to ensure actions are coordinated and resources available to respond quickly to address risks to fish populations. *Flow management guideline: Having regard to water quality targets* was published.

[9] i.e. The salinity value not exceeded 95% of the time, estimated over the five-year reporting period

To what extent have the MDBA, Basin state governments and the Commonwealth Environmental Water Holder had regard to targets for salinity, dissolved oxygen and blue-green algae outbreaks when making flow management decisions?

The Basin Plan requires the MDBA, Basin state governments and the Commonwealth Environmental Water Holder to have regard to targets for salinity, dissolved oxygen and blue-green algae. The following targets apply (Basin Plan Chapter 9 Part 3):

> (a) to maintain dissolved oxygen at a target value of at least 50% saturation at 25°C and 1 atmosphere of pressure;
> (b) for recreational water quality, the values for cyanobacteria cell counts or biovolume meet the guideline values set out in Chapter 6 of the Guidelines for Managing Risks in Recreational Water, which states that fresh recreational water bodies should not contain:
> i. ≥10 µg/L total microcystins; ≥50 000 cells/mL toxic Microcystis aeruginosa; or biovolume equivalent of ≥4 mm^3/L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume; or
> ii. ≥10 mm^3/L for total biovolume of all cyanobacterial material where known toxins are not present; or
> iii. cyanobacterial scums consistently present;
> (c) salinity measurements need to be below target levels at reporting sites 95% of the time over a five year period (refer to research question for the target levels).

Where the Basin Plan requires that a person 'have regard to' a matter, or that 'regard must be had' to a matter, this means that the relevant decision maker must give those matters proper, genuine and realistic consideration.

Flow management decisions fall into both longer-term policy development and the development of short-term operational procedures.

Extensive, year-by-year information and case study descriptions on this matter, available in the Basin Plan Schedule 12 reports (i.e. reporting from 5 entities over 5 years), were analysed to address this research question.

The Independent River Operators Reference Group reviews and reports on the MDBA compliance with its requirement to have regard to the water quality targets in the Basin Plan when undertaking its flow management functions each year. These reports were reviewed to address this research question.

The capacity of the MDBA to influence water quality outcomes as part of its flow management activities is limited under many circumstances. Even where capacity to provide dilution flows exists, the MDBA may be prevented from acting by the need to avoid potential or material impact on state water entitlements.

In general, the requirement of reporting in a standardised template has resulted in clear articulation of how regard to water quality targets was had in making flow management decisions each year.

Evidence for consideration of salinity, dissolved oxygen and blue-green algae issues in making operational decisions on flow management is clearly reported in narrative form by most entities on a year-by-year basis in the Basin Plan Schedule 12 reports. Detailed descriptions of case studies are also provided in the reports and selected ones are used to illustrate the effectiveness of Basin Plan implementation in the MDBA's annual Basin Plan report.

A summary of information contained in Basin Plan, Independent River Operators Reference Group reporting for 2018–19 and other relevant documents is below.

MDBA

The Independent River Operators Reference Group reports state the capacity of the MDBA to influence water quality outcomes as part of its flow management activities is limited under many circumstances. Even where a capacity to provide dilution flows exists, the MDBA may be prevented from acting by the need to avoid potential or material impact on state water entitlements. The report also notes the MDBA maintains a water quality data base to support flow management decision-making.

A review of the Independent River Operators Reference Group reports shows MDBA has had regard for dissolved oxygen targets through a range of activities including:

- maintaining minimum flow rates at strategic points, according to the River Murray 'Operations objectives and outcomes' document
- contributing to the monitoring of dissolved oxygen levels along the Murray at key locations
- reviewing real-time dissolved oxygen information collated and periodically provided by the New South Wales Office of Water. This served as a surveillance tool intended to provide 'early warning' of potential low dissolved oxygen levels
- facilitating Lake Victoria transfers and delivering at a seasonally appropriate time.

Regarding the Basin Plan target for recreational water quality, the MDBA had regard by:

- contributing to the collaborative monitoring program
- maintaining weekly maps of blue-green algae alerts for the Basin
- liaising with regional groups and jurisdictional partners
- managing flows to mitigate the impact of algal bloom where possible.

The MDBA demonstrated regard for salinity by managing flows, where practicable, in the southern connected Basin in such a way that target values were not exceeded (with the exception of exceedances at Milang), by carrying out appropriate monitoring, and by supporting projects led by state partners.

MDBA also had regard through its involvement in environmental watering coordination in the southern Basin. For example:

- The Southern Connected Basin Environmental Watering Committee (SCBEWC) has a risk management strategy to identify, evaluate and control risks associated with coordinating the delivery of water for the environment and a framework for managing salinity spikes.

- Jointly held water for the environment has been delivered to support the health of the River Murray for over 10 years and a range of management and tools have been developed to assist decision-making.
- The MDBA is working with partner governments to develop operating plans for environmental works that include manage risks, including water quality risks, associated with the delivery of water for the environment.
- The MDBA is developing models to inform environmental watering activities.

In addition, the MDBA has developed a guideline to provide additional advice on having regard to water quality targets for managing water flows in the Murray–Darling Basin. The guideline applies to the management of water flows by the MDBA, the Basin Officials Committee and agencies of the Basin States, and to decisions about the use of water for the environment by the Commonwealth Environmental Water Holder, holders of held environmental water and managers of planned environmental water.

Commonwealth Environmental Water Office[10]

The Commonwealth Environmental Water Office (CEWO) considers expert regional knowledge, in-field monitoring and salinity forecast modelling to support the planning and active management of the Commonwealth environmental water portfolio. For every Commonwealth watering action, a risk assessment is undertaken 'including with regard to the Basin Plan's water quality and salinity targets for managing water flows.

As part of these risk assessments, contingency plans and procedures for the monitoring and operational response to risks are developed and integrated within the delivery arrangements for Commonwealth environmental water use.

Delivery arrangements are agreed with state delivery partners through Watering Schedules, which outline the operational strategies and procedures for the management of Commonwealth environmental water, including the ongoing assessment and management of water quality risks where required.

New South Wales

In New South Wales, when delivering water for the environment, managers assess delivery risks, including those associated with water quality. On completion of a watering event, any issues—including those relating to water quality—are identified and documented. This information is used to inform adaptive management of environmental water delivery.

Other current procedures and tools to enable meeting water quality targets for dissolved oxygen, recreational water quality and salinity are:

- operating a network of dissolved oxygen early warning sensors in the Murray and Riverina regions
- physical monitoring of dissolved oxygen occurred routinely in all New South Wales Murray–Darling Basin catchments

[10] The Commonwealth Environmental Water Office supports the statutory Commonwealth Environmental Water Holder position

- response to the risk of algal blooms through managed by the regional algal coordinating committees and a state-wide algal monitoring program.

The Basin Plan annual Schedule 12 reports contain some ad-hoc examples of water quality considerations in the delivery of consumptive water (e.g. from the 2016–17 report 'The Lachlan water quality allowance was used to maintain flows >100 ML/day at Booligal in the lower Lachlan between January and April 2019. The primary purpose was to reduce the risk of algal blooms'). However, the reports do not include information about operational procedures or guidelines, or about longer-term policy development.

Victoria

The Victorian annual Schedule 12 reports contain information about long-term and annual environmental flows planning, long-term and annual risk management processes, and processes for responding to current water quality conditions. The reports also include information about the obligations of Victorian water corporations to ensure risks associated with the functions they perform are identified, prioritised and managed. This includes the development of a specific emergency management plan for risks to water quality and discrete requirements for reporting on any blue-green algae blooms affecting water supply or delivery services.

The reports also contain evidence that Victoria had regard to the dissolved oxygen targets, (through Goulburn Murray Water), by:

- maintaining minimum flow provisions
- contributing to real-time and spot monitoring at locations along Victorian tributaries, including daily dissolved oxygen in daily data for operational planning
- participating in advisory groups for e-water planning
- maintaining a 30 GL reserve in the Goulburn system for mitigation of poor water quality.

In relation to recreational water quality targets, Goulburn Murray Water has demonstrated regard through:

- operating as the delegated regional coordinator for blue-green algae management across northern Victorian water systems
- participating in the Murray Regional Algal Coordinating Committee (MRACC) convened by the New South Wales Government
- maintaining regional blue-green algae management plans for northern Victorian water systems
- maintaining local blue-green algae management for Goulburn Murray Water-operated water storages and irrigation areas
- contributing to the monitoring of blue-green algae concentrations at key locations in Victorian tributaries to the River Murray
- distributing regular external reports on blue-green algae concentrations at key locations and issuing extra reports (including media releases for public information and regular email correspondence with Victorian water management agencies) as data trended towards target levels
- maintaining the availability of the 30 gigalitre reserve in the Goulburn system for mitigation of poor water quality.

Goulburn Murray Water had regard to the salinity targets of section 9.14(5)(c) by:

- maintaining the minimum flow provisions of the bulk entitlements for the Ovens, Broken, Goulburn, Campaspe and Loddon bulk entitlements
- contributing to the monitoring of salinity concentrations (real-time and spot measurement) at locations along the Victorian tributaries to the River Murray (e.g. Rice's Weir and Goulburn Weir)
- including salinity concentration data in daily data used for operational planning
- participating in operations advisory groups for environmental watering events including the Barmah-Millewa Forest, Goulburn River, Campaspe River, Loddon River, Gunbower Forest and Hattah Lakes as appropriate.

South Australia

South Australia has had regard to the water quality through the South Australian River Murray Operating Plan and the Annual Environmental Watering Plan, which guide River Murray operational decisions in South Australia, consistent with Basin Plan objectives.

The Annual Environmental Watering Plan describes risk management, which is undertaken in accordance with Basin Plan objectives. This includes consideration of flow management targets key water quality factors (including dissolved oxygen, cyanobacteria bio-volume and salinity). In particular, site and water managers consider potential water quality impacts during annual and real-time planning (including potential cumulative impacts from multi-site actions) and manage any risks that may emerge once water is being delivered in real time.

The Department for Environment and Water, SA Water and the MDBA work cooperatively to manage arrangements for the delivery of water to South Australia for all purposes including water for the environment. During 2018–19, flow management and environmental watering decisions were made daily by the Department for Environment and Water, consistent with the objectives and outcomes of the South Australian River Murray Operating Plan and the Annual Environmental Watering Plan plans.

Proposed actions, delivery mechanisms and costs are described by managers in their watering proposals. Real time environmental management groups operate to adapt watering actions in response to changing conditions and provide advice on the preferred pattern of delivery for environmental outcomes. These groups include the Barrage Operations, Advisory Group, Chowilla Operations Group and the Environmental Flows Reference Group.

Before implementing environmental watering actions that extract or use water from the River Murray, managers need to submit an action request form to the River Murray Operations Working Group. This form is used to consider impacts on the operation of the River, potential risks and water quality impacts—including cumulative impacts where multiple actions are to be undertaken at similar times. This process also assists in the coordination of environmental watering activity and allows the Department of Environment and Water to have oversight of environmental watering activities throughout the region.

During 2018–19, a total of 52 River Murray action requests were submitted to Department of Environment and Water relating to wetland management, increasing flows through regulators, floodplain management, raising and lowering of weir pools, and testing of injection bores. All

requests were assessed for their individual and cumulative impacts on the River Murray and downstream users, and all requests were deemed as low risk to water quality. Water quality monitoring is required, prior to and after actions, to ensure the action did not result in an unintended consequence.

Queensland

Queensland has limited opportunity to 'have regard to water quality targets' when making flow decisions, as the largely unregulated nature of rivers in the Queensland part of the Murray–Darling Basin prevents active management of un-supplemented flows. There are some medium-sized storages in the Queensland area of the Murray–Darling Basin that do supply irrigation water (e.g. Leslie Dam, Beardmore Dam, Coolmunda Dam and Glenlyon Dam); however, the Queensland Government reports that there is no evidence that these releases have any effect on the targets in s9.14(5) (Basin Plan Schedule 12 *for 2018–19*).

However, even though there is limited ability to 'have regard to water quality targets when making flow decisions', the Queensland Government coordinated, consulted and cooperated with other Basin jurisdictions on the management and delivery of water for the environment in both 2017 and 2019, particularly in the Border Rivers water resource plan area. This included participation in the Northern Connectivity Event in April 2018 and the Northern Fish Flow Event in April and May 2019. The Northern Connectivity Event (2017–18) built on natural inflows and provided for connectivity between waterholes across multiple river systems in the northern Basin, including the Border Rivers, to protect and support native fish. The Northern Fish Flow (2018–19) provided for connectivity between waterholes across multiple river systems to protect and support native fish.

The Queensland Government has also participated in the Commonwealth Environmental Water Office's event-based management project for the Lower Balonne. This included work that led to an amendment of the Basin Plan Intergovernmental Agreement to include the creation of a formal group to enhance the communication across the northern Basin and provide a future forum for discussion of the management of environmental flows on both sides of the Queensland–New South Wales border. The formal establishment of interjurisdictional collaboration is an opportunity to examine how water quality and salinity can be integrated into interjurisdictional management actions across the northern Basin.

Summary

In general, most entities provide a large amount of information, from descriptions of opportunistic collaborative arrangements during blue-green algae events or low dissolved oxygen incidents to structured risk assessments associated with operational and flow management decisions that explicitly consider the effects of alternate flow management scenarios on water quality parameters.

In general, the requirement to 'have regard to' water quality when making flow-management decisions appears to have been demonstrated by the MDBA, the Commonwealth Environmental Water Holder and the Basin state governments. The Australian Capital Territory is an exception as it is largely within an unregulated part of the Murrumbidgee River system and is limited in its ability to influence flows through management actions.

River managers are encouraged to document how they plan to 'have regard' to water quality management in their business planning, operating and reviewing cycles. This is evident to a limited

extent in operational procedure documents like the annual River Murray System Operational Plan, which identifies potential water quality considerations under different environmental releases proposed for the year, and MDBA's annual River Murry Operations 'Objectives and outcomes' document.

Similarly, the lower Darling operational plan has some water quality operational procedures, but they are related to consumptive water issues rather than the whole range of water quality considerations included in Chapter 9 of the Basin Plan—such as water quality targets for ecosystems dependent on fresh water.

The publication of the *Guideline: 'having regard' to Water Quality Targets for Managing Water Flows* in September 2019 has the potential to guide river managers and environmental water managers in what relevant considerations of salinity, dissolved oxygen and blue-green algae may be in relation to making water flow decisions at site scales to system scales.

What actions are underway to monitor and report on dissolved oxygen levels and blue-green algae outbreaks? How is this information used in water quality and salinity management?

Monitoring for dissolved oxygen levels and blue-green algae outbreaks are part of:

- event-based management of water quality issues
- operations and water for the environment planning or delivery activities
- targeted investigations of specific issues, such as the investigation of stratification following the fish death events in the lower Darling in 2018 and 2019 (Baldwin 2019).

Blue-green algae monitoring

When blue-green algae outbreaks occur, they are managed in accordance with emergency management protocols guided by the national guidelines.

The management of individual algal blooms is best undertaken at a local level, as the most effective approaches differ according to each bloom and location. In the southern Basin, well-established cooperative arrangements exist to monitor and manage blue-green algae outbreaks. This is done by regional algal coordinating committees in New South Wales, SA Water in South Australia, and Goulburn-Murray Water in Victoria.

These organisations put out public alerts to make sure all water users are aware of problems and know to avoid direct contact with the water. These alerts come out as media statements, signage at selected sites and direct advice to groups of river users. Once a blue-green algae bloom occurs, very little can be done to stop it.

In addition, the Murray Regional Algal Coordinating Committee supports coordination across the Basin at a broad scale and interjurisdictional arrangements depend on the scale, location and size of individual blooms.

Blue-green algae outbreaks can also be detected through reports from the public.

Routine reporting of monitoring information differs between jurisdictions. WaterNSW routinely provides information on blue-green algae levels at sites in Murray River on its website, including alert

level and date when the last samples were taken. Other jurisdictions, including the MBDA, provide information only during outbreaks or high-risk periods, such as summer.

Once an outbreak has been detected, monitoring may be expanded in line with risk assessments and response plans. During a blue-green algae outbreak, the MDBA supports the Murray Regional Algal Committee by producing River Murray System-wide maps. The committee can then use these maps for updates and public alerts.

WaterNSW uses three alert levels (green, amber and red) aligned with the National Health and Medical Research Council guidelines (NHMRC 2008). Red alert levels represent bloom conditions. At amber alert levels, blue-green algae may be multiplying. At green alert levels, blue-green algae are present in the water at low densities, possibly signalling the early stages of the development of a bloom, or a period where a bloom is declining.

At a green alert level, routine monitoring is all that is called for. An amber alert level triggers increased sampling and a red alert level triggers notification of the public through signage and media avenues. In addition, monitoring results should be forwarded to the appropriate regional algal coordinating committees for further dissemination and assistance in managing blooms.

Dissolved oxygen monitoring

Dissolved oxygen monitoring is also part of routine monitoring across the Basin, as well as targeted monitoring during high-risk times or in response to specific incidents. Again, interjurisdictional coordination may be required to respond appropriately to these events, although a recent review suggested that a lack of clarity around roles and responsibilities of different jurisdictions and organisations can delay appropriate actions to respond to an event (Baldwin 2019).

Following several fish death events in the lower Darling in December 2018 and January 2019, the MDBA commissioned a comprehensive monitoring program to examine stratification, mixing and dissolved oxygen concentrations in the lower Darling River over the following summer (Baldwin 2019). The report was delivered in July 2019 and recommended that prior to the beginning of the summer of 2019–20, key stakeholders should meet to address the question of who has responsibility for the design, implementation, data interpretation, reporting and resourcing of future monitoring programs in the lower Darling River at sites that are not currently being routinely monitored by WaterNSW.

The Baldwin report also recommended that, unless there are substantial inflows in the lower Darling River, water quality monitoring should be undertaken from late spring to late autumn in 2019–20, and in subsequent years with low or no flow.

Future monitoring programs should include measurements of dissolved oxygen and other parameters at the surface (top 10 cm) and bottom of the sampling site.

The following examples illustrate recent actions to monitor and report on dissolved oxygen levels and blue-green algae outbreaks by Basin States, the MDBA and the Commonwealth Environmental Water Office. They also illustrate how the information was used in water quality and salinity management.

The examples are extracted from the 2017–18 and 2018–19 Schedule 12 implementation reports, and IRORG reports.

Example 1

Widely publicised, fish deaths in the lower Darling and Murrumbidgee have resulted in considerable activity around the causes (and prevention) of hypoxia. This has included an audit of regional dissolved oxygen data including routine monitoring and special projects. It provides an opportunity to develop a fit-for-purpose dissolved oxygen monitoring program in collaboration with state partners and observing the principles described at the beginning of this section. It is hoped that, in the long term, predictive models, where appropriate, will be generated from these data – in line with adaptive management principles.

Assessing dissolved oxygen for a site (be it a sampling point or a whole water body) or describing its oxygen 'environment' over a period, is put at risk by spatial and temporal variability (as described above). It is further threatened by deterioration of sensing equipment in the field (over a period of 1-2 weeks). Sound quality of sampling design and sample analysis is necessary for a reliable dissolved oxygen monitoring program. The MDBA supports a substantial dissolved oxygen monitoring program in collaboration with state partners sampling at nearly 200 sites throughout the lowland sections of the major rivers of the Basin. Most of the data are provided by state authorities in the form of continuous (15-minute intervals) logging of dissolved oxygen concentration.

Example 2

Environmental water holders were able to be responsive to deteriorating water quality conditions in the lower Murrumbidgee and prevented further mass fish deaths through delivering elevated base flows over the summer months, but active management of water in the lower Darling was not an option due to low water availability.

An action plan was developed in January 2019 to highlight how Basin governments were working together to mitigate fish death risks, including a recommended action plan to manage the risk of future fish deaths.

An independent panel was appointed by the Australian Government to assess fish death events in December 2018 and January 2019. A preliminary report and early advice and recommendations was provided to the Australian Government Minister for Agriculture and Water Resources on 20 February 2019. The final report was released in April 2019, along with a summary of the report findings.

In the lower Darling, a water quality monitoring program was implemented from January to May 2019. The data gathered from monitoring, funded as part of the Joint Venture under the emergency response provisions in the Murray–Darling Basin Agreement, provided near real-time information to New South Wales Fisheries staff, while also supporting the evaluation of the efficacy of different types of aeration technology. The learnings from this monitoring are informing preparations for the summer of 2019–20.

The MDBA worked with the community, the Central Darling Shire Council and the New South Wales Department of Primary Industries to contribute towards the costs of installing, operating, monitoring and removing the aerators, through use of River Health Joint Venture Funding under the Murray–Darling Basin Agreement. Expert water quality advice suggests that the deployment of aerators in the lower Darling provided refuge habitat for native fish and likely prevented further fish deaths.

From January to April 2019, approximately 26 GL of water for the environment was delivered to provide refuge flows to the lower Murrumbidgee River. This action was successful, as dissolved oxygen levels significantly improved and there were no further reports of mass fish deaths. The coordinated action comprised 16 GL from the jointly held Living Murray portfolio, 5 GL of Commonwealth water and 5 GL of New South Wales Environmental Water Allocation.

Example 3

Blue-green algae

During 2017–18, red alerts for blue-green algae were issued by States at a number of locations in the southern Murray–Darling Basin. The MDBA considered the algal alerts when making flow management decisions in a number of instances with mixed responses:

- In the lower Darling, red alerts for blue-green algae were issued at several locations including the lower Darling between Pooncarrie and Burtundy, Weir 32, Lake Tandure, Lake Wetherell and Lake Menindee. A red alert was first issued for the Menindee Lakes and lower Darling on 6 September 2017. Due to limited water availability and inflow from upstream there were limited operational options available to help address water quality issues.
- In the first week of March 2018 red alerts for blue-green algae were issued in the Edward-Wakool at Merran Creek (adjacent to Lake Tooim), the Edward River at Deniliquin and the Gulpa Creek at Mathoura. No practicable changes to flow management were possible to the MDBA and the red alerts were lifted for the Edward River by mid-March 2018.
- A red alert for blue-green algae was issued for the Lake Victoria outlet in the first week of March 2018. During the bloom, the MDBA and SA Water kept the releases from Lake Victoria as low as practical to limit impacts on water quality downstream.

Dissolved oxygen

A natural event in the Ovens River system in December 2017 resulted in higher flows in the River Murray downstream of Yarrawonga Weir and the opening of some Barmah–Millewa Forest regulators. A range of risk mitigation strategies were explored by river operators, including assessing whether additional water could be supplied to localised areas to improve dissolved oxygen levels. Consideration was also given to whether prolonging floodplain inundation of Barmah–Millewa Forest would be beneficial.

Collectively it was decided that the best operational strategy was to allow the flow to recede naturally to within channel capacity through the Barmah–Millewa Forest, and to reroute some of the flow already in transit down the Murray to the Edward River. Dissolved oxygen levels started to rise in affected locations and the operational strategy was considered a success. No further actions were required.

Example 4

Goulburn River

In December 2017, rainfall resulted in overbank and near bank full flows in the Goulburn River. Recognising the risk of decreased dissolved oxygen levels from increase in organic matter and rising summer temperatures, water managers including the Commonwealth Environmental Water Office worked proactively with on-ground managers from the Goulburn Catchment Management Authority

and the Victorian Environmental Water Holder to support the delivery of flows which would assist in managing the risk of a hypoxic blackwater event.

As the natural flows receded, use of Commonwealth water for the environment recommenced to maintain base flows while water for the environment from the Victorian Environmental Water Holder's Water Quality Reserve was delivered across a 10 day period to slow the recession in the peak flow and to increase the flow rate to help dilute organic matter. The coordination between Commonwealth and Victorian environmental water holders helped stabilise dissolved oxygen levels and supported fish health.

Edward-Wakool and Lachlan Rivers

The Commonwealth Environmental Water Office is required to have regard to the recreational water quality targets of blue-green algae of the Basin Plan, which guide the green, amber and red alert levels issued by relevant state management agencies. Because of this, use of Commonwealth water has been suspended in a number of catchments during periods of blue-green algae red alerts. This reflects a consideration of the risk that the use of water could impact on the water quality of towns and communities located further downstream.

During early March 2018, red alerts for blue-green algae were issued in the New South Wales Edward-Wakool River and Lachlan River catchments. The use of Commonwealth water for the environment was suspended in both catchments as there was a risk that it may adversely impact on downstream communities.

This suspension was lifted once the relevant blue-green algae alert levels had changed from red to amber. This demonstrates how Commonwealth environmental water holdings are being adaptively managed in collaboration with other water managers and state agencies to limit any negative impacts of environmental watering on local communities.

Example 5

Dissolved oxygen

The New South Wales Government operates a network of dissolved oxygen early warning sensors in the Murray and Riverina regions. Information from these sensors is disseminated weekly during high risk times and management options discussed by multi-agency river operation groups when a warning for a potential low dissolved oxygen or blackwater event is triggered. This enables the New South Wales Government to respond rapidly to prevent a blackwater event.

Physical monitoring of dissolved oxygen occurs routinely in all New South Wales Murray–Darling Basin catchments, with the potential to monitor key water flow events as required during high-risk times. This also allows the New South Wales Government to identify areas where there are risks from low dissolved oxygen. As an example, in the Gwydir valley New South Wales Department of Planning, Industry and Environment has identified that part of its watering portfolio is to prevent blackwater events happening following long dry periods.

Blue-green algae

In New South Wales, the State Algae Advisory Group, the Technical Advisory Group and the six regional algal coordinating committees within the Murray–Darling Basin are coordinated under the NSW Algal Risk Management Framework.

Managing the risk of algal blooms in New South Wales fresh waters includes a multi-agency coordinated algal monitoring program, management of blooms and the release of public notifications. Algal warning levels are for recreational water use as set out in the Australian Guidelines for Managing Risks in Recreational Water.

Areas identified as being under red alert are managed based on the above frameworks and are represented on an interactive map managed by WaterNSW.

Example 6

Goulburn Murray Water increased the baseflow in the Goulburn River during December 2017 at the request of the Goulburn Broken Catchment Management Authority to reduce the chance of a hypoxic blackwater event occurring with predicted severe weather.

The increased baseflow came from the Goulburn water quality reserve (5.8 GL) and allocation held by the Commonwealth Environmental Water Office (6.33 GL) and the Victorian Environmental Water Holder (2.23 GL).

Goulburn Murray Water issued warnings for high cyanobacteria levels in:

- Lake Eppalock in the Campaspe system
- Cairn Curran Reservoir, Tullaroop Reservoir and Laanecoorie Reservoir in the Loddon system
- Hepburn Lagoon in the Bullarook system
- Lake Charm and Gum Lagoon in the Torrumbarry Irrigation Area.

Example 7

During 2018–19, a total of 52 River Murray action requests were submitted to the South Australia Department for Environment and Water relating to wetland management, increasing flows through regulators, floodplain management, weir pool raising and lowering and testing injection bores. All requests were assessed for their individual and cumulative impacts on the River Murray and downstream users, and all requests were deemed as low risk to water quality.

Example 8

Monitoring of dissolved oxygen levels and blue-green algae outbreaks contributes to risk assessments included in water quality management plans within the water resource plans.

What actions are underway to mitigate the negative water quality impacts from natural flooding or extreme low flow or cease-to-flow events?

Ongoing monitoring, including water quality alerts and mapping, delivery on water for the environment (see case study: Northern Fish Flow) and the implementation of water resource plans.

Water resource planning

Under the Basin Plan, water resource plans are required to address management of extreme events. To date, 13 of 33 water resource plans have been accredited across the Basin. In line with Basin Plan requirements, measures in response to extreme events are described in section 13 of the water resource plans. These include emergency response protocols, as well as the requirement for appropriate risk management plans to adverse water quality incidents. Water resource plans include water quality management plans that identify water quality risks and measures to address risks arising from water quality degradation.

Emergency response plans

Emergency response plans are a central tool for directing actions during events. Given the low-flow issues in the lower Darling and associated fish deaths over the summer of 2018–19, Basin governments prepared a Native Fish Emergency Response Plan for the 2019–20 summer. The aim of the plan was to ensure actions are coordinated and resources available to respond quickly to address risks to fish populations. Key actions of the plan were to:

- identify which sites were likely to be at significant risk of fish deaths during the period
- establish a Basin-scale emergency response group (across jurisdictions and the agency) for scoping, planning and implementing a risk assessment framework for fish across the Basin and associated site-specific responses
- identify sites across the Basin that were key to the long-term maintenance of fish populations locally, regionally and across the entire Basin
- prioritise, where possible, intervention actions for these sites
- identify the range of technological interventions available to reduce the risk of fish deaths at key sites (e.g. de-stratification, oxygenation and fish removal)
- undertake preventative and reactive monitoring at key sites to assess impact of any deployed interventions.

Flow management priorities during floods

Given the paucity of floods in recent years little information is available about current actions to mitigate water quality impacts of floods. Operational plans cover emergency response in general, including guidance for river managers in more general terms. For example, *the Objectives and outcomes for river operations in the River Murray System 2019* identifies the following steps for managing floods:

- firstly, protect the security of relevant assets
- secondly, maximise the available water, calculated in accordance with clause 102 of the Agreement, at the end of the relevant flooding episode
- thirdly, subject to the foregoing items, limit flood damage to downstream communities and increase benefits to the environment and public amenity, for example, by prolonging wetland inundation or by supporting recreational activities.

Actions to mitigate negative water quality impacts are not explicitly discussed in this operational plan.

Case study: Northern Fish Flow

Most of the northern Basin experienced below average to well below average rainfall and record high temperatures for much of 2018–19, resulting in very low to no flows in the north. Flows had been small and isolated in the Barwon River, with some waterholes at their lowest level in 50 years, with poor water quality that is putting native fish at risk.

Between April and May 2019, the Commonwealth Environmental Water Holder coordinated with New South Wales environmental water managers to release a combined total of 36 GL (18 GL of Commonwealth water for the environment) from Glenlyon Dam (Border Rivers system) and Copeton Dam (Gwydir River system). This release improved water quality, replenished waterholes and helped native fish survive along 1,500 km of river. Large sections of river were connected by the flow.

The Northern Fish Flow also provided relief to communities in places such as Walgett, which had not seen parts of the rivers flow for nearly a year. The flow was planned with support from New South Wales and Queensland government agencies, local councils, irrigators and landholders along the rivers. The flow was protected from take for irrigation purposes by the New South Wales and Queensland governments and supported by on-the-ground compliance checks. The MDBA monitored the flow using satellites.

The Commonwealth Environmental Water Office worked closely with the New South Wales Department of Primary Industries—Fisheries to monitor native fish response to the river flows. Water quality monitoring shows the flow increased oxygen content in waterholes.

During the flow event, over 70 community members attended information drop-in sessions held at Texas, Goondiwindi, Toomelah, Boggabilla, Mungindi, Boomi, Moree, Collarenebri, Walgett and Brewarrina.

What have been the key achievements and learnings in salinity and water quality management under the Basin Plan and related instruments?

Salinity management in the Basin is considered a key achievement of the interjurisdictional, collaborative management approach that started with the beginning of the Murray–Darling Basin Agreement in 1988. The collaborative management arrangements were sustained through time and carried into the new management arrangements under the Basin Plan. The five-year review of the Basin Plan highlighted how it is part of an evolution in water quality management (Productivity Commission 2018).

The fundamental Basin salinity management framework among Basin governments was sustained and Basin Plan salinity targets were integrated into it. The success of the program is reflected in 10 years of consistent delivery on salinity targets in the River Murray at Morgan in four out of five Basin Plan salinity reporting sites, and in demonstrable improvements in salinity in most other areas. The *Basin Salinity Management 2030 2018–19 Comprehensive report* illustrated the effects of salinity

management between 2017 and 2019 through comparing recorded salinity levels with modelled levels under 1975 conditions (Figure 7).

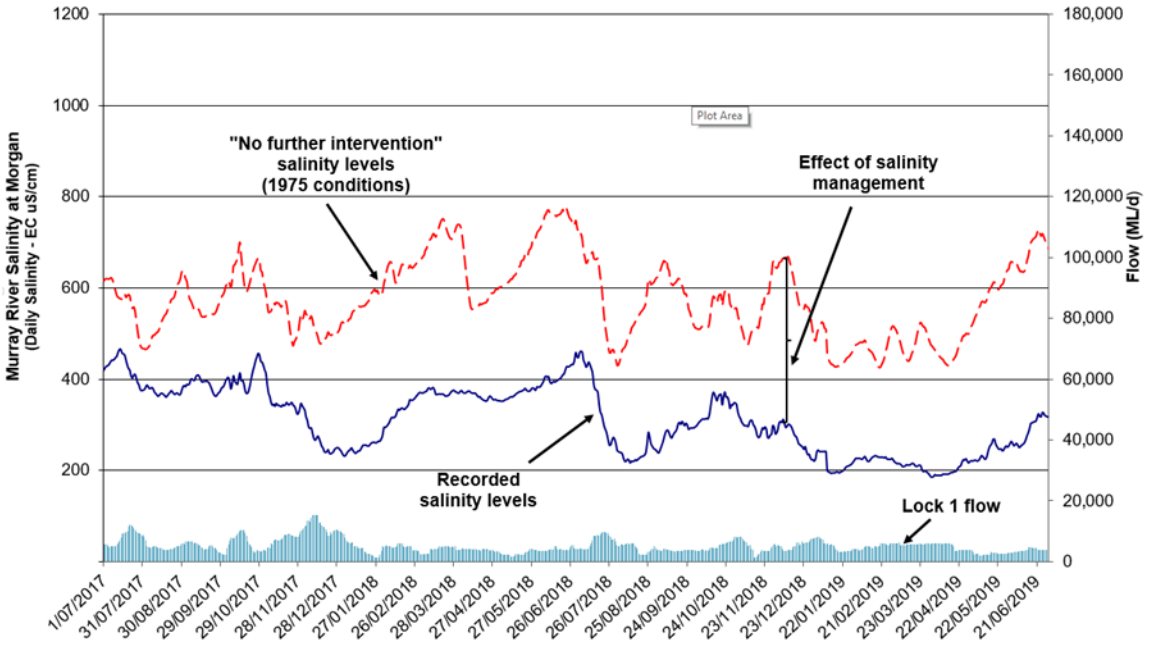

Figure 7 Comparison of mean salinity levels at Morgan from January 2017 to June 2019

A 2014 review of salinity management in the Basin confirmed the need to maintain the dedicated joint salinity program to ensure that salinity risks continue to be managed effectively. The review proposed the development of an updated strategy, the Basin Salinity Management 2030 (BSM 2030), to cover the period between 2015 and 2030, along with preliminary work to inform the objectives and elements of the strategy. The Basin Salinity Management 2030 strategy is now in effect with clear accountabilities and review mechanisms. Under the Basin Salinity Management 2030 strategy the MDBA has a clear coordinating role and the strategy continues to be implemented well through intergovernmental collaboration.

With the integration of flow and water quality management under the Basin Plan, the addition of provisional credits from the water for the environment use onto the salinity registers now brings water for the environment into the salinity accountability framework. This measure also supports Basin state governments in managing salinity in their catchments through their land and water management plans as outlined in their accredited water resource plans.

Examples of successful salinity management through integration with flow management includes the use of water for the environment to freshen the lower reaches of the River Murray, coupled with cycling of water levels in the Lower Lakes in 2015–17, as outlined the report for this period by the IAG report. This action was successful in bringing Lake Albert salinity levels down to 1690 EC and maintaining Lake Alexandrina below the Basin Plan salinity objective at Milang of 1000 EC.

Other elements of water quality management across the Basin have been less successful, possibly because the interjurisdictional mechanisms for collaboration, accountability and joint resourcing are less well established across the range of potential water quality issues.

The Basin Plan sets out objectives and targets to have regard to for water quality to be suitable for drinking, agricultural, recreational, cultural and environmental purposes. It also includes river targets

for dissolved oxygen (blackwater events) and blue-green algae outbreaks. These water quality issues are managed within a risk framework (rather than something akin to the salinity register accounting framework) that relies heavily on successful collaboration across jurisdictions and the MDBA.

Key achievements under the Basin Plan are that water quality management plans will be integrated into water resource planning by being required as part of accredited water resource plans for each resource area. The process provides a framework for developing water quality targets for each water resource area (based on the Australian and New Zealand Guidelines for Fresh and Marine Water Quality)

While the development of water resource plans is significantly behind schedule, a number of significant water quality issues have occurred across the Basin over the last few years and have provided an opportunity for new collaborative interjurisdictional management arrangements to be trialled and improved through adaptive management 'consultation, monitoring, reviewing and improving' cycles.

For example, the Northern Connectivity Event in 2018, which was a response to over 1000 km of the Barwon–Darling River ceasing to flow and emerging blue-green algae and low dissolved oxygen issues, demonstrated effectiveness of the collaboration model set up under the Basin Plan. The Australian and New South Wales governments worked together to release around 25 GL of water for the environment into the northern river system, following extensive consultation with stakeholders, including irrigators and local communities. The New South Wales government reported in 2017–18 (NSW Basin Plan implementation/Schedule 12 report 2018) that this event was highly successful in preventing algal blooms threatening town water supplies along the Barwon and Darling Rivers.

The management of the event included new cross-organisational committee arrangements and effective compliance monitoring. Connectivity was not maintained after the event and the Productivity Commission's inquiry was critical of a lack of evidence of an effective evaluation and improvement process following this event. However, other aspects such as the compliance component were thought successful and demonstrated the value of new collaborative arrangements in the relevant regions.

A recommendation from the Productivity Commission is that the water resource plan should set out how key operational plans (including the MDBA's River Murray System Annual Operating Plan and the WaterNSW Lower Darling Operations Plan) interact with each other to provide for critical human water needs. This recommendation provides an opportunity to incorporate learnings into the early phases of new water quality management arrangements across the Basin.

The Basin Plan is the mechanism by which jurisdictional and organisational collaboration can be developed to implement individual, collective and coordinated actions for water quality management and emergency response across the Basin.

What else needs to be done to improve water quality and salinity management in the Basin?

In 2017, the first five-year Basin Plan evaluation recommended the following for water quality and salinity:

- The 2020 review of water quality targets by the MDBA should examine the appropriateness of the salinity target at Burtundy and the salt export objective as an indicator of adequate flushing of salt from the river system in the context of a variable climate.
- The review could consider how salt export objectives could be varied to deal with periods of low flow.
- Basin governments and the MDBA should continue to investigate and analyse data on dissolved oxygen levels and the transfer of organic matter into river systems to develop improved management actions which can help mitigate blackwater events.
- Implementing the findings of the Northern Basin Review should contribute to achieving water quality outcomes through the enhanced protection of water for the environment. Addressing constraints through the agreed sustainable diversion limit adjustment projects will allow for more frequent delivery of water for the environment onto the lower floodplain, which could reduce the build-up of organic matter and help mitigate blackwater events.

The Productivity Commission's report stressed the importance of water resource plans and outlined how the implementation of water quality management plans, required as part of the water resource plans under the Basin Plan, were critical to the management of water quality events.

Given the importance of improving water quality and salinity management for achieving the Basin Plan water quality objectives, investigations of events related to water quality issues, among other things, are vital.

In December 2018 and January 2019, several fish death events in the lower Darling River below the Menindee Lakes prompted the Australian Government to commission an independent assessment. The assessment identified poor water quality and sudden changes of temperature as two of the three main immediate causes of the events.

Case study: Lower Darling Fish Deaths

This case study seeks to illustrate some of the challenges and opportunities associated with implementing the Basin Plan. The case study includes a summary of the adverse water quality events in the Lower Darling, the relevant measures in the proposed New South Wales's Murray and Lower Darling Water Resource Plan and other complementary activities which are expected to have an impact on water quality in the Lower Darling. Finally, it puts the Lower Darling within the context of risks to the condition, or continued availability, of Basin water resources.

Over the summers of 2018-19 and 2019-20 three significant fish death events took place within a 40 km stretch of the Darling River, downstream of the Menindee Lakes. The events were the result of adverse conditions characterised by extreme low flows, hot dry conditions and algal blooms in the Lower Darling (Vertessy et al. 2019). These factors combined caused stratification of the waterholes, followed by a sudden change in temperature and wind resulting in a sudden de-stratification and low oxygen throughout the water column and no refuge for the fish.

In line with the principles of adaptive management, preparation for the 2019-20 summer, a more substantive risk management approach was implemented that

included additional monitoring and planning for emergency measures by MDBA and Basin state governments. While these efforts were largely successful in mitigating against a repeat of 2018-19, the persistence of drought conditions into late 2019 and the recommencement of flows in early 2020 presented additional challenges for water quality which resulted in further fish death events in 2019-20.

The northern Basin river system has highly variable flow regimes. Compared with the southern Basin, managers do not have the same capacity to control flow regimes as the system has fewer large storages. The exception is the operation of Menindee Lakes in the lower reaches of the system, however even this capacity is limited during periods of low flows.

Vertessy et al. (2019) found the fish deaths were preceded and affected by exceptional climatic conditions, unparalleled in the observed climate record. They also found that the comparative effects of drought and development on inflows during 2018-19 could not be determined reliably, due to limitations in the river models used to plan water sharing, and insufficient metering of extractions. The report noted the relative effects of diversions on flows within the Barwon–Darling tributaries are greatest in dry years and that extractions from the tributaries of the Barwon–Darling have a much greater impact on Menindee inflows than extractions directly from the Barwon–Darling River.

Analysis undertaken for Basin Plan 2020 Evaluation suggest that hydrological connectivity in the northern Basin has largely declined over the period since Basin Plan implementation. In particular, there have been decreases in the proportion of flows that reach the Lower Darling, with increased evaporation in the dry climate having a major impact.

There have been large increases in cease to flow periods across much of the northern Basin. This has occurred in the context of very dry conditions across the northern Basin, including some of the lowest rainfall on record.

Despite the Basin Plan being implemented in the context of these dry conditions, it was found to have increased the amount of water in some northern Basin systems (e.g. Macquarie and Gwydir), and made some contribution to the duration of cease to flow events in the regulated system. However, the analysis suggests that to date, the Basin Plan has not improved the proportion of flows that reach the end of the system or Lower Darling.

Climate change forecasts suggest that intense droughts, such as the one experienced between 2017-2020, are more likely into the future. This means that the likelihood of extended periods of low or cease to flow in the Lower Darling have increased.

The next section of this case study examines the current approach to risk management in the Basin Plan and the Lower Darling Water Resource Plan.

The Basin Plan requires water resource plans to identify risks to water resources. This risk assessment process identified high risk of insufficient water for the environment and turbidity, and medium risk of harmful algal blooms and low

dissolved oxygen events in the New South Wales Murray and Lower Darling Plan water resource plan area. Under the Basin Plan, the proposed water resource plan is required to include strategies to address these risks.

The risk mitigation strategies in the water resource plan submitted to the MDBA include extraction limits, cease to pump rules in unregulated catchments, water for the environment allowances and strategic environmental releases in the regulated system downstream of Menindee Lakes, and improving the condition of riparian zones. It is acknowledged that the Basin Plan is not fully implemented including that New South Wales water resource plans are not yet accredited. It is anticipated that the implementation of measures in water resource plans will provide an opportunity for further improvements as described in the section below

Given that the risks in the Lower Darling are related to cease to flow events and a drying climate, there are a range of complementary activities that will contribute to further reducing risks. These include:

- measures in water resource plans for upstream Barwon–Darling tributaries (New South Wales and Queensland): for example, measurement and licencing of floodplain harvesting, rules to protect held water for the environment and first flush flows from being extracted
- full implementation of Northern Basin Toolkit measures, including targeted environmental works and measures projects
- full implementation of the sustainable diversion limit accounting and Compliance Compact commitments: for example, improved metering and measurement
- actions arising from the Emergency Response Plan and Native Fish Risk Strategy, including risk planning and review forums, water quality monitoring programs and operational and research recommendations
- planning for climate change, including improving forecasting, taking stock of mechanisms in the context of climate change and identifying what can be achieved under these conditions.

The Menindee Lakes Water Savings SDLAM Project also provides an opportunity to deliver multiple benefits to the river system, including an improved connection between the northern and southern Basins.

Summary

The Basin Plan and New South Wales Murray and Lower Darling Plan water resource plan both acknowledge the risks for the Lower Darling and seek to reduce the likelihood of adverse water quality through improved flow management in the northern Basin.

Vertessy et al. (2019) found both upstream extractions and drought likely played a role in producing adverse water quality in the Lower Darling. This has a number of implications. The first is that improvements in hydrological modelling are

required to manage these risks. Second, that there are likely to be circumstances in which flow management will not be a viable risk management strategy. The options are either other measures to reduce the likelihood of adverse water quality or measures to ameliorate the consequences.

The proposed New South Wales Murray and Lower Darling Plan water resource plan identifies riparian and land use management activities to improve water quality. In response the Commonwealth Government has committed $5m to install fencing. It is not clear to what extent these complementary activities will reduce adverse water quality events. Alternatively, measures could be implemented to reduce the consequences of prolonged cease to flow events. In 2018-19 and 2019-20 aerators were installed and fish rescued to reduce fish deaths. These actions were found to be effective, but this highlights the need to have strategies in place to manage risks as environmental flows may not be sufficient in some situations.

The independent assessment of the fish death events led to a recommendation to be implemented within three years, that the New South Wales Government should redress gaps in water quality monitoring (e.g. dissolved oxygen, temperature and algae) at high-risk sites in the Barwon–Darling. The assessment found that, for example, Weir 32 did not have real-time oxygen data and suggested that filling this gap would have helped in determining risks of low surface-water dissolved oxygen and in pre-empting the high daily fluctuations in oxygen caused by algal blooms at this location. Algal bloom warnings had been previously been issued for Menindee and the site was on red algal alert.

Water temperature outside natural ranges is considered a type of water quality degradation. Several reports recommend adding continuous monitoring, analysis and reporting of water and air temperature to Basin monitoring programs, both for determining long-term and large-scale trends and for managing localised issues and/or flow management decisions (Baldwin 2019, Clune and Eburn 2017).

At the regional scale, the independent assessment identified a paucity of data collected in a similar manner across the region. Suggestions for improvements included a monitoring system for the northern Basin that included effective monitoring (such as a smart monitoring system) of dissolved oxygen and other water quality variables that can affect ecosystem health during low-flow or no-flow periods.

The independent assessment also suggested adding real-time dissolved oxygen and temperature sensors to existing sites at different water levels for detecting stratification issues, while also recognising that effective management interventions following detection of such issues remained a challenge. Adopting emerging technologies such as remote sensing and improving the use of real-time data to support early warning and forecasting was also discussed.

Improvements in monitoring are identified in a range of other sources, such as the Schedule 12 reports. For example, the 2017–18 schedule 12 report by the CEWH relates discussions with water managers across the Basin to improve gauges for measuring continuous dissolved oxygen to increase capacity to respond to water quality issues.

The monitoring, evaluation and reporting capability assessment identified that monitoring, evaluation and reporting activities needed to improve across the implementation of the Basin Plan.

Some recommendations are directly relevant to water quality and salinity management to implement the desired adaptive management based on appropriate, fit-for-purpose information in response to management actions. For example:

- The MDBA should identify as a high priority (following water resource plan accreditation obligations) the development and implementation of an enterprise-wide data and information architecture that delivers on the MDBA's ongoing monitoring, evaluation and reporting responsibilities.

The assessment that followed the fish deaths in December 2018 and January 2019 recommended increased use of modelling and risk assessment, as well as on-ground improvements in monitoring and emergency management. Increased use of modelling and risk assessment would identify specific risk areas to prioritise for improving water quality and salinity across the Basin to deliver on the objectives for water-dependent ecosystems (Vertessy et al 2019:78):

> *We recommend that the risk assessment to be undertaken should determine which parts of the system are most susceptible to low oxygen levels as result of thermal and oxygen stratification in weir pools, block banks and other sections of rivers and lakes. This should be based on a consideration of channel depth and morphology, algal growth, organic carbon inputs and susceptibility to stratification and mixing. Simple models of thermal stratification could be used to determine at risk areas. A risk assessment of areas susceptible to high organic carbon low oxygen events should also be updated to ensure that there is comprehensive knowledge of risk areas, and to determine if there is combined potential impact with thermal and oxygen stratification. The impact of undershot weirs on releasing low oxygen water downstream should also be considered. Areas prioritised as risks should have oxygen, temperature and other monitoring equipment installed, if not readily available. These sites should be prioritised for additional monitoring, such as for algae and water quality, if not already covered by existing programs.*
>
> *The risk assessment should be undertaken over a 12-month period, involving fisheries, water quality and hydrology teams from NSW, with the MDBA providing planning, coordination and integration support under the aegis of the Native Fish Management and Recovery Strategy. Using the outcomes of that assessment, NSW should progress to develop an early warning system similar to those in use for algal bloom alerts. Concurrently, formal emergency response plans should be developed. These should be based on learnings from the response to the recent fish death events, around which government officials, science teams and community members were mobilised to mitigate impacts.*

More explicit and well-structured risk assessments can improve water quality and salinity management across the Basin and reflect best-practice water quality management in other contexts (e.g. drinking water quality and recreational water quality).

In the context of the Basin Plan, the recently developed MDBA *Guideline: 'having regard' to Water Quality Targets for Managing Water Flows* provides guidance on how water managers can include water quality risk assessments in making flow decisions while having regard to water quality and salinity risks and opportunities. The example provided outlines how the risks of generating low

dissolved oxygen water or a cyanobacterial bloom should be assessed as part of the planning for each proposed environmental watering.

In particular, the guideline recommends using a risk management approach consistent with the Australian Standard for Risk Management (AS/NZS ISO 31000:2018). A risk avoidance and mitigation strategy that is proportionate to the assessed risk, could then be determined in advance of the managed watering. This should include appropriate monitoring, evaluation, reporting and improvement processes. This approach will close the loop of the Basin Plan clause of 'having regard to' water quality in making flow decisions and can be reflected in the water managers' business planning, operating and reviewing cycles so they improve over time.

At the moment, Schedule 12 reporting does not include the full cycle, which means it does not illustrate more detail on how flow management can be used in general to also manage water quality issues.

The 2018–19 IRORG report noted that 'Recent, widely publicised, fish deaths in the lower Darling River and Murrumbidgee have resulted in considerable activity around the causes (and prevention) of hypoxia. This has included an audit of regional dissolved oxygen data including routine monitoring and special projects. It provides an opportunity to develop a fit-for-purpose dissolved oxygen monitoring program in collaboration with state partners and observing the principles described at the beginning of this section. It is hoped that, in the long term, predictive models, where appropriate, will be generated from these data – in line with adaptive management principles'. The report also states that:

- Sound quality of sampling design and sample analysis is necessary for a reliable dissolved oxygen monitoring program.
- Depending on the use to which the dissolved oxygen data are put, there may still be a need to manage spatial variation.
- As MDBA is not the primary source of most of the dissolved oxygen data, it should seek quality assurance regarding sampling and analysis, equipment performance, data handling, etc. Data uploaded to the Hydstra database should be first validated against an acceptable range of values as part of RMO's quality assurance program.
- The extensive store of raw data held on Hydstra, is a valuable resource that, in principle, could be mined in line with adaptive management principles. This could help to refine the monitoring program and seek better descriptors (indicators) of ecological condition related to the Basin ecosystem.
- Given the justifiable community concern over the risks of fish deaths, it may be appropriate for the MDBA to review the dissolved oxygen monitoring program and the metrics used to assess dissolved oxygen status and to drive flow management decisions and mitigation actions.

In summary, investigations of specific water quality incidents recommend improvements of water quality and salinity management in the Basin such as increased monitoring sites and parameters (e.g. water and air temperature), and reviewed methodologies (e.g. risk management techniques).

More broadly, the Lower Lakes Independent Science Review considered knowledge needs for the management of the Coorong, Lower Lakes and Murray Mouth under future climate change (Chiew et al 2020). The review noted management would become increasingly challenging. Evaporation from

the Lakes would be higher, sea level rise would alter the hydrodynamics of the Coorong and Murray Mouth, and cause more seawater to flow into the Lower Lakes. Therefore, more River Murray inflow would be needed to maintain lake water and salinity levels and flow over the barrages when catchment run-off in the southern Basin is already projected to decline under climate change.

The review noted there are gaps in the knowledge of the biophysical impact under climate change, and the social, environmental and economic vulnerabilities. Gaps could be addressed through targeted research and undertaking hydrodynamic modelling and bottom-up sensitivity analysis of potential outcomes under climate change. With better knowledge, management options and infrastructure solutions can be more confidently developed and assessed.

The review concluded there is a need to develop adaptation options, not just for the Coorong, Lower Lakes and Murray mouth, but as part of the whole Basin. Adaptive management of the Coorong, Lower Lakes and Murray Mouth area could be informed by a thorough review of the existing literature, matched to a monitoring program which can test the predicted changes over time. Exploring adaptation of ecosystems and the services they provide under future climate scenarios would inform better management and identify values that can be maintained, those that can transition to some new state and those that cannot be sustained.

However, while ways to improve water quality and salinity management in the Basin have been identified in this evaluation, and in the Productivity Commission's Inquiry in 2018, the Basin Plan does not guide joint government action in the day-to-day management of water quality. The Basin Plan is the mechanism by which governments collaborate on water quality and salinity management to implement individual, collective and coordinated actions in the shared water resources and, where necessary, in their catchments.

Critical improvements to water quality and salinity management in the Basin include:

- better communication with stakeholders
- integration with land management
- improved processes for collaboration to integrate the requirements of the Basin Plan into the joint arrangements for salinity management and river operations.

Are there opportunities to improve governance arrangements for water quality and salinity?

Opportunities to improve governance arrangements for water quality and salinity in implementing the Basin Plan can align with principles recommended in Productivity Commission's report.

The report notes that water quality is one of the six areas of the Basin Plan where the MDBA has compliance and enforcement responsibility (under the Water Act), once water resource plans come into effect. However, the MDBA's enforcement options are limited to non-judicial mechanisms such as investigations and audits, public reporting and data release. There is an opportunity to consider governance arrangements for water quality and salinity explicitly in any future separation of governance roles.

Another opportunity for improving governance arrangements for water quality lies in the successful Basin salinity management program. Under the Basin-wide Basin Salinity Management 2030 strategy,

the MDBA coordinates the review of elevated salinity events to examine the causes, impacts and effectiveness of management responses and to identify potential policy improvements.

There are opportunities to apply this model also to dissolved oxygen issues and blue-green algae outbreaks across the Basin. Currently the MDBA is at the table but does not have a coordinating role in these types of non--salinity issues related to water quality.

Blue-green algae outbreaks are a frequent concern across the shared water resources of the Murray–Darling Basin. Clune and Eburn, in their 2017 paper ('Blue-green algae in the Murray–Darling Basin: a case for Commonwealth leadership', Australian Journal of Emergency Management, Volume 32 Issue 3) propose that a significant blue-green algae outbreak, especially one related to increased water temperatures under climate change, could be considered as a natural disaster. They suggest that the Australian Government should have a greater responsibility in its emergency management by ensuring appropriate prevention of, preparation for, response to, and recovery from, such an event.

Environmental Watering

Overview

Chapter 8, Part 4 of the Basin Plan 2012 sets out the Environmental Management Framework as having three main objectives:

1. coordinating the planning, prioritisation and use of water for the environment (on both a long-term and annual basis)
2. enabling adaptive management
3. facilitating consultation, coordination and cooperative arrangements.

The Environmental Management Framework is made up of several components, which aim to provide guidance for environmental water planning and delivery at multiple temporal and spatial scales. Achieving system-scale outcomes depends not only on the effectiveness of each component, but also on the integration of these components.

The Environmental Management Framework facilitates long-term planning at a system scale through the Basin-wide Environmental Watering Strategy developed by the MDBA in 2014, as prescribed in the Basin Plan, and updated in 2019. The Basin-wide Environmental Watering Strategy sets out the overarching environmental watering strategy under the Basin Plan and asks that state long-term watering plans have regard to this strategy. The Strategy also provides the context for setting Basin annual environmental watering priorities and state annual environmental watering priorities.

Due to the complex nature of these activities, the Environmental Management Framework requires water planners and managers to apply a set of guiding principles when planning, prioritising and delivering environmental water.

Progress towards achieving Basin Plan environmental outcomes is measured against broad targets in the Basin Plan (Schedule 7). More specific Basin-wide targets are outlined in the Basin-wide Environmental Watering Strategy. This evaluation focuses on the implementation of the Environmental Management Framework only.

Key theme findings

- The Environmental Management Framework has generally been implemented as expected and is supporting coordinated and collaborative delivery of environmental water.
- The foundations for planning and delivery, and the co-ordination of environmental water have been successful, with adaptive management and flexibility important requirements in this area.
- There are opportunities for improvements through greater consistency across long-term watering plans and better alignment with the Basin-wide Environmental Watering Strategy as well as increased clarity around expected outcomes for environmental water. A greater focus is needed on identifying the objectives and outcomes for First Nations and the shared benefits of environmental water.

Evaluation assessment

Table 9 Performance descriptors for the environmental watering implementation theme.
Evaluation ratings are labelled 1-6, with 1 being the lowest performance rating and 6 being the highest performance rating.
Confidence ratings assess the confidence in the assessment given the available evidence.

Indicator	Evaluation rating	Confidence
The extent to which key stakeholders agree that the Environmental Management Framework is facilitating coordination of the planning, prioritisation and use of environmental water on an annual and long-term basis	5. The implementation is good	High
The Environmental Management Framework has been largely effective, with most plans delivered on time and providing high-level strategic direction for annual environmental water objectives. There is a need for clear guidance on how to prioritise those assets or types of watering events that are most important for achieving the Basin Plan's objectives and expected outcomes.		
The extent to which key stakeholders agree that the Environmental Management Framework is facilitating consultation, coordination and cooperative arrangements	5. The implementation is good	High
The Environmental Management Framework has increased the opportunity for coordination and cooperative arrangements in the planning and delivery of environmental water.		
The extent to which principles of environmental watering have been applied	5. The implementation is good	Medium
Water managers are applying most principles in their decision-making. Although water has been delivered to all manageable Ramsar sites since the implementation of the Basin Plan (Principle 9), the ecological character of some sites may still be at risk. This may mean Ramsar sites are not being inundated with sufficient frequency, constraints may be limiting the area of the floodplain which can be inundated, or other factors may be impacting the site.		

Program logic

The program logic for this theme within the Basin Plan 2020 Evaluation is:

'Implementation of the Environmental Management Framework is expected to support effective delivery of environmental water that achieves improvements in flow regimes and ecological condition' (Figure 8).

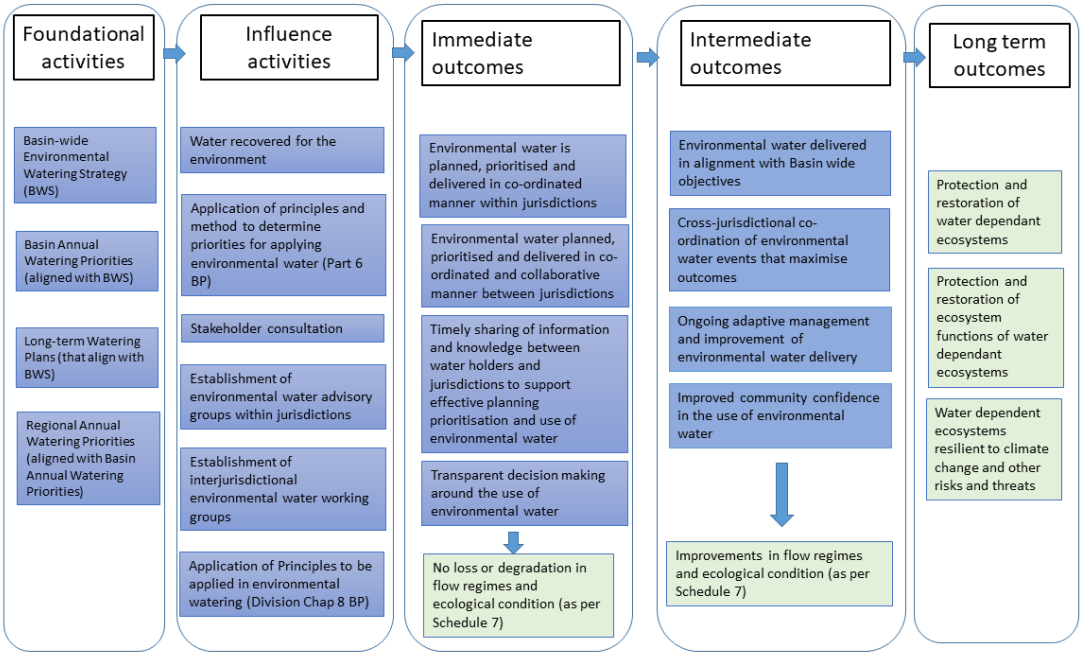

Figure 8 Environmental watering theme program logic

Evaluation questions

1. To what extent has the Environmental Management Framework been implemented as expected?
2. To what extent has implementation of the Environmental Management Framework facilitated coordination of the planning, prioritisation and use of environmental water on both a long-term and an annual basis?
3. To what extent have the principles of environmental watering been applied?

Summary of findings

- The 2020 Basin Plan Evaluation found that implementation of the components of the Environmental Management Framework had been largely effective, with most plans delivered on time and providing high-level strategic direction for annual environmental water objectives. However, environmental water managers noted improvements could be made in the following areas:
    - greater consistency across long-term watering plans and better alignment with the Basin-wide Environmental Watering Strategy
    - increased clarity around expected outcomes for environmental water.
- While the Basin-wide Environmental Watering Strategy provides high-level strategic direction for expected environmental outcomes at a system scale, there is a need for clear guidance on how to prioritise those assets or types of watering events that are most important for achieving the Basin Plan's objectives and expected outcomes.
- The Basin annual environmental watering priorities were often released too late to be considered in planning processes and were found to be increasingly redundant as environmental water holders moved to rolling, multi-year plans.

- There is a strong need to consider whether the method for developing Basin watering priorities can be improved. A method and process to achieve this must be determined.
- The foundations for planning and delivery, and the co-ordination of environmental water have been successful with adaptive management and flexibility an important requirement in this area.
- A greater focus is needed on identifying the objectives and outcomes for First Nations and the shared benefits of environmental water.
- There has been support for clearer communication of the intent of the water principles to ensure that state environmental water managers and local communities can all consider the desired flow regime with a clear understanding of the principles of environmental watering and their implementation,

Environmental watering findings

To what extent has the Environmental Management Framework been implemented as expected?

The analysis indicates that the Environmental Management Framework has largely been implemented as expected. The analysis dealt with:

- long-term watering plans for each water resource plan area
- state annual environmental watering priorities for each water resource plan area
- Basin annual environmental watering priorities
- principles to be applied in environmental watering.

Long-term watering plans for each water resource plan area

States have generally delivered long-term watering plans by the agreed timeframes. The long-term watering plans have been found to be a valuable resource for managers of environmental water. Analysis found that the consistency of long-term watering plans across states could be improved by ensuring continuous alignment between the Basin Watering Strategy and the long-term watering plans. Another aspect that could improve consistency is providing clear guidance material to Basin state governments on the expected content of long-term watering plans.

State annual environmental watering priorities for each water resource plan area

Annual environmental watering priorities have generally been delivered by all states by the required date every year. They have been helpful in decision-making when there is competition for environmental water.

Basin annual environmental watering priorities

Each year Basin annual environmental watering priorities have been developed by the MDBA in consultation with stakeholders and published on the MDBA website by 30 June. The priorities have been useful in providing high-level strategic direction for expected environmental outcomes at a system scale. Improved outcomes might also come from clear guidance on how to prioritise those

assets or types of watering events that are most important for achieving the Basin Plan's objectives and expected outcomes.

Principles to be applied in environmental watering

Water managers are applying most principles in their decision-making and there are high levels of support for the current principles. The principles could be given greater priority in MDBA communications and linked to other public communication on the management and delivery of environmental flows

Integration of the elements of the Environmental Management Framework

Overall, the evaluation of effectiveness reveals that most Environmental Management Framework components are being implemented and are effective at achieving their individual objectives. There is evidence that improvement through adaptive management occurs at all levels, as water managers generally have available levers to make operational improvements.

The key components of the Environmental Management Framework are the Basin-wide Environmental Watering Strategy, the long-term watering plans, the Basin annual environmental watering priorities and the state annual environmental watering priorities. Together, these documents aim to provide clear objectives and guidance for the coordination of environmental water across the Basin. The planning documents have been developed collaboratively by Commonwealth and state governments to form a cohesive framework which covers multiple temporal and spatial scales (Figure 9).

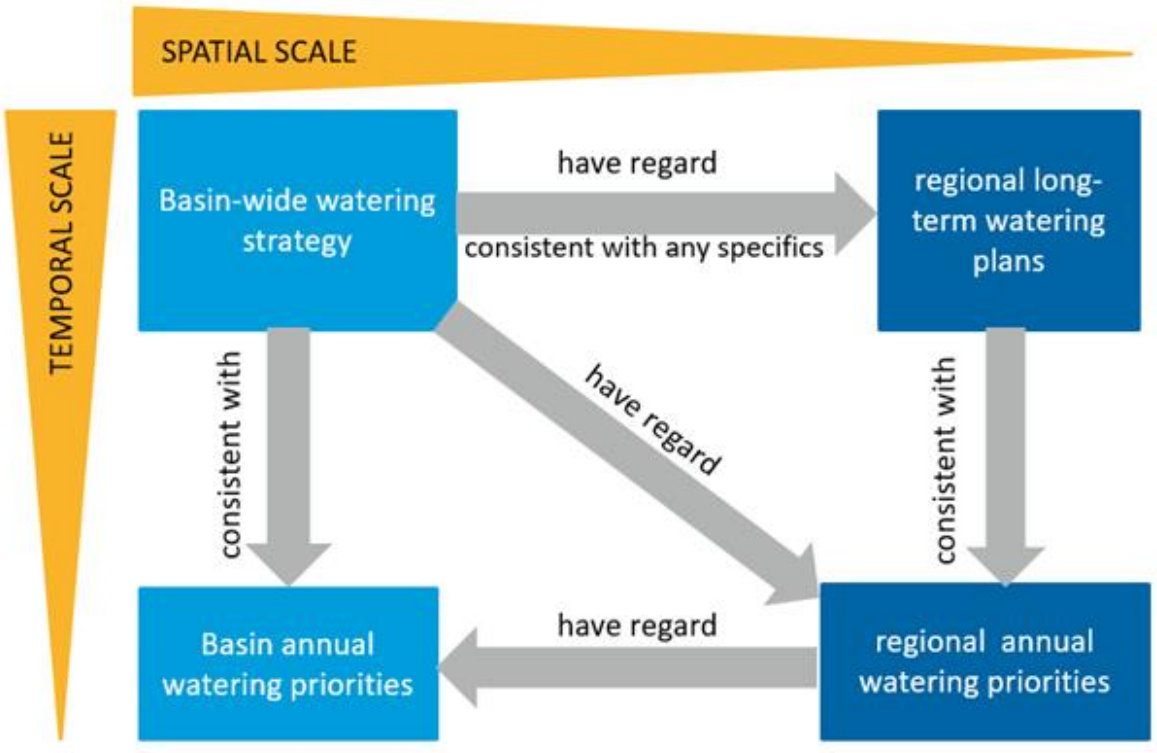

Figure 9 Components of the Environmental Management Framework

Recent reviews, including the *Review of Chapter 8 of the Basin Plan* (the Chapter 8 external review) and the Productivity Commission (2018) report *Murray–Darling Basin Plan: Five-year assessment* (the

Productivity Commission report), have identified some weaknesses in how the different components work together. They have also made recommendations to improve implementation.

Long-term watering plans must be prepared by Basin state governments for each water resource plan area and identify priority environmental assets and priority ecosystem functions. For each identified asset and ecosystem function, the long-term watering plans must identify objectives and ecological targets as well as environmental watering requirements to meet those targets and achieve those objectives. Long-term watering plans provide a link between system-scale objectives of the Basin-wide Environmental Watering Strategy, and regional assets and ecosystems, with the aim of achieving local outcomes and objectives.

The Productivity Commission report found that long-term watering plans are a valuable resource for managers of environmental water. The perceived value of long-term watering plans depends on the functions and responsibilities of the environmental water manager. For example, the Commonwealth Environmental Water Office finds the long-term watering plans to be useful in informing their decision-making.

Both the Chapter 8 review and the Productivity Commission report found that the approach to developing long-term watering plans has not been consistent across Basin state governments. The Productivity Commission report found that the long-term watering plans are likely to be an important component of the Environmental Management Framework. The report suggested that consistency can be improved by ensuring continuous alignment between the Basin-wide Environmental Watering Strategy and long-term watering plans. It also suggested providing clear guidance material to Basin state governments on the expected content of long-term watering plans.

The Basin-wide Environmental Watering Strategy was reviewed and updated in 2019, with its next update scheduled to be in 2022. At a minimum, long-term watering plans are to be reviewed every five years and a review can also be triggered when a new Basin-wide Environmental Watering Strategy is made.

The findings of these reviews reflect the difficulty of striking the right balance between providing flexibility and managing for uncertainty when planning and managing environmental water at a Basin scale.

Development of regional annual environmental watering priorities annually by 31 May

For every water accounting period, Basin state governments are required to identify annual environmental watering priorities by 31 May, for each water resource plan area. To date, regional annual environmental watering priorities have been required for the 2016–17, 2017–18 and 2018–19 water years.

During the 2016–17, 2017–18 and 2018–19 water years, the New South Wales, South Australia, Victoria and Queensland governments delivered their regional annual environmental watering priorities within the required timeframes.

Development of Basin annual environmental watering priorities annually by 30 June

Each year, Basin annual environmental watering priorities have been developed by the MDBA in consultation with stakeholders and published on the MDBA website by 30 June.

Development of long-term watering plans by June 2019

States have largely provided long-term watering plans by the due date (Table 10). Long-term watering plans will continue to undergo regular updates and improvements to maintain consistency with the Basin-wide Environmental Watering Strategy.

Table 10 Long-term watering plan status and timeframes for revision

State	WRP area	Delivery date	Update due date
QLD	Border Rivers–Moonie	February 2019	24 September 2020
	Condamine–Balonne	February 2019	21 September 2020
	Warrego–Paroo–Nebine	January 2016	February 2023
NSW	Gwydir	LTWPs finalised December 2019 (note that NSW surface water resource plans are yet to be accredited and implemented, which may impact on full implementation of NSW LTWPs)	February 2023
	Macquarie–Castlereagh		
	Lachlan		
	Border Rivers		
	Barwon–Darling		
	Namoi		
	Murrumbidgee		
	Murray–lower Darling		
	Intersecting streams		
ACT	ACT	Draft prepared March 2020	30 June 2021
VIC	Northern Victoria	September 2015	13 June 2021
	Victorian Murray	September 2015	13 June 2021
	Wimmera–Mallee	September 2015	24 September 2020
SA	SA River Murray	November 2015	16 November 2020
	Eastern Mt Lofty Ranges	July 2017	16 November 2020
	SA Murray region	December 2017	20 August 2020

To what extent has implementation of the Environmental Management Framework facilitated coordination of the planning, prioritisation and use of environmental water on a long-term basis and an annual basis?

Planning and prioritisation

The Environmental Management Framework facilitates long-term planning at a system scale through the Basin-wide Environmental Watering Strategy developed by the MDBA in 2014, as prescribed in the Basin Plan. The Strategy sets out the overarching environmental watering strategy under the Basin Plan and re-states the Plan's guidance for the development of state long-term watering plans.

The Strategy also sets context for Basin and state annual environmental watering priorities and state. The method for determining Basin annual environmental watering priorities is set out in the Basin-wide Environmental Watering Strategy. For the Environmental Management Framework to facilitate coordination of planning, prioritisation and use of environmental water, these elements must work together on a long-term and annual basis.

The Productivity Commission report acknowledged the strength of the Basin-wide Environmental Watering Strategy in providing high-level strategic direction for expected environmental outcomes at a system scale. However, it also identified a need for clear guidance on how to prioritise those assets or types of watering events that are most important for achieving the Basin Plan's objectives and expected outcomes. Without clear guidance, it is difficult for water planners and managers to make decisions about and evaluate how best to use environmental water in a way that considers both local, and system-scale outcomes.

Delivery

Responses to the 2018 Basin-wide Environmental Watering Strategy survey (contained in the Basin-wide Environmental Watering Strategy review) showed that one of the areas that the Strategy was considered to be weakest is helping environmental water managers make use of all available water to achieve long-term objectives.

Based on the free-text responses from the 2018 Basin-wide Environmental Watering Strategy survey respondents, this may be related to the fact that, while the strategy guides planning of environmental water, delivery of that water is ultimately valley-specific.

Adaptive management

Prioritisation of environmental water at a regional level through annual environmental watering is useful for helping water managers plan ahead. However, this prioritisation could be better supported by improvements to the Basin annual environmental watering priorities, specifically through improving the alignment between Basin and state annual environmental watering priorities. The Productivity Commission report, Chapter 8 review and the 2018 Basin-wide Environmental Watering Strategy survey results highlighted issues with the timing of the release of the Basin annual environmental watering priorities. These issues suggest that multi-year Basin environmental watering priorities may be more useful in informing the development of regional priorities.

The Productivity Commission report found that the Basin annual environmental watering priorities do not add value to the decision-making of environmental water managers as they are released too late to be considered in planning processes. They were also found to be becoming increasingly redundant as significant environmental water holders are moving to rolling, multi-year plans. The Productivity Commission report recommended that the Basin Plan should be amended to remove the requirement for the MDBA to produce Basin annual environmental watering priorities.

In response to the Productivity Commission report, the MDBA argued that the development of the priorities is being continuously improved through lessons learnt from previous watering activities, ongoing research, monitoring of biological responses and stakeholder feedback. Additionally, states provide feedback on priorities as part of their development, and more recently through the Environmental Watering Working Group.

The findings and recommendations of the 2018 Basin-wide Environmental Watering Strategy survey, the 2017 Basin Plan Evaluation and other reviews suggest that there is a strong need to consider whether the method for developing Basin annual watering priorities can be improved. If so, a method and process to achieve this must be determined. The Chapter 8 review also suggests that Basin annual environmental watering priorities can add value by providing Basin-scale guidance in instances where issues at regional levels arise.

It is important to note that, while the Basin-wide Environmental Watering Strategy contains a chapter on Basin priorities, the requirement to prepare priorities, and the method by which they are prepared, are established by the environmental watering plan of the Basin Plan.

Therefore, any work to change the requirement and method needs to be considered as part of the review of the environmental watering plan scheduled for 2020.

Facilitation of consultation, coordination and cooperative arrangements between the Authority, the Commonwealth Environmental Water Holder and Basin state governments

Implementation of the components of the Environmental Management Framework requires increased communication, consultation and coordination between different bodies responsible for water planning and delivery at state and Australian Government levels. As such, the Environmental Management Framework has increased the opportunity for coordination and cooperative arrangements in the planning and delivery of environmental water. This has been recognised by several reviews including the Productivity Commission report.

The Productivity Commission report made a number of recommendations suggesting improvements in this area. The majority of these recommendations focus on making improvements in the management of existing arrangements, suggesting the foundations for planning and delivery of environmental water are on the right track, but also highlighting the importance of adaptive management and flexibility in this area.

The Productivity Commission report found that coordination of environmental watering delivery events has been highly successful. The work of the Southern Connected Basin Environmental Watering Committee in 2014 saw an increase in coordination of events from 18% to 33% from 2014-15 to 2015-16. The result of this coordinated approach means there has been a decrease in the number of isolated watering events, while the total volume of environmental water delivery simultaneously increased. The Northern Basin Environmental Watering Group was subsequently established in 2019.

Opportunities for improving the planning, prioritisation and use of environmental water

The Basin Plan Chapter 8 review found that practitioners identified a few opportunities for improving the Basin-wide Environmental Watering Strategy. The Strategy review identified a number of minor changes which were subsequently included in the 2019 update. The Basin-wide Environmental Watering Strategy is due to be updated again in 2022. and the scope of the update process will include outcomes for First Nations and shared benefits of environmental water.

The survey responses from the Chapter 8 external review described the Environmental Management Framework as a useful guide. Water managers noted that planning is on track and environmental water is being delivered. Long-term watering plans were identified as useful in planning and delivering environmental water, and state annual environmental watering priorities as helpful in decision-making when there is competition for environmental water. Water managers supported the method for identifying assets and their watering requirements. Most thought the principles and method for determining environmental watering priorities to be appropriate.

The Chapter 8 review emphasised how changes to the way the environmental watering plan is implemented could improve environmental outcomes. Advice regarding the implementation of the Environmental Management Framework is included in the Review of Environmental Watering Plan. This advice could help address many of the issues described in earlier sections.

The Basin-wide Environmental Watering Strategy could be improved to address issues of illegal take of environmental water (water theft), climate change, and use of irrigation flows, all of which are important aspects of using all available water to achieve objectives.

To what extent have the principles of environmental watering been applied?

The Environmental Management Framework requires environmental water planners and managers to consider a set of principles when determining priorities for managing environmental water.

The Basin Plan identifies a set of principles to be applied in environmental watering (Basin Plan Chapter 8, Part 4, Division 6). The 2017 Basin Plan Evaluation and implementation reports up to 2018–19 demonstrate that water managers are applying most principles in their decision-making. One exception was Principle 9, which requires water managers to apply water in a way that is consistent with relevant international agreements identified in the objectives of the Basin Plan.

The Productivity Commission report discussed examples whereby principles are applied and considered in real time. For example, in the northern Basin, environmental water holders must make real-time decisions about the use of their water. Operational advisory groups meet weekly to provide real-time advice on environmental watering at the asset-scale. This allows water managers to maximise environmental benefits (Principle 3) while also working effectively with local communities (Principle 7).

The practicality of balancing the application of the principles can be challenging. For example, applying the precautionary principle (Principle 6) while adaptively managing (Principle 8) sometimes requires testing of new approaches.

The responses to a survey that informed the Chapter 8 review showed high levels of support for the current principles. Seventy-five per cent of practitioners (n=17) and advocates (n=4) and 100% of researchers (n=7) thought of the principles as fairly or extremely appropriate. The principles could be given greater priority in MDBA communications and linked to other public communication on the management and delivery of environmental flows

The Chapter 8 review made a number of recommendations, which are detailed in the report ‘Review of the Environmental Watering Plan.’.

Water trading rules

Overview

This theme is focused on evaluating progress in the implementation of water trading rules.

The Basin Plan employs a cap and trade model to meet its objectives. Water markets provide water users flexibility to respond to variable water availability and to manage their business risks. Water markets also allow water to move to its most productive or highest value use, which helps manage the transition to the Basin Plan. The Basin has some of the most mature water markets in the world.

The water trading rules in the Basin Plan (Chapter 12) are designed to support the efficient functioning and ongoing operation of Basin water markets. The rules have three main elements:

1. ensuring trade restrictions are consistent with the Basin Plan
2. improving information and transparency of the water market
3. improving confidence in the market (such as ensuring no insider-trading).

The Basin Plan water trading rules operate alongside existing Basin state government rules and irrigation infrastructure operator rules.

Basin state governments set the trading rules within their jurisdictions and each state has a multitude of complex rules relating to water trade. A key element of the Basin Plan water trading rules is to prohibit unnecessary restrictions on trade. This means that Basin state governments must ensure restrictions on trade are appropriate and consistent with the Basin Plan.

The MDBA is responsible for ensuring regulated entities, including Basin state governments, act consistently with the Basin Plan water trading rules. This includes ensuring that Basin state governments do not have unnecessary restrictions on trade. As outlined in the MDBA's 'Compliance and enforcement policy', the MDBA takes a risk-based approach to regulation, targeting its compliance efforts towards matters with the highest risks and greatest potential to affect the water market.

Key theme findings

- The Basin has some of the most mature water markets in the world. Water trade rules implemented through Basin reform are supporting on-going improvement to water markets across the Basin. The water trade market in the Basin has experienced exponential growth in a short period. Water trading has enabled the water to move to its higher value uses. Trade has also provided benefits to water users in managing their business, particularly as a risk management tool.
- The rapid growth in the water trade market the water trade market has in turn tested the appropriateness and robustness of the current trading rules, regulatory and governance arrangements that support the water market.
- Water trading rules are complex. Sometimes the benefits for changing the rules may outweigh the costs in terms of time, resources and outcomes.
- Due to the sheer number and complexity of these rules the MDBA implements a risk assessment approach to determine which trade rules have the most effect on the market

and should therefore be addressed as a priority. MDBA's strategic priorities guide MDBA's effort and resources to address the most significant compliance risks.

- The MDBA's 2019 Trade Price Audit found that misreporting of prices is extensive (MDBA 2020f). MDBA's formal management response includes ongoing work with Basin state governments to address fundamental issues. This work program includes putting in place better systems and processes to enable traders to report their prices accurately.
- While effort and progress has been made towards implementing trading rules, the rules have not been implemented to the extent expected.
- The work to ensure there are no unnecessary restrictions on trade is an ongoing process, with many reviews completed. Those remaining are challenging.
- Perceived, and at times actual, lack of transparency and timely information continues to undermine market confidence.
- The ACCC Inquiry into Murray–Darling Basin water markets (ACCC 2020a; ACCC 2020b) examined the water market structure, how participants operate and the quality of information available. The ACCC Inquiry provided its interim report to the Treasurer on 30 June 2020. MDBA looks forward to ACCC's final report due 26 February 2021.
- The new Inspector-General Water Compliance and associated Office, announced in September 2020, will enable greater focus on and resourcing of trade rule assessment and compliance.

Evaluation assessment

Table 11 Performance descriptors for water trade implementation themes.
Evaluation ratings are labelled 1-6, with 1 being the lowest performance rating and 6 being the highest performance rating. Confidence ratings assess the confidence in the assessment given the available evidence.

Indicator	Evaluation rating	Confidence
The extent to which requirements in Chapter 12 of the Basin Plan have been implemented	4. The implementation is satisfactory	High
Some progress has been made towards implementing trading rules. The work to ensure there are no unnecessary restrictions on trade is an ongoing process. More regulatory reforms are needed.		

Program logic

The program logic for the Water trade rules implementation theme within the Basin Plan 2020 Evaluation is:

'The implementation of activities related to implementation of the Basin Plan water trading rules is expected to contribute to productive and resilient water-dependent industries with confidence in their long-term future' (Figure 10).

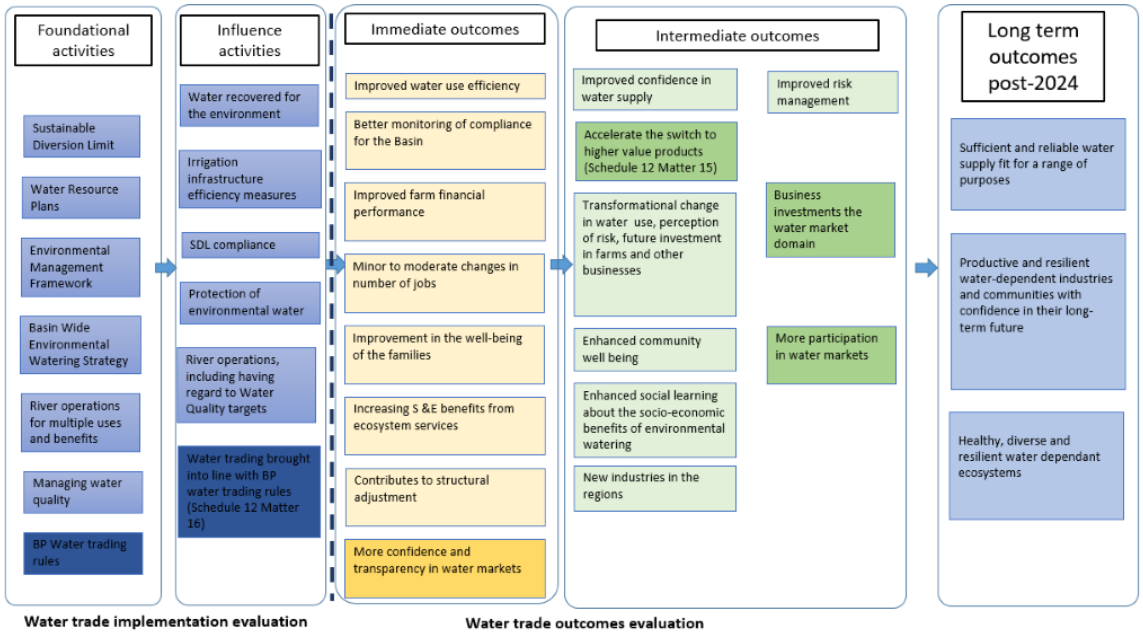

Figure 10 Water trade rules implementation program logic

Evaluation questions

1. To what extent have the water trading rules been implemented on time and as expected?
2. What opportunities exist to improve the implementation of water trading rules in order to achieve Basin Plan objectives and outcomes in relation to water trade?

Water trade rules findings

To what extent have the water trading rules been implemented on time and as expected?

MDBA has set strategic priorities to guide effort

MDBA has developed a set of strategic priorities that inform the MDBA's risk-based approach to compliance, and direct resources to the most significant compliance risks. The MDBA assessed the relative importance that each rule under the Basin Plan water trading rules has on the achievement of water market and trading objectives to develop its strategic priorities. This most recent assessment (conducted in December 2019) identified two areas of the water trading rules which present the potential to significantly compromise the objectives of the rules:

1. trade restrictions (sections 12.06 to 12.14 and 12.16 to 12.18)
2. disclosure of water announcements (section 12.51).

These areas are primarily associated with the activities of Basin state governments, reflecting that they undertake the majority of activities associated with water trade. Individuals and agencies that operate in the water market may also present compliance risks, but on a more limited basis.

The MDBA focuses its work program on these areas of high priority. However, this does not indicate that noncompliance is acceptable outside these areas, or that work is not undertaken to assess

compliance risk on other matters. It reflects that the MDBA devotes more resources to these priorities and anticipates that Basin state governments will do the same.

Progress to date

Market transparency has improved across the Basin

Market transparency and performance has improved across the Murray–Darling Basin through actions that have been implemented by State Governments. The New South Wales, Victorian and South Australian governments all now have itemised trade data for all groundwater and surface water sources. They also provide a breakdown between environmental and non-environmental allocation trades. The Queensland Government provides aggregated information for most surface water and some groundwater sources.

However, a lack of transparency and timeliness of market information remains and is affecting market performance. This is particularly true for secondary products and internal trades within irrigation infrastructure operator schemes. Further work in this area is required and is discussed later in this report.

Several significant audits have been completed by the MDBA

The MDBA has a broad audit function with significant information gathering, inspection and investigation powers under the Water Act and the Basin Plan. The MDBA has completed a number of significant reviews under this function including:

- Water Trade Price Reporting Audit (2019) (discussed further below)
- Review of metering in the Victorian lower Murray regulated surface water system (2020)
- Review of metering in the lower Murrumbidgee regulated surface water system (2019)
- Review of the Condamine Alluvium Groundwater self-meter read process (2019)
- Review of metering in the Riverland regulated surface water system (2020)

During 2018–19, the MDBA conducted a two-part audit of water trade price reporting. The first part of the audit assessed the effectiveness of the processes and procedures of each Basin state government to collect, validate, record and report accurate water trade pricing information for the water year 2017-18. The second part assessed water traders' compliance with reporting requirements in accordance with section 12.48 of the Basin Plan.

The findings of the trade audit highlighted some significant areas for improvement. It identified that:

- a large number of transactions are recorded as '$0' value
- information flowing to markets often lacks description
- nearly all transactions recorded in Basin state governments' registers are unverified.

The audit identified challenges for the MDBA to influence change. Under section 12.48 of the Basin Plan the obligation to report trade price is on the seller. There is no requirement for Basin state governments to ensure that they accurately collect and record this information and there are limited levers for the MDBA to influence fundamental improvements in this area.

The MDBA and Basin state governments are working collaboratively to improve trade pricing information. The MDBA has published a formal management response to the audit which includes a

work program to address the audit's findings. New South Wales and Victorian governments implemented improved trade reporting for the start of 2020-21 based on recommendations from the MDBA's Price Reporting Audit. Both governments have made changes to their allocation trade application forms which will more accurately capture reasons for trade, including the use of secondary water market products.

The trade price audit also identified that the rapid development of new (or secondary) water market products, such as forward leases, has outpaced the regulatory systems designed to report on trade. In many cases state systems and registers have no way to record some of these new ways of trading water accurately. The ACCC inquiry's interim report also found that "the governance, regulatory and operational framework supporting water markets have not developed to accommodate a market of this scale…" (ACCC 2020b).

Initial work has been done by the MDBA to understand the types of water market products available on the market. The MDBA has commissioned and published a report identifying the secondary water market products that people are trading in the Basin. This will help market participants better understand their trading options. The report also provides guidance to Basin state governments on upgrading their systems to recognise the full range of trade types and market activity.

Review of Basin Plan section 12.02

Section 12.02 provides specific exemptions to several trading rules to protect the delivery of environmental water. The Basin Plan requires the MDBA to complete a review of these exemptions in 2020 to ensure that the clause is appropriate. MDBA is currently finalising the review.

An initial assessment has indicated that environmental water holders have not relied on the section 12.02 provisions to deliver water. The initial assessment also found that Basin state governments and Environmental Water Holders generally support the retention of section 12.02 provision.

Changes to the section 12.02 provisions would require legislative changes. It is important that matters of potential non-compliance are given priority and resolved prior to consideration of legislative amendment. Further consideration to amending the section 12.02 provisions could potentially be undertaken at broader review points in the Basin Plan.

What opportunities exist to improve the implementation of water trading rules in order to achieve Basin Plan objectives and outcomes in relation to water trade?

With the recent drought and increased water prices due to reduced water availability, water market participants have become increasingly concerned about the operation and transparency of Basin water markets. Inaccurate and inaccessible market information, if left unattended, can diminish the trust and confidence of water market participants and affect market accessibility.

Opportunities to improve implementation of the water trading rules include:

- identifying and addressing issues relating to water market transparency, particularly about accurate pricing information
- improving market regulation.

Improving market transparency and information

Transparency of information is fundamental. Inaccurate and inaccessible market information, if left unattended, can diminish the trust and confidence of water market participants and affect market accessibility.

There are three primary areas for market transparency and improvement action across the Basin:

- improving the quality and accessibility of information needed to inform trading decisions and efforts to support equitable participation in the market through capacity building
- comprehensive and consistent reporting of market data
- harmonising trade processing across jurisdictions and entities.

Information provision and responsibilities are shared across numerous state and Commonwealth agencies, and across multiple reporting platforms. There have been calls from several inquiries and reviews to improve the quality and accessibility of market information.

Basin states governments have recently made changes to improve general water market information. The New South Wales Government has launched Trade Dashboards and the Water Insights Portal. The Victorian Government has also improved its water market information on its website and launched the Water Market Watch application.

Ultimately improvements to market-relevant information needs to be guided by end users in terms of the type of information, level of detail, and access channels that suit their needs. This needs to be complimented by capacity building to ensure all water holders can use the information available to participate effectively in the water market. Without these considerations, increasing the availability of information will more likely create further complexity and confusion, and increase the disparity between those with access to expertise to interpret the information available and those that do not have this capacity.

The recently announced Murray Darling Communities Investment Package seeks to improve market information and ensure stronger compliance. The one-stop platform for water storage, in-stream flows and trade information will be critical in improving the quality and accessibility of information.

Improving market regulation

The work to ensure there are no unnecessary restrictions on trade is an ongoing process. Additional resourcing would be required to effectively navigate the thousands of restrictions, most of which are extremely complex in nature. The new Inspector-General Water Compliance (announced in early September 2020) will enable greater focus and resources towards trade rule assessment and compliance.

The MDBA agrees with the recent ACCC (2020b) interim report findings that more fundamental regulatory reforms are required to support effective market regulation. Although, any significant proposals to improve the operation of water markets would require full support from the Basin state governments.

Governance

Overview

Water governance is defined by the OECD (2015) as

> *the range of political, institutional and administrative rules, practices and processes (formal and informal) through which decisions are taken and implemented, stakeholders can articulate their interests and have their concerns considered, and decision makers are held accountable for water management.*

Over the past few years, several reports have been released which assess and provide commentary on Murray–Darling Basin governance, particularly the Productivity Commission (Productivity Commission 2018) and the Claydon (2019) review of joint governments' governance arrangements (the latter a requirement of the Basin Plan Compliance Compact). In 2020, reports were released by the Interim-Inspector General of Murray–Darling Basin Water Resources, and the Panel for the Independent Assessment of Social and Economic Conditions in the Murray–Darling Basin. Both of these reports also noted issues, improvements and recommendations on governance.

The timing of the reviews and reports must be considered when interpreting findings. The Basin governments have or are in the process of implementing changes and undertaking action to enhance the governance processes in response to these reviews, in addition to other limitations and concerns referenced in this report. It is inappropriate to evaluate these recent changes and actions at this time, so much of the commentary for the 2020 Evaluation focusses on governance arrangements up to early 2020. It is noted throughout this governance theme report where implementation of actions are underway.

Key theme findings

- Community trust and confidence in the implementation the Basin Plan continues to be a major issue.
- The geographical, socio-economic, environmental and political context of the Basin Plan itself provides fertile ground for mistrust in governance and institutional arrangements.
- Key weaknesses in governance arrangements have been:
    - the complexity of governance structures and arrangements negatively impacting collaboration and coordination
    - lack of transparency
    - lack of clarity regarding roles and responsibilities, including leadership.
- Significant effort and commitment has been made in recent years to improve these governance deficiencies, with implementation of many actions still underway.
- A concerted effort is needed by all Basin governments to agree on who is responsible for leading implementation of the Basin Plan.
- The Basin governments need to work together and with communities collaboratively to complete the remaining implementation challenges.

Evaluation assessment

Table 12 Performance descriptors for Governance enabler theme.
Evaluation ratings are labelled 1-6, with 1 being the lowest performance rating and 6 being the highest performance rating.
Confidence ratings assess the confidence in the assessment given the available evidence.

Indicator	Evaluation rating	Confidence
The extent to which governance and institutional arrangements are appropriate for enabling the implementation and achievement of Basin Plan objectives	4. The implementation is satisfactory	High
Key weaknesses in governance arrangements are the complexity of governance structures and arrangements which are seen to negatively impact collaboration and coordination, and a lack of transparency. Significant effort and commitment has been made in recent years to improve these governance deficiencies, with implementation of many actions still underway.		
The extent to which governance arrangements operate to effectively implement the Basin Plan	3. The implementation is just satisfactory	High
A concerted effort is needed by all Basin governments to agree on who is responsible for leading implementation of the Basin Plan. The Basin governments need to work together and with communities collaboratively to complete the remaining implementation challenges.		

Program logic

The program logic for the governance enabler theme within the 2020 Basin Plan Evaluation is:

'Governance arrangements are expected to effectively enable implementation of the Basin Plan, to contribute to water that is fit for purpose, and healthy, diverse and resilient water dependent ecosystems'.

Evaluation questions

1. What are the institutional or organisational arrangements established for implementation of the Basin Plan?
2. To what extent are governance and institutional arrangements fit-for-purpose to meet internationally agreed standards of governance?
3. To what extent do the governance and institutional arrangements facilitate, enable or support trust and transparency?
4. To what extent do the governance processes enable collaboration on implementation of the Basin Plan?
5. Are roles and responsibilities clear and adhered to?
6. Do the governance arrangements encourage policy coherence?
7. To what extent is implementation of the Basin Plan affected by the governance arrangements relating to ancillary mechanisms (e.g. sustainable diversion limit adjustment mechanism)?
8. Are governance and institutional arrangements robust and resilient enough to deal with risks and emergency events?

9. Are there opportunities to improve governance arrangements to implement the Basin Plan, such as:

    - roles and responsibilities
    - collaboration and coordination amongst stakeholders
    - policy coherence
    - integrity and transparency?

10. Are there opportunities to better align instruments for managing Basin water resources?

Summary of governance findings

Appropriateness of governance and institutional arrangements

Extensive governance and institutional arrangements have been established for implementing the Basin Plan. These governance arrangements seek to establish and support the cooperative management of Basin water resources. To be most appropriate and effective, they require a high level of coordination and collaboration between the different stakeholder groups. The arrangements and associated documentation are intended to outline the roles, responsibilities and relationships of key stakeholders, including the Basin governments and established committees.

In considering the appropriateness of current arrangements supporting Basin Plan implementation, it is important to note the institutional agreements have been superimposed on long-standing settings (Productivity Commission 2018). This has added complexity to governance and institutional arrangements, resulting in some institutions having multiple roles, which may affect perceived appropriateness.

With over 30 subcommittees and multiple layers of government involved in the Basin Plan, the governance structure has generally been considered to be highly complex (Claydon 2019). Independent reviews conducted in 2018 and 2019 identified deficiencies in the design and implementation of Basin Plan governance that had the potential to impact on appropriateness[11]. Such reviews emphasised:

- the perceived complexity of governance structures and arrangements, seen as negatively impacting stakeholder understanding, collaboration and coordination
- lack of transparency and clarity around roles and responsibilities, with conflicting functions and responsibilities noted (Productivity Commission 2018; Claydon 2019)
- limited engagement with stakeholders and the community, which had contributed to a sense of distrust in organisations implementing the Basin Plan (discussed further below)
- governance arrangements and responsibilities with regards to implementation and collaboration were perceived as sentiments rather than commitments (Claydon 2019), likely affecting adherence.

[11] Note: action has and is being undertaken in response to the recommendations of these independent reviews, with a view to enhancing the appropriateness and effectiveness of governance. This has included work to promote collaboration, encourage public trust and streamline governance. Some of these actions are outlined within this section of the report, while more discussion on actions is documented in latter sections.

Significant concerns have been raised around the level of trust and confidence in the Basin Plan and its implementation. While this has been attributed in part to the context of the Basin Plan (noting its geographical, socio-economic, environmental, and political context), multiple external reviews have noted the implementation approach contributes to community concern, distrust and misunderstanding (Wentworth Group 2017; Productivity Commission 2018; Basin Community Committee 2019a, 2019b; SARC 2019; Vertessy et al. 2019; Sefton et al. 2019, 2020; Interim Inspector-General 2020). Of note, the following perceptions are considered as negatively impacting trust and community confidence:

- lack of appropriate oversight and collaborative leadership to support implementation of the Basin Plan
- conflict in the role of the MDBA with concerns raised around its functions as independent advisor to the government, regulator and agent of Basin state governments
- lack of accountability and action to ensure implementation of review recommendations, with community members seeing no change or progress as a result of any submissions made
- perception that Basin state governments and other stakeholders do not have the capacity to ensure water take laws are enforced and compliance obligations are met.

In addition to the lack of trust and transparency, limitations have been identified in the extent of collaboration to support implementation. Need for improvement has been highlighted in external reviews (Productivity Commission 2018; Alluvium 2019; Claydon 2019). Multiple factors (including governance deficiencies mentioned above) were identified as contributing to this lack of collaboration.

The complexity, lack of trust and transparency, and limitations around Basin Plan governance and implementation has been acknowledged by the Basin governments, and a range of actions to address these concerns have been agreed and partially or fully implemented (Department of Agriculture 2019a, 2019b; MDBA 2019f). This has included actioning or agreeing to the recommendations identified in multiple external reports and reviews, which are detailed in the latter section of this theme report.

Of note, the statutory position of Inspector-General of Murray–Darling Basin Water Resources was established to provide assurance and increase community confidence in water management, Basin Plan implementation and compliance. It was announced in September 2020 that this position would be replaced by the Inspector-General of Water Compliance.

Communications and engagement improvements include simplifying and expanding content and information relevant to the Basin Plan and its implementation on websites, increasing the delivery and publication of reviews and reports, and strengthening and expanding stakeholder consultation and engagement activities.

Other actions include reviewing governance arrangements at the Basin Officials Committee level and below, implementing collaboration protocols to support information sharing and joint enforcement of water management and compliance activities, and investing in water measurement and real-time dissemination of information (e.g. the monthly Flow in the River Murray System snapshot). While such actions are perceived as progress, reporting has suggested that further action is required.

This evaluation cannot comment on the appropriateness of the recent changes to governance arrangements as they have only been implemented for a short period of time or not fully implemented as yet.

Any outstanding challenges to collaboration and governance following completion of current actions would need to be overcome to support effective functioning. Intent to enhance the level and effectiveness of collaboration has been identified through prior evaluation activities.

Effective operation

For Basin Plan governance to operate effectively, it is critical that arrangements are well understood and adhered to by the Basin governments. Any lack of clarity is likely to cause confusion and may impact on the successful completion of governance tasks (either through duplication of effort or activities being missed). In addition, the political context and sometimes competing values adds another layer of complexity for effective operation of governance arrangements.

Analysis of research and documentation relating to the Basin Plan outlines multiple limitations in the implementation and operation of governance arrangements. Despite efforts to document roles and responsibilities, reviews conducted in 2018 and 2019 raised concerns around clarity, definition, and adherence to governance arrangements.

- Concerns were raised by the Productivity Commission (2018) about a lack of strategic leadership, with responsibility for leading implementation of the Basin Plan reportedly unclear.
- Stakeholders have viewed governance structures and requirements as being highly complex, with confusion around roles, functions and reporting requirements (Basin Community Committee 2018). This has reportedly caused frustration for stakeholders and the community, resulting in uncertainty around decision making powers and demarcation of committee responsibilities, while contributing to 'ineffective arrangements for intergovernmental collaboration and policy coherence' (Productivity Commission 2018:350).
- The lack of clarity in governance roles and responsibilities has resulted in a duplication of effort across multiple committees or confusion about which agencies should be present for discussions.
- There is a perception that the MDBA (which performs both regulatory and service delivery functions) has conflicting roles which may compromise its work.
- While the governance of the Basin Plan seeks to achieve policy coherence through joint stewardship of the Basin's water resources, multiple challenges have been experienced. The literature acknowledges a need for Basin governments to prioritise this joint stewardship role and focus on effective collaboration, which will help provide more certainty about long-term water reform (Productivity Commission 2018; Interim Inspector-General 2020).

While the roles and responsibilities of Basin governments, multijurisdictional committees and working groups are documented (including within the Water Act, Basin Plan, Murray–Darling Basin Agreement, and Ministerial Council–MDBA Service Level Agreement) limitations were identified. Established terms of reference for committees may lack detail, not be current (with no recent review or update) or have no documented terms of reference (Claydon 2019). This is likely to have contributed to the confusion and uncertainty around roles and responsibilities.

In response to these concerns, the Basin governments have undertaken work to streamline and simplify governance arrangements (as detailed later in this evidence pack). Of note are the governance improvements underway (to be completed early 2021) by the joint governments in response to recommendations from the Productivity Commission and Claydon reviews, and numerous discussions since mid-2018.

The *Basin Plan Monitoring, Evaluation and Reporting Capability Assessment* (Alluvium 2019) highlighted that governance within MDBA had improved since 2017. Reported clarification of roles and responsibilities in terms of evaluation coordination, project management and decision making suggest that actions to improve governance are having a positive impact in some areas. Further, both the Department of Agriculture and Water Resources and the Commonwealth Environmental Water Office were rated as meeting the capability targeted of 'Embedded'.

On 4 September 2020 the Australian Government Minister responsible for water announced a new Office of Inspector General of Water Compliance would be established under the Department of Agriculture, Water and the Environment. The Office will merge the MDBA's Office of Compliance functions with the Interim Inspector-General of Murray Darling Basin Water Resources, consolidating the Commonwealth's compliance responsibilities for water in the MDB. Legislative changes will be required to move the compliance functions from the MDBA; therefore it is not expected that the Office will be established until the latter half of 2021.

Anticipated and unanticipated risks

Multiple risks relating to governance and institutional arrangements were identified through the research, primarily relating to delays in implementation and the effectiveness of stakeholder communications. If not addressed, such risks (described below) will affect implementation and may ultimately impact on the ability of the Basin Plan to achieve its environmental, social and economic outcomes.

- Unrealistic timeframes and lack of clarity around responsibilities for implementation ownership may continue to result in delays to the progression and completion of activities under the Basin Plan. Such delays will inhibit full implementation and delivery of activities within required timeframes, potentially putting environmental outcomes and creating tension with social and economic outcomes.
- Basin Plan resourcing and government cooperation will be insufficient to facilitate the effective stakeholder collaboration and engagement required to gain community trust and support. A potential need for increased resourcing and greater coordination across governments is suggested in the literature (e.g. Productivity Commission 2018; Claydon 2019; Interim Inspector General for Murray–Darling Basin Water Resources 2020; Sefton et al. 2020).
- Governance arrangements may not enable community trust and support transparent implementation of the Basin Plan, creating dissatisfaction among stakeholder groups. Greater emphasis on effective community engagement and ongoing communication is required to ensure stakeholder buy-in and support.
- Current planning and governance structures may not support coordinated and collaborative responses to the management of emergency situations in the Basin. Further planning (such as that undertaken for the Native Fish Emergency Response Plan 2019–20) may be required

to ensure strategic directions and responsibilities are understood to support the efficient and effective management of emerging risks.

In considering identified risks it was apparent that there is a need to increase collaboration, transparency, and adherence to governance structures in support of implementation and ongoing delivery. Such risks may be addressed in part through recent actions undertaken by the Basin governments to enhance governance.

While risks have previously been identified, there is some evidence that Basin Plan governance and institutional arrangements will be able to appropriately respond and have been improved in the recent years. While Claydon (2019) identified limited consideration of the management of strategic risk, the Interim Inspector-General for MDB Water Resources (2020:39) identified that 'The governance arrangements do provide some flexibility and ability to respond to emerging conditions'. This is expected to assist in mitigating implementation risks on an ongoing basis.

Opportunities

Governance opportunities and recommendations have been identified in multiple reviews and reports relating to the Basin Plan. Recommendations from the Productivity Commission (2018) review and Claydon (2019) governance review are currently being implemented to improve governance (Department of Agriculture 2019a), with further opportunities expected to arise from the current evaluation.

Opportunities to enhance governance and institutional arrangements to date have focused on:

- increasing and promoting ongoing collaboration amongst Basin Plan stakeholders
- establishment and implementation of the Inspector–General of MDB Water Resources
- encouraging public trust in the Basin Plan by providing greater transparency and assurance around metering, compliance, monitoring and accountability activities, and publication of high-level meeting communiques and key documents
- simplification and streamlining of roles and responsibilities within the governance structure, including ensuring clarity around decision making authorities.

Multiple actions to improve Basin Plan governance and institutional arrangements have been approved and/or are currently underway since many of the reports used as evidence for this evaluation were released. While there is evidence of improvement, the impacts of enhancement actions may have yet to be realised. Agreement to address common themes and findings from earlier reviews (including Claydon 2019 and the Productivity Commission 2018) was only reached in December 2019. The majority of these actions will be implemented by end of 2020, with Tier 2 committee memberships and Terms of Reference on track for completion early 2021. Some recommendations with a focus on stakeholder engagement have been delayed until 2021 due to COVID-19 restrictions.

In addition to governance improvements, opportunities to align instruments for managing Basin water resources have been identified and are being actioned. This has included:

- development of a water resource plan compliance framework
- revision of the approach to setting Basin annual watering priorities

- incorporation of long-term water planning content into a planned 2020 review of the Environmental Watering Plan
- consideration of recommendations to separate the service delivery and regulatory functions of MDBA, and subsequent announcement to move the MDBA Office of Compliance into the new Office of Inspector-General for Water Compliance.

The Interim Inspector-General for MDB Water Resources identified ongoing concerns that Productivity Commission recommendations are being ignored. He also expressed concern that Basin governments were not leveraging opportunities to build accountability and trust from multiple recent reviews (Interim Inspector-General 2020). However, with many actions not scheduled to be completed by the end of 2020 or beyond, not enough time has passed to see the full effects of governance improvement activities.

Most recently, the Sefton et al. (2020) report notes that Basin governments and communities need to work together to rebuild trust. The Panel found 'many people have diminished trust in federal and state governments to deliver good long term policy and support rural and regional Basin communities.' (Sefton et al. 2020:11). Additionally, the distrust has been fed by feelings of over-consultation and not being listened to, and successive governments not providing clear leadership or a compelling vision.

The first two recommendations by Sefton et al. (2020) relate to improvements in governance. Recommendation 1 includes building local leadership capacity, building community and catchment involvement, strengthening community consultation, and strengthening the capacity of Basin governments to engage regionally to implement the Panel's recommendations.

Recommendation 2 focuses on the need for Basin governments and relevant authorities to work together cooperatively, and recognise the importance of transparency and accountability in providing certainty and confidence to communities (Sefton et al. 2020). Actions include investment in a Basin-wide information platform, the Basin Officials Committee to publicly report advice to the Ministerial Council, joint Basin Community Committee and Basin Officials Committee meetings (first held October 2020), investment to support informed dialogue and rebuild trust, and improve data and information about social and economic conditions in the Basin.

With multiple sources of improvement opportunities, it is important that any potential or enacted enhancements to Basin Plan governance, institutional arrangements and instruments are carefully documented, assessed, and prioritised for action. An ongoing, concerted effort to communicate and ensure transparency about how Basin Plan governments are adapting to improve governance and institutional arrangements will be required. This will ensure that stakeholders involved in the implementing and delivering the Basin Plan can appropriately target effort and maximise improvements to governance and institutional arrangements.

Clarity of roles and responsibilities is the foundational principle and fundamental driver of effective institutional arrangements (Productivity Commission 2018). While the legislation sets out that the MDBA is responsible for *overseeing implementation* of the Basin Plan, all Basin governments have roles and responsibilities in implementing the Basin Plan. To achieve overall improvement in governance and effective and appropriate implementation of the Basin Plan, a concerted effort is needed by all Basin governments to *agree* on who is responsible for leading implementation (Productivity Commission 2018; Claydon 2019).

Governance findings

What are the institutional or organisational arrangements established for implementation of the Basin Plan?

The overarching governance arrangements for the Basin Plan are set out in the *Water Act 2007* (Cwlth), which seeks to establish cooperative arrangements for the management of water resources in the Basin. Specifically, the Water Act (Schedule 1) has the purpose to 'promote and co-ordinate effective planning and management for the equitable, efficient and sustainable use of the water and other natural resources of the Murray–Darling Basin, including by implementing arrangements agreed between the Contracting Governments [Basin governments] to give effect to the Basin Plan, the Water Act and State water entitlements.' – this is the Murray–Darling Basin Agreement 2008.

The Productivity Commission (2018) notes the institutional arrangements agreed by the Basin governments for implementation of the Basin Plan were superimposed on long-standing settings, resulting in key institutions having multiple roles. The governance arrangements are summarised by the Productivity Commission (2018:18) as

> *The Basin Plan is an instrument of the Australian Parliament, and Basin Governments have committed to implement the Plan through intergovernmental agreements.*
> *The Australian Government has responsibility for water recovery programs and the management of this water (by the Commonwealth Environmental Water Holder)(expanded) for environmental purposes.*
> *Constitutional responsibility for water resource management in the Basin resides with the Basin States. It is their role to ensure that their own State-based arrangements reflect and are consistent with the Basin Plan.*
> *Basin Governments agreed that the MDBA (an independent Australian Government Corporate Commonwealth Entity) would be responsible for preparing and [overseeing] implementing the Plan, enforcing compliance with it, and monitoring and evaluating the outcomes. The institutional arrangements agreed by Basin Governments for the Basin Plan were superimposed on long-standing settings, including those of the Murray–Darling Basin (MDB) Agreement.*

Governance arrangements established by the *Water Act 2007* (Cwlth)

The MDBA was constituted as a corporate Commonwealth entity by the Water Act s171. Its functions and powers are prescribed at s172, Part 2, and at Schedule 1 (the Murray–Darling Basin Agreement 2008) of the Water Act. Decisions under the Water Act and the Basin Plan are ultimately made by the seven-member Authority or the Australian Government Minister responsible for Water.

The MDBA has multiple roles (Productivity Commission 2018):

- an independent authority providing advice to the Australian Government in its role to prepare, recommend and amend the Basin Plan
- a regulator ensuring compliance with the Basin Plan and reporting on Basin Plan implementation by Basin governments

- a service provider, acting as the agent of Basin governments, funded and directed by them under the Murray–Darling Basin Agreement, to deliver River Murray operations and other joint programs.

The Murray–Darling Basin Ministerial Council and the Basin Officials Committee were established under the Murray–Darling Basin Agreement. The Ministerial Council and Basin Officials Committee have solely consultative or advisory functions (South Australian Murray–Darling Basin Royal Commission 2019). The functions of the Ministerial Council are to 'consider and determine outcomes and objectives on major policy issues of common interest to the Contracting Governments in relation to the management of the water and other natural resources of the Murray–Darling Basin … but otherwise only in so far as those issues are not provided for in the Basin Plan.' (Murray–Darling Basin Agreement 2008).

The Basin Officials Committee advises the Ministerial Council and has two roles (Productivity Commission 2018):

- Under the Murray–Darling Basin Agreement, it directs the MDBA on Murray–Darling Basin Agreement functions and approves the MDBA's operating plan and budget for these functions before the Ministerial Council formally endorses them.
- Under the Water Act and the Basin Plan, it provides advice and facilitates cooperation between the MDBA and jurisdictions during development and implementation of the Basin Plan. It also notifies the MDBA regarding supply and efficiency measures.

The Basin Community Committee, established by the MDBA under the provisions of the Water Act, also provides advice to the Ministerial Council under the Murray–Darling Basin Agreement.

The Ministerial Council and the MDBA entered into a service level agreement in 2014, which sets out how the MDBA undertakes its functions under the Murray–Darling Basin Agreement and delivers programs agreed by the Ministerial Council (Claydon 2019).

Governance arrangements established by the Basin Plan

As per s1.12 of the Basin Plan, the MDBA entered into the Basin Plan 2012 Implementation Agreement with the Basin state governments and the Commonwealth Environmental Water Holder in August 2013 (Claydon 2019). The Basin Plan 2012 Implementation Agreement's purpose is:

- to identify the obligations and agree the tasks which will meet the Basin Plan's implementation obligations
- to define where obligations between the parties are co-dependent
- to describe the MDBA's proposed approach to discharging its regulatory obligations under the Basin Plan.

The principles of the Basin Plan 2012 Implementation Agreement are:

1. All parties commit to the collaborative implementation of the Basin Plan.
2. In making this commitment, the parties agree to:

    a. work transparently and respectfully with each other, including acknowledging and respecting each other's roles, responsibilities and legislative frameworks
    b. be innovative in the way they address the challenges that arise

c. seek cost-effective, efficient and fit-for-purpose approaches
d. work closely with each other when engaging with the community.

The Basin Plan 2012 Implementation Agreement also states that the MDBA and Basin state governments will work together to 'ensure the Basin Plan's implementation obligations are given effect in ways that are consistent with the intent of, and provisions in, the Intergovernmental Agreement.'

The Intergovernmental Agreement (IGA) sets out some of the governance arrangements, including roles and responsibilities, for implementing the Basin Plan and associated measures, specifically the:

- Australian Government commitment to 'Bridge the Gap' between Baseline Diversion Limits and Sustainable Diversion Limits
- Sustainable Diversion Limit Adjustment Mechanism (evaluated in the 'Reviews and Adjustments' theme)
- Constraints Management Strategy
- environmental measures in the northern Basin

The Basin Plan 2012 Implementation Agreement established the Basin Plan Implementation Committee with the purpose of being a high-level forum to monitor, review and make decisions relevant to implementing the Basin Plan 2012 Implementation Agreement, including ways of working with communities. It also allowed the MDBA to consult with Basin state governments and the Commonwealth Environmental Water Holder on all aspects of Basin Plan implementation, including the annual MDBA Plan Implementation work program. The Basin Plan 2012 Implementation Agreement also established several Basin Plan Implementation Committee working groups.

In December 2019 the Basin Officials Committee and Ministerial Council agreed to a number of governance improvements (Basin Officials Committee Governance Joint Governments' Response Paper (Department of Agriculture 2019b) including dissolving the Basin Plan Implementation Committee, with matters considered by this committee to be streamlined and reallocated to more relevant committees (Tier 1 committees). Working groups established under the Basin Plan 2012 Implementation Agreement will also be reviewed (Tier 2 committees).

Mapping the MDB governance

The functions and governance of the Basin Plan and the Murray–Darling Basin Agreement 2008 are summarised in Figure 11 and Figure 12, although recent arrangements for the Northern Basin Commissioner are not included.

More than 30 sub-committees, advisory panels and working groups were established by the Basin Officials Committee, the Basin Plan Implementation Committee and the MDBA (Figure 13) - although Claydon (2019) notes the map is useful but not complete. For example, the Northern Basin Advisory Committee[12] is not included in the committee map. The focus of the committee was their northern Basin work program, which is guided by six key objectives:

- to achieve positive social and economic outcomes
- to achieve sensible water recovery and effective use

[12] This committee concluded operations after the completion of the Northern Basin Review in 2017–18

- to identify the best environmental science
- to ensure communities have confidence in the implementation of the Basin Plan
- to establish reliable monitoring and evaluation methods
- to recognise cultural flows.

Claydon (2019) also recognises that the map of committees has some consultative and reporting relationships incorrect and appears to minimise the collaborative effort in joining Basin Plan implementation (under the Water Act) and joint venture activities (under the Agreement at Schedule 1 to the Act) by depicting the connection only via the MDBA.

The revised Joint Governments' governance arrangements will place the Basin Officials Committee as the peak body of Basin government officials to provide advice to and be consulted by decision makers on all Murray–Darling Basin matters. In some instances, the Basin Officials Committee will:

- provide advice to the Ministerial Council
- be consulted by the MDBA prior to the Authority making a decision or recommendation to the Commonwealth Minster responsible for water
- make decisions (Department of Agriculture 2019b).

The revision of committees under this structure recognises the interface the Authority has with the governance framework and the advisory role of the Basin Officials Committee, as well as the role of the MDBA as an organisation being the agent of the joint venture in accordance with the Water Act and Basin Plan Implementation Agreement (Department of Agriculture 2019b). The revised governance structure of Tier 1 committees reporting to the Basin Officials Committee is mapped in Figure 14. As Tier 2 committees won't be finalised until early 2021, they are not included in this map

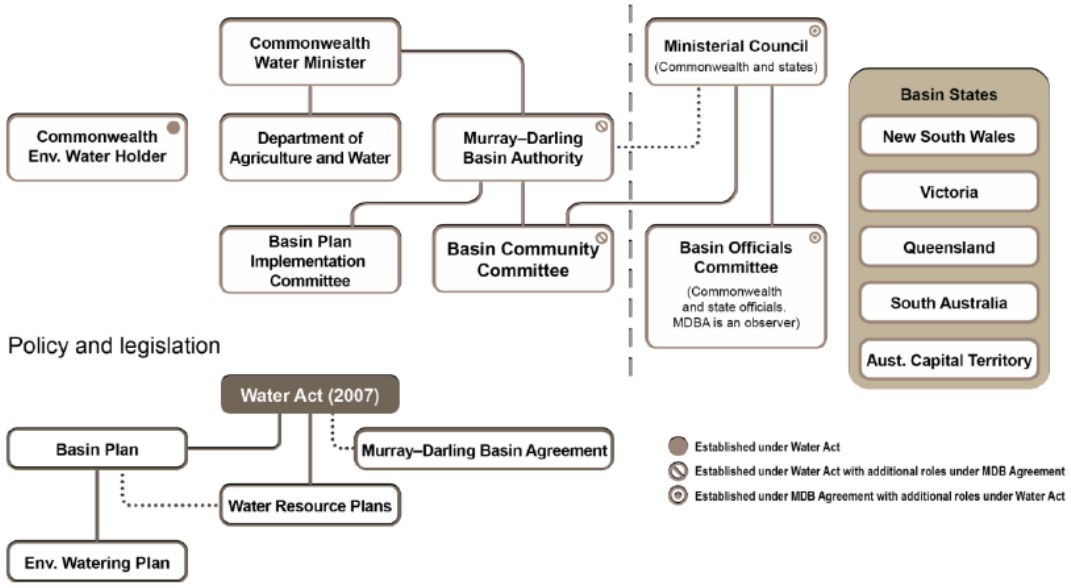

Figure 11 Governance in the Murray–Darling Basin (Claydon 2019)[13]

[13] The Basin Plan Implementation Committee has been dissolved and responsibility reallocated to other Tier 1 committees (see Figure 14)

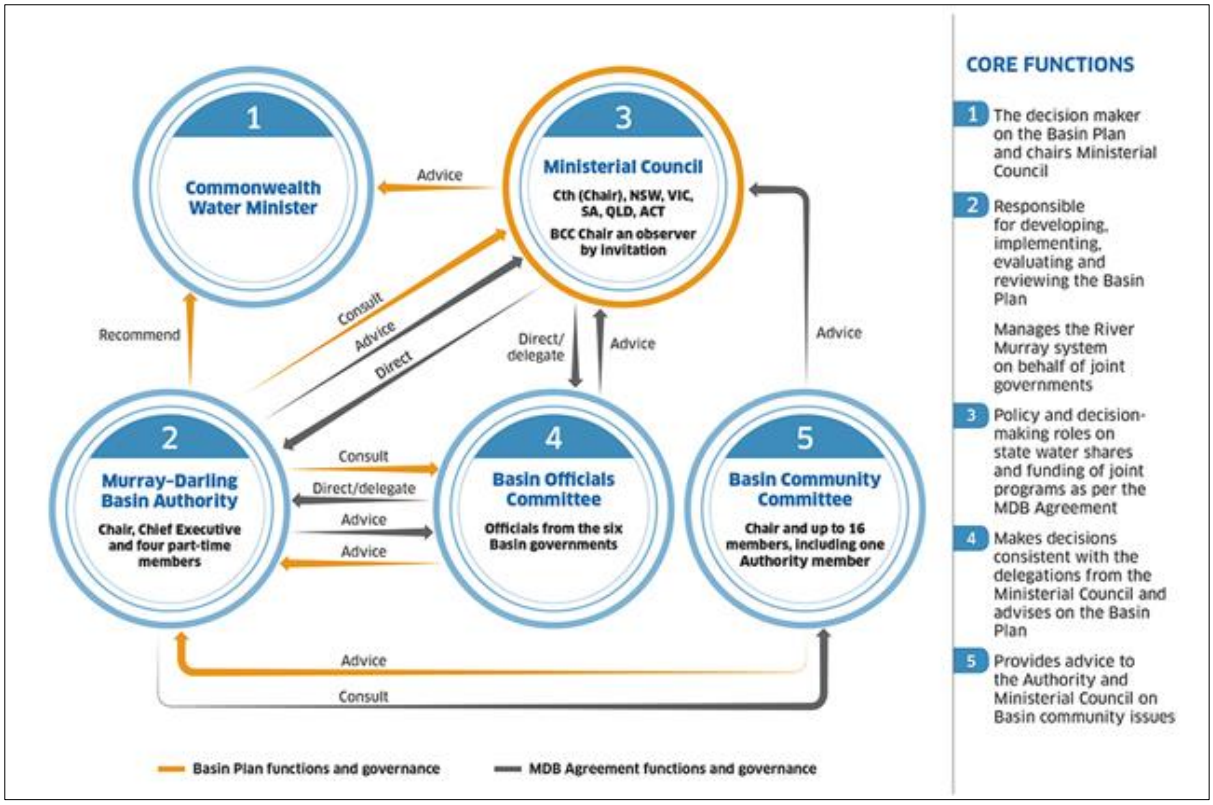

Figure 12 Functions and governance of high level Murray–Darling Basin committees (MDBA 2019f)

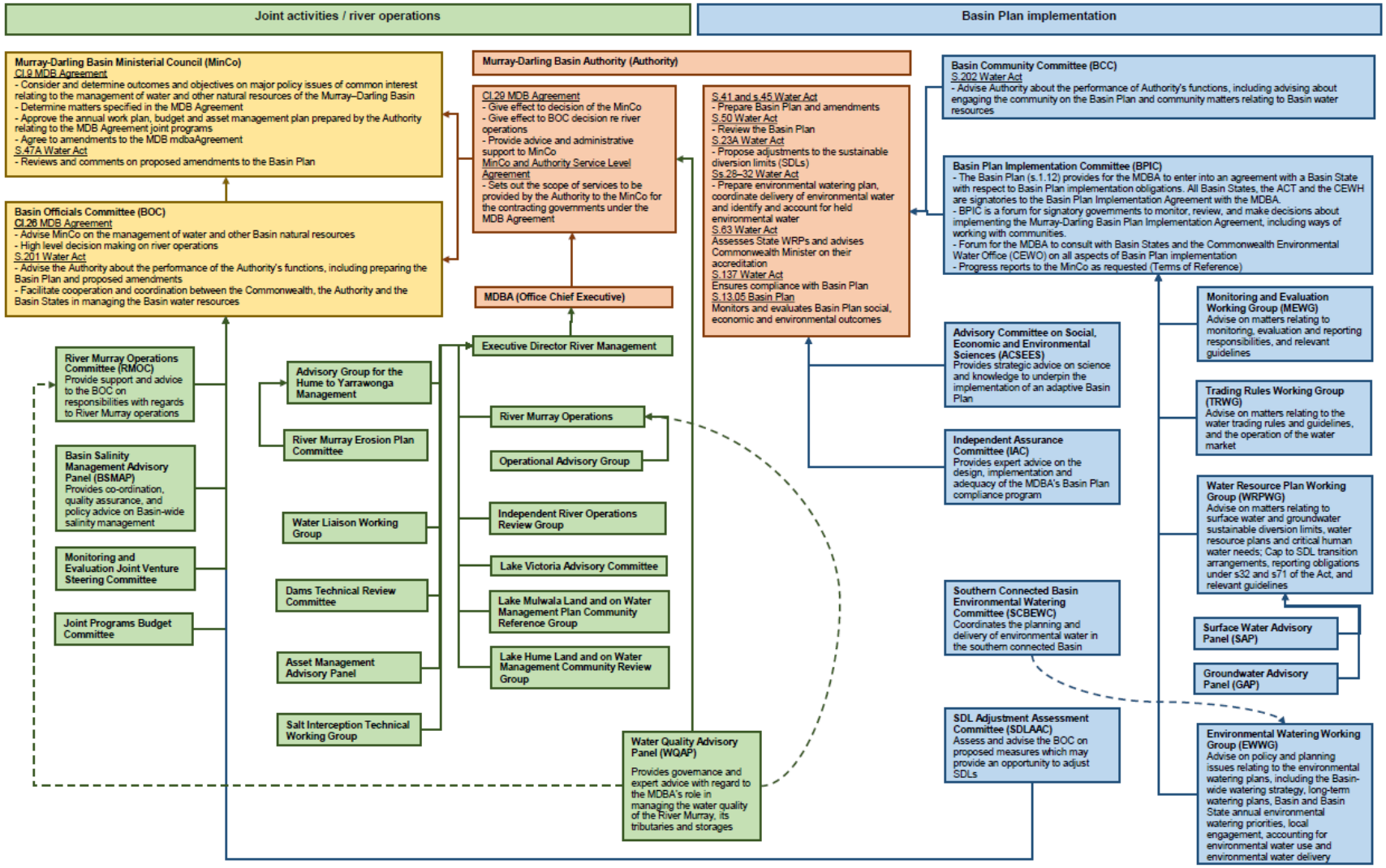

Figure 13 Map of MDB committees as at early 2020 (Claydon 2019)

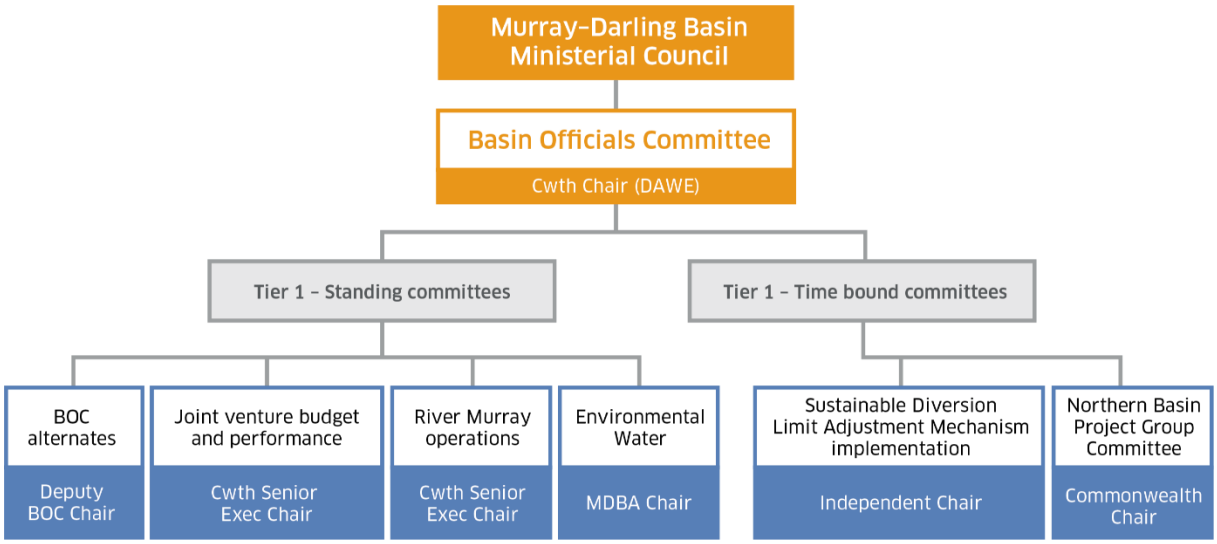

Figure 14 The revised Basin Officials Committee governance structure as of late 2020

To what extent are governance and institutional arrangements fit-for-purpose to meet internationally agreed standards of governance?

The Productivity Commission (2018) used six key principles to assess the effectiveness of the current institutional and governance arrangements, drawn primarily from the OECD (2014) and Australian National Audit Office. Claydon (2019) also used the Productivity Commission principles for effective institutional arrangements and good governance as the framework for the recommendations to improve joint government governance arrangements. The principles are:

- clear roles and responsibilities
- effective management of conflicting objectives and functions
- effective accountability mechanisms
- effective collaborative processes
- adequate capabilities
- effective stakeholder engagement.

The Productivity Commission (2018:346) 'found serious deficiencies in the areas of role clarity, conflicting functions, and stakeholder engagement'. The Claydon (2019) review noted the roles and responsibilities are no longer clear and many of the commitments in multiple agreements and terms of reference are more like sentiments—particularly around collaboration, consultation and capabilities. Claydon (2019:36) likened the governance arrangements to

> *… a very cluttered house, with too many small rooms that don't serve modern approaches to living well … There is not a good logical 'flow' from one room to the other … Anyone new to the house has considerable difficulty finding their way around … Living in this house is also impacted by … a lack of a regularly stated agreement and an understanding and an acceptance as to who is responsible for cleaning up and putting away the dishes … as people have resorted to doing their own thing.*

The Basin Officials Committee developed the Governance Joint Governments' Response Paper (Department of Agriculture 2019b), incorporating some of the broader outcomes and

recommendations from recent reviews (including the Productivity Commission report and Claydon review) and input from strategic discussions between Basin jurisdictions.

The Ministerial Council endorsed the Basin Officials Committee response paper and it was published in December 2019. The Ministerial Council noted the MDBA would develop an implementation plan to give effect to the governments' response with a view to delivering on all actions by 31 December 2020. This implementation plan was first drafted in January 2020 and is a working document that is constantly updated to track progress.

The governance improvements are intended to address the common themes and findings of the reviews and discussions that occurred between mid-2018 and the end of 2019. The focus of the improvements are to:

- simplify and streamline decision-making
- increase transparency
- improve clarity of accountability, roles and responsibilities of various committees
- and improve clarity of decision-making authority (Department of Agriculture 2019b).

To what extent do the governance and institutional arrangements facilitate, enable and support trust and transparency?

The geographical, socio-economic, environmental and political context of the Basin Plan has not provided fertile ground for genuinely transparent and trusting governance and institutional arrangements to be built (Alexandra 2018; Wentworth Group 2017). Further, the Productivity Commission (2018:13) noted that 'Deficiencies in the way that Governments have approached implementation of the Plan have caused considerable concern in many Basin communities. This has left a legacy of community distrust, which the Commission considers is a risk to effectively implementing the next phase of the Plan.'

In this context, effective governance arrangements to facilitate and enable trust and transparency were always going to prove exceptionally challenging, as evidenced through multiple reports.

Wentworth Group of Concerned Scientists

> *The 2004 National Water Initiative was almost universally supported, and the Basin Plan was a bipartisan agreement, yet how governments have gone about these reforms has resulted in conflicts among communities and this has contributed to an overwhelming erosion of public trust in government.* (Wentworth Group 2017:46).

South Australia Royal Commission

> *The evidence persuasively shows the National Water Commission [expanded] provided a necessary check and balance, and oversight, that is now lacking in the implementation of the Basin Plan. To some extent, the MDBA has been left to check its own work… and in other cases bodies such as the Productivity Commission fail to provide the expert, independent and appropriately funded oversight that is needed in the complex and specialized Basin context.* (SARC 2019:695).

Independent Panel assessment on fish deaths in the Lower Darling

> *The public discourse frequently calls into question the legitimacy and effectiveness of water management arrangements in the Basin, and highlights the differing expectations that people hold about the purpose and promise of the Basin Plan.* (Vertessy et al. 2019:30).

Basin Communities Committee

Calls to stop 'playing politics' and for renewed support, unity and leadership made in the Basin Community Committee's open letter to the Prime Minister (2019b).

> *Unrest in the NSW Mid Murray and Goulburn Murray Irrigation District in Victoria about the Plan's implementation is escalating. Local governments in northern Victoria are wavering in their support of Basin Plan implementation. Sentiment against the Basin Plan is becoming more widespread.* (Basin Community Committee 2019a).

Independent Panel assessing social and economic conditions in the Basin

> *Trust in governments, water agencies and water markets is at a low point, and is related to an accumulation of issues, including the fragmented nature of government responsibilities and the complexity and lack of transparency of water policy, allocation frameworks, environmental watering, water markets and decision-making across governments. Some communities are losing confidence in their capacity to influence fair and equitable decision-making.* (Sefton et al. 2019:29).

> *…[over the past 12 months governments have] taken steps to increase confidence and trust in institutions and governance … [including] establishing the Interim Inspector-General of Murray–Darling Basin Water Resources and NSW's Natural Resources Access Regulator … but more effort and goodwill are required from our governments, communities and their leaders … There is a risk that a growing toxicity infecting our Basin conversations will set back our capacity to understand and cope with future change and make the best of it.* (Sefton et al. 2018:11)

Productivity Commission

Many participants in the Productivity Commission inquiry expressed concerns about the inherent conflict in the MDBA's roles of providing independent advice to the government concerning making and amending the Basin Plan; its regulator function ensuring compliance with the Basin Plan, and its role as agent of Basin State governments in providing services under the Murray–Darling Basin Agreement. These conflicting functions have the potential to erode trust in compliance regimes (Productivity Commission 2018).

The Productivity Commission review noted 'there is a widely held view in the community that Governments have failed to provide clear and decisive direction-setting leadership' and

'Government's approach has regularly lacked transparency and candour' (Productivity Commission 2018:13).

There has been a lack of transparency in Basin governments' and the MDBA's decision-making, particularly in regard to supply measures and water purchases, resulting in low confidence and trust in governments (Productivity Commission 2018).

> *An overwhelming number of participants in the inquiry indicated that stakeholder confidence has been further diminished by concerns that some Basin States had substantial deficiencies in enforcement of their water take laws. An unwillingness to demonstrate that water acquired for the environment can be protected from extraction further downstream, and allegations of fraud in water recovery programs have compounded these concerns and left stakeholders sceptical of the motivations of Basin Governments.* (Productivity Commission 2018:13)

Interim Inspector-General of the Murray–Darling Basin Water Resources

> *Fuelled by uncertainty, misinformation, misperceptions or misappropriation of available information, the public debate around Basin management has become increasingly toxic. It is creating division between the Basin states and even within communities themselves. In the absence of strong, basin-wide leadership, there is a perception that some parties are too busy 'playing politics' and are ineffectual at making any tough decisions—especially when it comes to making decisions in the national interest and at the 'whole of Basin' level.* (IIG of the MDB Water Resources 2020:38)

> *There is often no clear accountability for governments or agencies to assess, consolidate and implement the recommendations from these reviews [over 40 reports delivered in the last few years on issues relating to the Basin]. This can result in people feeling as if little progress is being made and that submissions they have made for past reviews have not been taken into account or resulted in any change… A single point of truth on many issues appears to be more challenging to establish than it should be. This is at the core of many issues brought to the Inquiry.* (IIG of the MDB Water Resources 2020:39)

> *A lack of trust and confidence in the science underpinning many aspects of water management in the Basin contributes to tensions about water-sharing and use … There also needs to be trust in the agencies that provide the science and the independence of scientific advice. There appears to be a lack of trust in the Basin Plan settings—for example, the setting of the Baseline Diversion Limit (which is a foundation of the Sustainable Diversion Limit), and the amount of environmental water to be recovered.* (IIG of the MDB Water Resources 2020:41)

Actions

It is clear from the evidence above that the governance arrangements have not enabled trust and transparency in governance and Basin Plan implementation. As such, there have been significant

effort and commitment to cultivate improve trust and transparency amongst the governance structures and the Basin Plan stakeholder groups, particularly in recent years.

This is evidenced by:

- The range of actions detailed in the joint government response to the Productivity Commission Report (Department of Agriculture 2019a) outlined in Table 13. (Note: these were the actions that were underway at the time of the joint government response in 2019, and the status column provides the most recent update on implementation).
- The Ministerial Council and Basin Officials Committee agreement on, and implementation of, recommendations to address common themes and findings of various recent reviews (Department of Agriculture 2019b). In particular, the range of mechanisms to improve transparency and engagement with key stakeholders and the community, including:
    - refreshed webpage for Basin Officials Committee related information
    - at least one regional Basin Officials Committee meeting per year, including site visits and opportunities to meet with local stakeholders (delayed due to COVID-19 travel restrictions)
    - joint meetings with the MDBA Board and Basin Community Committee (the first was held on 20 October 2020)
    - Annual Basin Conference and Roadshow (originally planned for October 2020 but postponed to 2021 due to COVID-19).
- The MDBA has endeavoured to strengthen and expand its engagement across the range of diverse stakeholders and to significantly enhance the information made available on its website, including reviews and the MDBA's responses (MDBA 2019f).
- Community consultation efforts such as the MDBA's 'Basin and Eggs' public engagement breakfast seminar series, inviting prominent speakers to discuss topics of Basin interest with community leaders (MDBA 2019f).
- Ensuring expert peer-reviews are undertaken and published (e.g. Vertessy et al. (2019) report on fish deaths, and Sefton et al. (2020) Independent Social and Economic panel review).

The Ministerial Council has recently reaffirmed its commitment to address community concerns surrounding transparency and data (Murray–Darling Basin Ministerial Council 2020). The Ministers have acknowledged the improved information sharing about water management and markets by government, but noted the effort needs to be strengthened and coordinated. The Basin Officials Committee will provide a framework for collectively sharing information and developing a single-source information portal for the Murray–Darling Basin, to Ministerial Council at their next meeting on 27 November 2020.

Table 13 Joint government response to the Productivity Commission recommendations related to governance, and status of implementation

Key action	Status
Implement the Murray–Darling Basin Compliance Compact 2018 to strengthen compliance in water resource management.	Underway. Includes the Claydon (2019) governance review and implementation of revised governance arrangements for the Basin Officials Committee and Basin Plan Implementation Committee (Department of Agriculture 2019b).
The Queensland Government will implement new provisions for measuring the take of overland flows to improve compliance and management of water.	Underway as one of the initiatives of the Rural Water Management Program. A consultant has been engaged to evaluate how overland flow is managed and measured and recommend an improved measurement framework. Development of an overland flow measurement standard and a risk-based overland flow management program to improve the measurement and accounting of take of overland flow is currently underway, due to be completed in early 2021 (Department of Natural Resources, Mines and Energy 2020).
The Australian Government will establish a statutory position of Inspector-General of Murray–Darling Basin Water Resources to provide independent assurance and community confidence in water management, Basin Plan implementation and compliance.	Mick Keelty was appointed as Interim Inspector-General from 1 October 2019. The Interim Inspector-General is a non-statutory role for a period of 12 months, or until a statutory appointment was made. Note, on 4 September 2020 it was announced the Commonwealth would seek to establish a new Inspector-General of Water Compliance that will encompass the responsibilities of the Interim Inspector-General of MDB Water Resources. There is currently no-one filling the position of Interim Inspector-General MDB Water Resources as Mick Keelty did not seek to extend his tenure. The Interim Inspector-General completed the inquiry into the management of Murray–Darling Basin water resources. The *Impact of lower inflows on state shares under the Murray–Darling Agreement* report was published on 17 April 2020. A number of the recommendations are already underway (MDBA 2020g).
The Australian Government will invest $35 million in the 'Northern Basin satellite and remote river sensor program' to improve the	The Australian Government has invested $35 million in the Hydrometric Networks and Remote Sensing Program to improve the transparency, consistency and accessibility of water information in the Northern Basin. The program will fund development of web-

Key action	Status
measurement of inflows, river height, river response and provide real time information to the public.	based water information platforms, remote sensing technologies and expansion of the hydrometric stations network. Tailored information will be accessible to the public, entitlement holders and compliance officers. The program will be delivered by project partners MDBA, New South Wales, Queensland, the Bureau of Meteorology and Geoscience Australia by June 2023.
Implement collaboration protocols developed by the MDBA and Basin governments for information sharing and joint enforcement of water compliance in the Basin Plan.	Collaboration protocols are in place between the MDBA and all Basin state governments.
Conduct an Australian Competition and Consumer Commission (ACCC) review of the Basin water market and its operation.	On 7 August 2019 the Government announced it would direct the ACCC to conduct an inquiry into markets for tradeable water rights in the Murray–Darling Basin. An issues paper was released on 17 October 2019 and submissions were due by late November 2019. The interim report was released publicly on 30 July 2020 and the due date of the final report has been extended by the Commonwealth Treasurer to 26 February 2021 (ACCC 2020a).
The New South Wales Government will implement the 'Water Reform Action Plan' and establish the Natural Resources Access Regulator	The 'Water Reform Action Plan' follows Ken Matthew's review into compliance and contains 40 discrete actions. An independent review (Owens 2019) completed in February 2019 identified that 34 actions were completed, 1 action was not completed, and 5 actions were not the subject of the review (compliance dates outside or post the review). The independent Natural Resources Access Regulator was established in 2018 with powers of enforcement.
The New South Wales Government will implement new metering rules to ensure the vast majority of licensed water take is metered and that meters are accurate, auditable and tamper-proof.	The new non-urban metering framework commenced in December 2018 and will be implemented over a five-year staged roll-out. Due to severe drought conditions, the first three start dates for the new metering rules have been adjusted. The first start date is now scheduled for 1 December 2020 (Department of Planning, Industry and Environment 2019).

To what extent do the governance processes enable collaboration on implementation of the Basin Plan?

The Productivity Commission states that effective collaboration processes are a fundamental requirement for successful implementation of the Basin Plan (Productivity Commission 2018), and describes the requirements for effective cross-entity collaboration as:

- All parties have genuine commitment to shared goals and cooperative working arrangements. These are essential to development of trust among collaborators.
- Arrangements for collaboration are clearly documented—including how collaborative work is to be undertaken, roles and responsibilities and how collaborative activities are overseen, tracked and reported on.
- Information about shared programs and functions is communicated across entities.
- Shared risks are identified and managed.
- Potential overlaps and gaps (between entities' roles) are identified and addressed.

The most recently available information indicates improvement on collaboration was required, with deficiencies in the clarity of roles and responsibilities weakening processes for effective collaboration (Productivity Commission 2018).

The Claydon (2019) governance review notes there are multiple agreements in place which outline the commitment for Basin Governments to collaborate on implementation of the Basin Plan, but while not completely ignored, the commitments have become "more like sentiments" in some cases. There was a general view that the unwieldy governance arrangements and number of committees adversely affected coordination. In addition, the quality of relationships and in some cases the lack of collegiality and commonality of purpose impacted on the effective functioning of committees. As already noted, the Joint Governments have agreed to a set of recommendations in response to the Productivity Commission and Claydon reviews, and other discussions, to streamline the governance arrangements, improve clarity of roles and responsibilities, and improve relationships (Department of Agriculture 2019b).

The Alluvium (2019) review provides specific information on the assessment of collaboration within the activity of monitoring, evaluation and reporting. The level of collaboration capability was assessed as 'Developing' (MDBA, Basin state governments) to 'Embedded' (Basin state governments, Department of Agriculture, Commonwealth Environmental Water Office). Specific comments about the collaborative capability of these organisations were:

- MDBA—'There is a strong intent to improve on the collaboration and engagement of the 2017 evaluation. This was intended to be coordinated through the updated monitoring, evaluation and reporting framework. There have been some early attempts at productive coordination with the Basin States on how State information may feed into the 2020 evaluation, but further work is required in this area.' (Alluvium 2019:17)
- Basin state governments—'Internal Basin State collaboration is routine and mostly effective resulting in shared decision-making and accountability. Planning and resources generally include consideration of collaboration and engagement. Collaboration with other state or commonwealth organisations on specific programs and projects is typically effective; however, in terms of Basin Plan monitoring, evaluation and reporting it is acknowledged that coordination and collaboration could be improved and that forums such as the Monitoring

and Evaluation Working Group could operate more effectively. While many examples of positive engagement with stakeholders have been provided, there is limited evidence of engagement on monitoring, evaluation and reporting-specific activities.' (Alluvium 2019:20)

- Department of Agriculture—'There is strong collaboration and alignment with delivery partners through the fundamental program design. There is ongoing collaboration and coordination with MDBA and Commonwealth Environmental Water Holder. There is ongoing engagement with Basin States.' (Alluvium 2019:22)
- Commonwealth Environmental Water Office—'There is strong collaboration with delivery partners and relevant stakeholders. There is significant investment in engagement as part of the Long Term Invention Monitoring program. Collaboration with MDBA and Basin States occurs but could be more efficient and effective.' (Alluvium 2019:24).

Recent actions and commitments to improve governance processes are expected to improve collaboration on implementation of the Basin Plan.

Are roles and responsibilities clear and adhered to?

The roles and responsibilities of all Basin governments and the multijurisdictional committees and working groups are set-out in various documents, including the Water Act, Basin Plan, Murray–Darling Basin Agreement, and Ministerial Council–MDBA Service Level agreement. Claydon (2019) notes that most, but not all, of the sub-committees in Figure 13 have written terms of reference of varying detail, although some have not been reviewed or updated for many years. These are being reviewed as part of the agreed governance improvements in 2020-21. In addition, the MDBA website provides overarching summaries of the roles and responsibilities of jurisdictional governments, Australian Government agencies and some committees for better transparency to the public.

Clarity and adherence to the outlined roles and responsibilities of the various governing bodies is an issue that has been raised by multiple reviews, reports and some of the committees. The joint government governance review noted the following general comments during interviews with committee members and key stakeholders (Claydon 2019:27-36):

> *The demarcation between the various committees can be confusing. Over relatively recent times this has been a frustration to new senior officials who have often been confused about the role, function and reporting requirements of different committees. All external stakeholders contacted are also confused as to who has what roles and responsibilities, and "Who is in charge?", or "Is there no-one in charge?".*
> *It is not always clear what decisions the MDBA has to make, nor is it always accepted that the MDBA has the remit to make those decisions. So, there can be uncertainty as to whether "we [BPIC] are advising on something" or "we [BPIC] are co-designing something".*
> *There are examples where issues are being considered in several committees, or the wrong committee. There are other examples where relevant agencies are not present for key discussions concerning their responsibilities. There is a need to review and streamline these arrangements so that all relevant senior officials are engaged on Basin Plan implementation and/or Joint Venture issues, while respecting the different responsibilities of each party.*

At times, the [River Murray Operations Committee's] RMOC's role overlaps with other groups and the hierarchy of various committees can be confusing.
RMOC reports directly into the [Ministerial Council] which is not ideal, and there is confusion about the BOC's involvement. Understanding the role of other sub-committees will help the [Southern Connected Basin Environmental Watering Committee] SCBEWC understand its own role.
[there is] a lack of … understanding and an acceptance as to who is responsible … as people [analogy for committees] have resorted to doing their own thing.

The Productivity Commission's view is there are 'major shortcomings in the current institutional and governance arrangements' regarding clarity of roles and responsibilities:

> *Responsibility for leading the implementation of the Basin Plan is not clear and there has been a lack of strategic leadership. There is uncertainty about who should respond to issues as they arise … The Murray–Darling Basin Authority has conflicting roles. Its ability to effectively perform its collaborative service delivery functions (as the agent of governments) and be an independent and credible regulator that ensures compliance with the Plan is compromised by these conflicts.* (Productivity Commission 2018:358)

> *There is a widely held view in the community that Governments have failed to provide clear and decisive direction-setting leadership. Communities are uncertain about who is responsible, and this has made it difficult for them to navigate the institutional landscape for implementing the Plan. Much of the community concern is driven by the way Basin Governments have sought to negotiate and navigate their way through issues. Consultation has been inconsistent and inadequate, and the community has often had little sense that decision makers have listened to their concerns.* (Productivity Commission 2018:13)

The Basin Community Committee noted the 'continuing lack of knowledge and misunderstanding of aspects of the Basin Plan in many communities. "Who does what" is an issue which creates considerable frustration at the local level.' (Basin Community Committee 2018).

(Alluvium (2019) considered monitoring, evaluation and reporting governance arrangements for all Basin jurisdictions and made some specific comments about Australian Government agency roles and responsibilities. The report noted the MDBA had made significant improvements since the Basin Plan 2017 Evaluation on internal governance arrangements. These improvements include clarifying roles and responsibilities in terms of evaluation coordination, project management and decision-making. Although governance capability is rated as 'Developing-embedded', the current capability is close to the 2020 target of 'Embedded'.

The Department of Agriculture and Water Resources and the Commonwealth Environmental Water Office were rated as meeting the capability target of 'Embedded' for monitoring, evaluation and reporting governance. The knowledge and understanding of roles, responsibilities and requirements was clearly understood across and within the respective agencies (Alluvium 2019).

This evidence indicate that governance roles and responsibilities are no longer clear or not adhered to in the majority of circumstances, with respect to Basin Plan implementation. However, a number

of actions are underway with the agreement by the Basin governments on responding and implementing actions to address these issues (Department of Agriculture 2019b).

Do the governance arrangements encourage policy coherence?

The OECD work on policy coherence for sustainable development is relevant to assessment of this research question. Gurria Angel, OECD Secretary-General, states policy coherence is 'a central policy tool to inform decision-making for managing potential trade-offs and inconsistencies among economic, social and environmental policy objectives, to consider trans-boundary and inter-generational impacts, and take into account enabling or disabling factors, as well as the role of different actors.' (OECD 2016, Forward).

The governance of the Basin Plan seeks to achieve coherence by the Basin governments having joint stewardship of the Basin's water resources, but it is evident that there is more work to be done. The Interim Inspector-General for MDB Water Resources noted that management of the Murray–Darling Basin is a complex web of policies and laws across multiple jurisdictions, some of which are contradictory (in particular for compliance) (Middleton, 2 Nov 2019).

Alluvium (2019:26) stated 'The complexity of Basin Plan governance was raised by many organisations in terms of the increasing complexity of governance requirements within each organisation.'

The Productivity Commission (2018) noted that, to date, the interests of individual governments have been the central focus in negotiating and reaching agreement on the detailed settings of the Basin Plan. Now with the settings largely agreed, Basin governments need to prioritise their role as joint stewards of the Basin's water resources and collaborate effectively.

For many aspects, the Basin Plan integrates with state water resource frameworks when Water resource plans are accredited. For other elements of the Basin Plan, there are significant risks to implementation unless the Basin governments make joint decisions to ensure consistent approaches, particularly with respect to delivery of supply measures and constraints easing projects (Productivity Commission 2018).

However, it is unclear who is actually responsible for leading the implementation of the Basin Plan, as the COAG 2013 Intergovernmental Agreement on Implementing Water Reform in the Murray–Darling Basin was silent on this aspect. Basin state governments are constitutionally responsible for water resource management, but the lack of clarity on overarching roles and responsibilities has contributed to ineffective arrangements for intergovernmental collaboration and policy coherence to implement the Basin Plan (Productivity Commission 2018).

The Interim Inspector-General for MDB Water Resources (2020:38) noted

> *A more unified Basin-wide position and plan of action for Basin Plan implementation is required across all levels of government to improve leadership in the Basin and address the current crisis in confidence. Coordinated and strategic leadership will help by providing more certainty about water reform in the long-term, which will be beneficial for everyone in the Basin.*

To what extent is implementation of the Basin Plan affected by the governance arrangements relating to ancillary mechanisms (e.g. Sustainable Diversion Limit Adjustment Mechanism)?

The Productivity Commission (2018) found the timeframes for the supply package (to be completed 2024) are likely unrealistic at the time of the review. Timelines for decisions such as notification of supply measures had slipped and been amended due to a lack of clearly assigned responsibility for leading implementation of the Basin Plan. The MDBA Basin Plan Report Card December 2019 (MDBA 2019d) noted progress was still slow on both supply and efficiency projects (refer to 'Review and Adjustments' evaluation theme for more details). If projects are not fully implemented, additional water recovery will be required to achieve the environmental outcomes of the Basin Plan and will be in tension with social and economic outcomes.

Further, the Productivity Commission (2018) noted stakeholder consultation in the development of supply measures was a key example of the lack of effective collaboration and stakeholder engagement, two of the key principles of good governance. The 'Reviews and Adjustments' evaluation theme notes that concerted effort and increased resourcing to facilitate stakeholder engagement is critical to accelerating progress. Governments need to continue to act cooperatively to lift the level of engagement and the transparency and provide access for all stakeholders to input to the projects.

As outlined earlier in the governance theme report, current governance arrangements are not enabling trust and transparency of implementation. For ancillary mechanisms such as supply measures, the Productivity Commission (2018) noted there is community dissatisfaction with the level of transparency and consultation to date and as the Basin governments further develop the supply projects, addressing the trust deficit will be a major challenge.

Slow progress in the ancillary mechanisms (due to governance inefficiencies) will have impacts on the achievement of the Basin Plan outcomes. Basin Plan governance structures need to act on this information now to achieve the overall outcomes of the Basin Plan.

Are governance and institutional arrangements robust and resilient enough to deal with risks and emergency events?

The Interim Inspector-General for MDB Water Resources (2020:39) noted that 'The governance arrangements do provide some flexibility and ability to respond to emerging conditions.' This is in contrast to Claydon (2019), who highlighted that 'With the preponderance of "emergency" decision making as critical timelines loom, the Basin Officials Committee has devoted very little if any time considering strategic directions and management of strategic risks'. The contrasting views suggest improvements may have been made during the 12 months between release of each report.

The 2018–19 fish deaths are discussed below as just one example of a recent emergency event.

Three significant fish death events occurred in the Darling River near Menindee between December 2018 and January 2019. The then Australian Government Minister for Agriculture and Water Resources called for an independent assessment into the matter. The independent report made 27 recommendations (Vertessy et al. 2019), some of which are relevant to good governance.

The independent report found that since 2012 'The Basin states have largely progressed native fish management and research independently' (Vertessy et al. 2019:79). It recommended for Basin governments to ensure that the Native Fish Recovery Strategy involve authentic collaboration with government water scientists, academics and consultants, local communities and Aboriginal stakeholders.

Baldwin (2019) made a recommendation relating to governance of future monitoring programs, in particular the need for a clear understanding of which organisation is responsible for the various phases.

The Australian Academy of Sciences (2019:2) investigation into the 2018–19 fish deaths reported that there were 'serious deficiencies in governance and management, which collectively have eroded the intent of the *Water Act 2007* and implementation of the Murray–Darling Basin Plan (2012) framework.'

To deal with the potential risk of more fish deaths over the 2019–20 summer, the Native Fish Emergency Response Plan 2019–20 (MDBA 2019g) was developed, addressing some of the recommendations from Vertessy et al. (2019) and Baldwin (2019).

The Emergency Response Plan sets out how Basin governments will manage significant fish deaths in 2019–20 in a coordinated manner. The Plan details roles and responsibilities, collaboration mechanisms, and an Emergency Response Protocol. The protocol further defines roles and responsibilities if a significant fish death occurs, provides a decision support tool, and sets out emergency communication principles.

The Native Fish Emergency Response Plan 2019–20 sits within the broader strategy to manage and recover native fish populations, which will be delivered as part of the long-term Native Fish Recovery Strategy (MDBA 2019g).

The Native Fish Recovery Strategy is a major program involving governments, communities and industries across the Basin, and will provide a high-level framework to guide investment and implement priority actions (MDBA 2020e). The Strategy emphasises increased engagement and involvement with communities, which is already reflected in the strong involvement of First Nations in the development of the Strategy (MDBA 2020e).

The Strategy will be implemented collaboratively with the Basin state governments, First Nations peoples, recreational fishers, conservation groups, industry and the wider community. The draft Native Fish Recovery Strategy was released on 10 March 2020 for public consultation. The Strategy was endorsed by the Ministerial Council in June 2020.

The Strategy is now finalised and was submitted to the Basin Officials Committee in June 2020 committed the balance of the $5m to implementation of the strategy.

Are there opportunities to improve governance arrangements to implement the Basin Plan, such as: roles and responsibilities; collaboration and coordination amongst stakeholders; policy coherence; and integrity and transparency?

There are a range of governance recommendations from prior reports that have been considered, or are currently being considered, through the governance channels. Management responses have been developed for some of these reports and their implementation is in progress (Department of Agriculture 2019a). Implementation of the Joint Governance recommendations (Department of Agriculture 2019b) is predominantly on track. The MDBA has worked with the Basin jurisdictions through the Governance Improvements Steering Committee, the Basin Officials Committee Alternates Committee and the Basin Officials Committee to further develop and ultimately implement the majority of recommendations from the Governments' response by early 2021. Implementation of a few recommendations related to stakeholder engagement will be delayed until later in 2021 due to COVID-19 travel restrictions.

A range of other reports and recommendations directed at other areas of the Basin Plan implementation have been published since 2012. Furthermore, articles from Alston et al. (2016) and Bischoff-Mattson and Lynch (2017) call for integrative governance in this space.

Several recommendations were made by the Productivity Commission (2018) to improve governance arrangements for implementing the Basin Plan, as outlined in Table 14. The joint Basin governments responded to the recommendations, including an outline of how some of the governance arrangements will be or have been improved (Table 14; Department of Agriculture 2019a). In addition, as a response to the Productivity Commission report, the MDBA will now hold annual technical workshops on the roll-out of sustainable diversion limit adjustment mechanism measures to encourage collaboration between Basin governments and relevant experts on sustainable diversion limit adjustment project implementation (Department of Agriculture 2019a).

In response to concerns regarding compliance from the Productivity Commission, the joint governments supported the establishment of an Inspector-General of MDB Water Resources and implemented actions in the 2018 Compliance Compact.

The MDBA December 2019 Report Card notes there is generally good progress against the compliance compact commitments. Some of the commitments which have been or are in the process of being implemented are outlined below.

Basin state governments have agreed to a number of measures to improve metering as part of the 2018 Compliance Compact, including:

- ensuring that all new non-urban water metering meets the relevant Australian Standard for non-urban water metering (AS4747) by 2025
- a review of the appropriateness of AS4747 which found the Australian Standard was reasonable, but the Metrological Assurance Framework (part of the National Framework for Non-urban Water Metering) could be adjusted to improve metering compliance and renewal (Department of Agriculture 2019b).

Table 14 Status of Productivity Commission (2018) recommendations relevant to governance

Productivity Commission (2018) recommendation	Joint government response (Department of Agriculture 2019a)	Status
14.1 In 2019, the Ministerial Council should commence reforms to the institutional and governance arrangements for implementing the Basin Plan by: • enhancing the role of, and delegating accountability for, implementation to the BOC. BOC should be responsible for managing the significant risks to successful implementation and ensuring effective intergovernmental collaboration • ensuring that formal directions to BOC regarding implementation are publicly available • ensuring that arrangements to assess progress, evaluate outcomes, and ensure compliance with the Basin Plan are fully independent • recognising that the MDBA's agent of government role will continue to be key to driving collaboration between and providing technical support to Basin Governments as they implement the Basin Plan • ensuring that Basin governments are individually and collectively resourced to perform their roles to implement the Plan.	Basin governments agree that the implementation of the Basin Plan requires a Basin-wide, strategic approach with transparent and accountable governance arrangements to ensure Basin Plan outcomes and the expectations of the community are met. In response to the interim findings in the Productivity Commission's draft report released in August 2018, the Ministerial Council commissioned an independent review of the governance arrangements for implementing the Basin Plan. This review (Claydon 2019) drew on the findings and recommendations of the Productivity Commission. It included recommendations on effective and streamlined processes to support the delivery of water reforms and improved institutional and governance arrangements for implementing the Basin Plan.	The Basin Officials Committee developed recommendations for revised joint governments' governance arrangements, addressing the common themes and findings of the Claydon (2019) and Productivity Commission (2018) reviews, amongst others. The Ministerial Council accepted the Basin Officials Committee recommendations in December 2019, and the revised arrangements have been implemented through 2020 and will continue into early 2021 (see Department of Agriculture (2019b) for the range of governance improvements that will be actioned).
14.2 Basin governments should agree to the restructure of the MDBA to separate its service delivery and regulatory functions into two institutions.	The Ministerial Council will further consider recommendations relating to compliance, including separating the MDBA's service delivery	On 4 September 2020 the Australian Government Minister responsible for Water announced the intention to create an

Productivity Commission (2018) recommendation	Joint government response (Department of Agriculture 2019a)	Status
The Australian Government should then embark on the necessary institutional reforms to establish the: • MDB Agency—as the agent of Basin governments providing Murray–Darling Basin Agreement services and supporting Basin governments to implement the Basin Plan (Corporate Commonwealth Entity) • Basin Plan Regulator—an independent Commonwealth Statutory Authority with compliance and evaluation responsibilities. These institutional reforms should be in place by 2021.	and regulatory functions, in 12 months' time. Advice will be sought from the Inspector-General to support their further decision-making.	Inspector-General for Water Resources, and transition of the MDBA compliance responsibilities to this office. No timeframe has been given at this stage due to the legislative changes that will be required. While institutional reform has not been implemented, the MDBA restructured from 1 July 2020 and established the Basin Plan Regulation Portfolio, separate from the other responsibilities. Compliance and evaluation responsibilities sit in this portfolio.
14.4 By 2020, to enable it to carry out its enhanced role (recommendation 14.1) the Basin Officials Committee should: • have an independent Chair, appointed by the Australian Minister for water in consultation with the Ministerial Council • comprehensively review the capability and the resourcing it requires to jointly implement the Basin Plan • agree on the capability and services Basin governments require of the MDBA to support them to implement the Basin Plan and for shared water resource management	The Basin governments regularly review the capability and resources needed to implement the Basin Plan, including the role of the Basin Officials Committee in supporting Basin ministers. This also includes reviewing the functions fulfilled by the MDBA and the resourcing needed to support the implementation of the Basin Plan and deliver programs under the Murray–Darling Basin Agreement. Basin governments do not agree with the recommendation to have an independent Chair of the Basin Officials Committee at this point in time.	See status of recommendation 14.1 above. The Australian Government continues to Chair the Basin Officials Committee. Any future change to the chairing arrangements may require changes to the *Water Act 2007*.

Productivity Commission (2018) recommendation	Joint government response (Department of Agriculture 2019a)	Status
• establish new arrangements and processes to support ongoing intergovernmental collaboration.	The Claydon (2019) review of governance has been commissioned and is under consideration.	
4.1 Basin Governments should, as soon as practicable: • resolve governance and funding issues for supply measures, including risk sharing arrangements • develop an integrated plan for delivering supply measures to improve understanding and management of interdependencies within the package of supply measures • develop clear mechanisms for consultation on the package and individual projects with Traditional Owners and local communities.	Governance and funding arrangements for implementation of preconstruction supply and constraints measures have been established with each state (Stage 1). A National Partnership Agreement is being negotiated for the full implementation of supply and constraints measures, including risk sharing arrangements. There will be a gateway assessment undertaken by the Department of Agriculture Water and the Environment in consultation with Basin state governments for each project between Stage 1 and Stage 2 to determine whether a project will be eligible to be considered for implementation funding (Stage 2) under the proposed National Partnership Agreement. Basin governments have established an inter-jurisdictional committee to provide strategic direction and support the delivery of the package of supply and constraints measures projects. Basin state governments are also establishing governance arrangements for their individual supply and constraints measure projects.	At the June 2020 Ministerial Council meeting, the need to finalise the National Partnership Agreement for supply and constraint measures was discussed. Basin officials are to bring recommendations to resolve the outstanding issues for the National Partnership Agreement National Partnership Agreement to the December 2020 Ministerial Council meeting (Ministerial Council 2020).

In relation to compliance, the Wentworth Group (2017) had the following recommendations to rebuild public trust in the integrity of the Basin Plan, with greater transparency:

- improving metering and compliance, by Basin governments agreeing to comprehensive measurement of consumptive water use and water interception, including groundwater, across the whole Basin to a standard suitable for compliance action
- improving accountability with professional water accounting standards and independent auditing against standards, accompanied by annual audits of expenditure of public funds and annual reviews of the Basin Plan's progress by an independent auditor
- reinstating a Basin-wide river monitoring program to measure and report regularly on the overall condition of the 23 river systems across the Basin as well as targeted programs reporting on progress towards specific Basin Plan objectives against what would have occurred without the Basin Plan
- strengthening the capacity of the MDBA to fulfil duties as a regulator.

In November 2017, the MDBA Office of Compliance was established as a separate division within the MDBA. Its functions include coordinating and undertaking the MDBA's compliance activities, including overseeing compliance with respect to sustainable diversion limits and water resource plans (Department of Agriculture 2019b). On 4 September 2020 the Australian Government Minister responsible for Water announced the intention to move the MADBA Office of Compliance into a new Office of Inspector-General for Water Compliance.

Although a number of the Productivity Commission (2019) recommendations are being implemented, the Interim Inspector-General for MDB Water Resources (2020:39) noted that 'Many stakeholders raised concerns that the Productivity Commission recommendations have seemingly been ignored … [and] this is an example of the way in which the status of actions and recommendations can be readily lost from the public's perspective.'

In December 2019, the Ministerial Council agreed to adopt recommendations from the Basin Officials Committee to address common themes and findings of the Claydon (2019) and Productivity Commission (2018) reviews, amongst others. The focus of the agreed revised governance framework is on the requirement for:

- simplified and streamlined decision making
- increased transparency
- improved clarity of accountability, roles and responsibilities of various committees
- clarity of decision-making authority (Department of Agriculture, 2019b).

In summary, the agreed improvements are:

- clarifying and clearly stating the role of the Basin Officials Committee in MDB decision-making
- clarifying the Basin Officials Committee functions and streamlining meetings
- reviewing the Basin Officials Committee Chair arrangements
- reviewing membership and the capability of the Basin Officials Committee members
- streamlining committees
- reviewing the Basin Officials Committee performance, including stakeholder feedback, annually

- developing agreed KPIs
- implementing a range of mechanisms to improve transparency and engagement with key stakeholders and the community, including a refreshed webpage, regional Basin Officials Committee meetings, joint meetings with the Basin Community Committee, and an Annual Basin Conference and Roadshow
- developing and implementing a new support model for administration and secretariat.

The majority of the improvements are on track for implementation by the end of 2020, with the Tier 2 committee review likely to be finalised early 2021. A few of the recommendations related to stakeholder engagement have been delayed into later 2021 due to COVID-19 travel restrictions.

Sefton et al. (2020:15-16) provides the following recommendation related to governance:

> *Recommendation 1*
> *Basin governments and communities must find better ways to engage about Basin and broader reforms and strengthen leadership capacity of regional communities and government agencies. Specific actions … may include:*
>
> - *building local leadership capacity to work with governments to design policies and programs that are tailored to community needs. Programs such as the Basin Communities Leadership Program could be scaled up and/or the Murray–Darling Basin Leadership Program reinstated to support local capacity development*
> - *building community and catchment involvement by engaging with local communities, landholders and Catchment Management Authorities to support coordination of environmental watering and investments in complementary measures*
> - *strengthening community consultation approaches so that consultation on issues with potentially material social, economic and/or environmental implications are not rushed or superficial. This applies to initiatives including, but not limited to, Sustainable Diversion Limit Adjustment Mechanism (SDLAM) projects, the remaining Water Resource Plans, and river operation decisions*
> - *further strengthening the capacity and capability of the Australian Government Department of Agriculture, Water and the Environment, the Murray–Darling Basin Authority (MDBA) and Basin states to engage regionally and implement the Panel's recommendations.*
>
> *Recommendation 2*
> *All parties involved in designing, developing, implementing, monitoring and evaluating water policy and reform must recognise the importance of transparency and accountability in providing certainty and confidence to communities. Actions to achieve this include:*
>
> - *investing in an easily accessible, Basin-wide water resource information platform. The platform should provide timely information and simple description and definitions of water terms, policies, operational settings, rules and their implementation, and changes (or those proposed) to them. It could also provide easily understandable indicators of water supply and demand and enable rapid understanding of the composition of, and changes in, river flows*

and storages, both temporally and spatially, as well as access and release triggers. It should also track how governments have assessed, consolidated and implemented recommendations from reviews on issues relating to the Basin

- *having the Basin Officials Committee publicly report advice provided to the Ministerial Council and advice provided for implementing policy and decisions of the Council on matters such as state water shares and the funding and delivery of natural resource management programs*
- *investing in water literacy in communities, media organisations and local government to support informed dialogue and rebuild trust*
- *improving data and information about social and economic conditions in rural and regional Basin communities, the drivers, and dynamics of change.*

The Alluvium (2019) monitoring, evaluation and reporting capability review noted improvements in governance have been made by the MDBA, including clarifying roles and responsibilities in relation to monitoring, evaluation and reporting. It also noted capability will need to continue to improve in this space to be 'Leading' by 2025. Specifically, the review recommended that in organisations seeking to achieve 'Leading' monitoring, evaluation and reporting governance (MDBA, Commonwealth Environmental Water Office, Basin state governments), policies and procedures should allow for flexibility and innovation and each evaluation function should strive for high performance, within clear responsibilities and scope.

All parties should commit to improving the Monitoring and Evaluation Working Group effectiveness and efficiency (which will be driven top–down by implementing recommendations from the Claydon (2019) governance review). Alluvium (2019) recommended that consideration could be given to engaging independent facilitators or conducting a review of governance of the group. This latter recommendation is anticipated to occur by the end of 2020 as part of implementing the joint government response to the Claydon review (Department of Agriculture 2019b).

Alluvium (2019:28) also recommended improving collaboration. The priority recommendation (to be actioned prior to this 2020 evaluation) was:

> *That MDBA, Basin States, CEWH and DAWR develop a Community of Practice to raise MER capability and exchange experiences. An annual conference (similar to that held for WRP development) may assist raising capability, while providing a forum to exchange experiences across a broader scope of staff involved in MER, outside the more restricted membership and more structured workplan agenda of the [Monitoring and Evaluation Working Group]. Involvement of professional evaluators from the industry and connection with established industry development bodies to ensure that the best available insights, knowledge and resources are harnessed for Basin Plan MER should also be considered.*

The Interim Inspector-General of MDB Water Resources (2020:35) recommended the following in relation to river operations for New South Wales, Victoria and South Australia:

While existing governance arrangements are in place to ensure river operators are held accountable and that State governments actively participate in operational decision-making, the transparency of these arrangements could be improved. The river operations process is not well understood by the community and the processes and outcomes are not clearly set out in an easily accessible and readily available format. Increasing the transparency of these processes and outcomes would provide stakeholders with confidence that river operators are being held to account for minimising conveyance losses, as well as potentially highlighting the complexity of decision-making and the processes that underpin river operations.

In relation to trust and accountability, the Interim Inspector-General for MDB Water Resources (2020:39) noted that 'The number of reviews undertaken in recent years provides an opportunity to build… accountability and trust with people in the Basin. However, this opportunity does not appear to have been leveraged by Basin governments.'

Although several actions are being taken to improve a variety of governance aspects, clarity of roles and responsibilities is the foundational principle and fundamental driver of effective institutional arrangements (Productivity Commission 2018). To achieve overall improvement in governance and effective and appropriate implementation of the Basin Plan, a concerted effort is needed by all Basin governments to agree on who is responsible for leading implementation (Productivity Commission 2018; Claydon 2019).

Are there opportunities to better align instruments for managing Basin water resources?

Some opportunities exist to better align instruments, particularly water resource plans, Basin Plan objectives, environmental watering priorities, and long-term watering plans. Many of these are already being addressed, as outlined below.

The Productivity Commission review (2018:198) indicated that the five-yearly evaluation should 'consider opportunities to improve the utility of water resource plans in a robust and impartial way including: scope to reduce compliance costs by examining whether content currently included in them are better addressed in other Basin Plan instruments or could be streamlined; ensuring water resource plan obligations align with Basin Plan objectives; and that adaptive management is not constrained.'

The MDBA is developing a water resource plan compliance framework which will include details of the annual self-reporting process, guidance on the rolling annual audit program and the MDBA's approach to spot audits for plan compliance (Department of Agriculture 2019a).

The Productivity Commission (2018) indicated that the value of Basin annual environmental watering priorities should be reviewed in the context of implementing improvements to Basin-wide environmental watering strategy. The Productivity Commission review states that the requirements for Basin annual environmental watering priorities should be removed to streamline processes if they no longer fill a strategic gap in the Environmental Management Framework.

The approach to setting Basin annual watering priorities was revised in 2018 and includes new rolling multiyear priorities that are responsive to opportunities arising under different water availability scenarios.

The Productivity Commission (2018) also flagged the need to review the alignment of long-term watering plans as there is 'a risk that targets specified in some LTWPs may not align with the Basin-wide Environmental Watering Strategy [expanded] or be fully consistent with the objectives and outcomes sought by the Basin Plan as a whole.' The content of long-term watering plans will be considered as part of the 2020 review of the Environmental Watering Plan (Department of Agriculture 2019b).

The Productivity Commission (2018) also recommended restructuring the MDBA into two institutions to separate its service delivery and regulatory functions (see Table 14). The Ministerial Council noted it will further consider this recommendation in 12 months' time (due late 2020) and advice will be sought from the Inspector-General to support their further decision-making. On 4 September 2020, the Australian Government Minister responsible for water announced the MDBA compliance responsibilities would be transitioned to a new Office of Inspector-General of Water Compliance.

Monitoring, Evaluation, Reporting and Improvement

Overview

Monitoring, evaluation, reporting and improvement are a key step in public policy and, in particular, natural resource management policy implementation. The premise of this is that natural resources policies often relate to highly complex ecological interactions for which the knowledge base may be incomplete. As such, natural resources policies need to be built on the best available knowledge with an understanding that improvements will be made along the way.

The Basin Plan was developed on the best available science and modelling approaches available. However, improving and adapting over time was recognised as essential to ensuring success of this complex water reform policy.

Chapter 13 of the Basin Plan does not prescribe a specific monitoring, evaluation, reporting and improvement program or framework to support ongoing improvement of the Basin Plan. Instead, it details principles, responsibilities and requirements for monitoring the effectiveness of the Basin Plan. Chapter 13 builds on the premise that jurisdictions will coordinate and collaborate to ensure that their individual monitoring programs provide the necessary information to support evaluation and improvement of the Basin Plan.

While Chapter 13 does not provide a framework, there are well established frameworks for adaptive management and associated monitoring. From a Basin Plan perspective, there are three types of monitoring required to address adaptive management and risk management:

Adaptive management

1. condition monitoring that assesses condition to inform progress toward management objectives and the design or prioritisation of interventions
2. intervention monitoring quantifies the response to management interventions. One of the challenges with Basin Plan intervention monitoring is that the outcomes of short-term and often small-scale interventions are expected to contribute to long-term, large scale changes in condition (Gawne et al. 2013).

Risk management

3. Assessing likelihood and consequences of risks to availability and condition of water resources. This is done though a risk-based approach to water resource planning and management and effective monitoring and evaluation of the implementation of the Basin Plan.

The indicators and sampling undertaken within each of these types of monitoring may be the same or, at worst, data from one program can be used to strengthen the inferences drawn by another. This is only possible, however, if the intent to share data and information across programs is built into the

design. Currently, the programs owe more to their heritage than they do to the needs of the Basin Plan.

Key theme findings

- Monitoring, evaluation, and reporting under the Basin Plan is resulting in some increased knowledge and improvement in how environmental water is managed.
- Monitoring programs under the Basin Plan have produced extensive outputs, and evidence suggests that, at a local scale, programs are informing adaptive management and building scientific knowledge.
- Monitoring programs across the Basin vary in spatial scales and approaches.
- In the absence of a Basin-wide monitoring framework, understanding the effectiveness of the Basin Plan is difficult.
- Effort is needed to ensure monitoring programs are spatially appropriate for better evaluating the effectiveness of the Basin Plan in the future.
- Improved cooperation, collaboration and commitment amongst Basin governments and partners will assist with the development and implementation of more spatially appropriate monitoring programs.

Evaluation assessment

Table 15 Performance descriptors for monitoring, evaluation, reporting and improvement theme.
Evaluation ratings are labelled 1-6, with 1 being the lowest performance rating and 6 being the highest performance rating.
Confidence ratings assess the confidence in the assessment given the available evidence.

Indicator	Evaluation rating	Confidence
The extent that monitoring and reporting has supplied the information needed for evaluation	2. The implementation is not suitable in its current format	Medium
Monitoring programs are being implemented across the Basin by all governments, however these vary at scale and in collaborative effort often resulting in data gaps. Monitoring programs also need to consider social, economic and cultural consequences from actions aimed at restoring ecological health. In the absence of a Basin-wide monitoring framework understanding the effectiveness of the Basin Plan is difficult.		
The extent to which the program for monitoring and evaluating the effectiveness of the Basin Plan has contributed to adaptive management and improving the available scientific knowledge of the Murray–Darling Basin	3. The implementation is just satisfactory	Medium
The majority of technical reports from monitoring and research programs under the Basin Plan make recommendations regarding future management and or inferences about conceptual understanding. Monitoring programs intended to meet Basin Plan requirements are contributing to scientific knowledge in the Murray–Darling Basin. However, there is limited evidence of systemic approach to capturing learning and acting upon them.		

Program logic

The program logic for this theme within the 2020 Basin Plan Evaluation is:

'Monitoring, evaluation, reporting and improvement is expected to enable adaptive and improved implementation of the Basin Plan, to contribute to water that is fit for purpose and healthy, diverse and resilient water dependent ecosystems' (Figure 15).

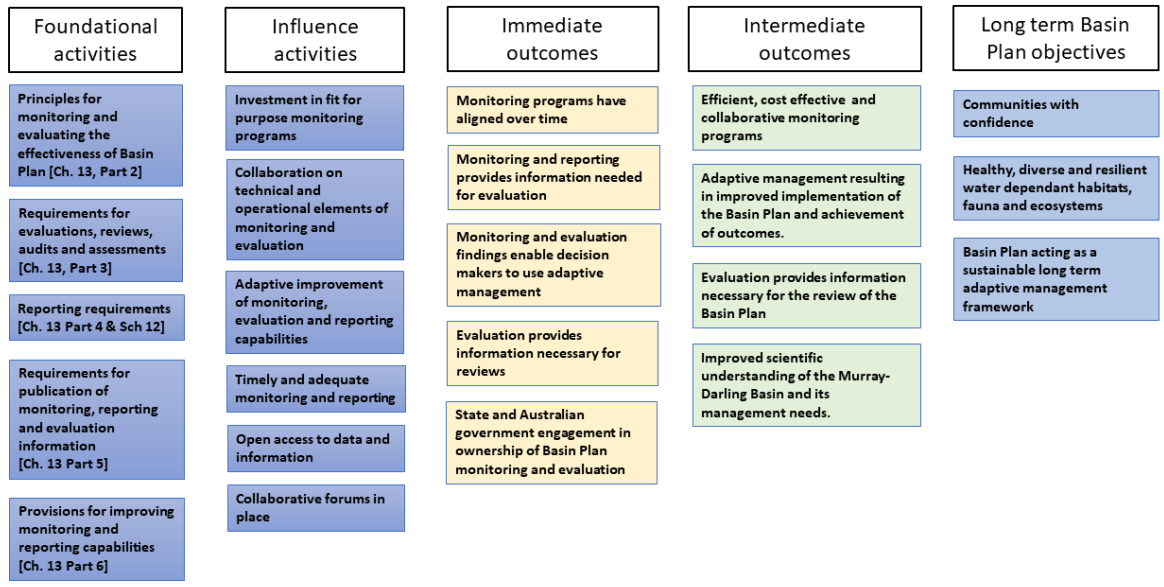

Figure 15 Monitoring, evaluation, reporting and improvement theme program logic

Evaluation questions

1. What monitoring is occurring under the Basin Plan?
2. To what extent has monitoring and reporting supplied the information needed for evaluation?
3. To what extent has the program for monitoring and evaluating the effectiveness of the Basin Plan contributed to adaptive management and improving the available scientific knowledge of the Murray–Darling Basin?

Summary of findings

Implementation

Monitoring programs are being implemented across the Basin by all governments, however these vary at scale and in collaborative effort often resulting in data gaps. Monitoring programs also need to consider social, economic and cultural consequences from actions aimed at restoring ecological health. Different reporting requirements also make evaluation more difficult and less certain.

The completion of the water resource plans, delivery of the Basin Plan 2020 Evaluation and planning for the Basin-wide Environmental Watering Strategy review in 2022, mean that this is an ideal opportunity to adapt monitoring arrangements to address the limitations identified by the

Productivity Commission (2018) and this evaluation. Ensuring that the end result is an effective and efficient program of monitoring to support adaptive management will require several elements:

- a robust monitoring framework
- collaboration across governments
- a forum to exchange ideas and lessons between key stakeholders.

It is clearly important that the Monitoring and Evaluation Working Group and other key stakeholders identify and address issues that affect collaboration and agree on the objectives, resources available, roles and responsibilities and decision-making processes.

Adaptive management and knowledge

Monitoring

The majority of technical reports from monitoring and research programs under the Basin Plan make recommendations regarding future management and or inferences about conceptual understanding. However, the specificity of these recommendations or inferences varies markedly.

In addition to this varying specificity, it is also important to note that these learnings and recommendations are most often buried in numerous highly technical reports, which results in information being inaccessible to many audiences.

This issue relating to the way in which learnings and adaptive management are reported was picked up by a review of the Commonwealth Environmental Water Office's long-term intervention monitoring program (Hart and Butcher 2018). Interactions between monitoring and delivery staff were resulting in considerable learnings, transferring into improvements in the management of the Commonwealth's environmental water. However, there is a need for a more systematic approach to capturing learnings and the reports need to be more accessible to a wider audience (Hart and Butcher 2018).

Despite a lack of systematic adaptive management documentation, adaptive management is occurring. In some cases this occurs in real time, in other cases the outcomes of monitoring at specific sites have resulted in delivery of flow changes in subsequent years. There is limited evidence on slower adaptive management processes and how outcomes from particular events are expected to contribute to longer-term expectations and needs.

The volume of outputs produced indicates that monitoring programs intended to meet Basin Plan requirements are also contributing to scientific and other knowledge in the Murray–Darling Basin. The intervention monitoring program review (Hart and Butcher 2018) did however identify the need for an independent review of the quality of science being developed through its selected area reports.

There is a need for a Basin-wide database to collate data and information from all agencies relating to Basin Plan requirements (Hart and Butcher 2018). A multi-jurisdictional Basin science platform is currently being developed with the potential to meet this need. The Commonwealth Environmental Water Office's current Monitoring, Evaluation and Research Program (Flow-MER) is improving reporting requirements to assist in consistency and accessibility to the science being reported by the selected areas.

Evaluation

There has been no formal process for addressing the overarching recommendations in the Basin Plan 2017 Evaluation. As such, only some of them have been addressed and in an ad-hoc manner. Stakeholders' buy-in into the recommendations is needed to ensure they are addressed. To ensure better adaptive management outcomes from the current evaluation, the *Framework for evaluating the Murray–Darling Basin Plan* sets out a participatory approach with the intention to improve buy-in and, ultimately, the impact of the evaluation.

Monitoring, evaluation, reporting and improvement findings

What monitoring is occurring under the Basin Plan?

Murray–Darling Basin Authority

The MDBA invests in ecological condition monitoring, largely focusing on waterbirds, fish and vegetation as per key areas of the Basin-wide Environmental Watering Strategy. As per Chapter 13 Principle 6 of the Basin Plan, the waterbird and fish monitoring programs harness the capabilities of existing monitoring programs. Vegetation monitoring has evolved since the implementation of the Plan, but it has depended on investment from jurisdictions. Further details of these programs are as follows:

- Waterbird monitoring is done through the South-East Australian Aerial Waterbirds Survey which started in 1983. This survey measures the distribution and abundance of about 50 waterbird species along a series of transects covering the Basin in Queensland, New South Wales, Victoria and South Australia.
- Fish monitoring is done through the Murray–Darling Basin Fish Survey. This program has evolved from the Sustainable Rivers Audit, which ran from 2005 to 2013 with the purpose of assessing the health of the Basin's rivers. The Murray–Darling Basin Fish Survey uses sampling protocols developed for the SRA, but only samples 145 of the original 510 SRA sites.
- Vegetation monitoring is done with remote sensing (the Stand Condition Assessment Tool, as per Cunningham et al. 2014) to monitor the condition and extent of native riparian and floodplain vegetation. This monitoring program started in 2013 with a focus on water-dependent native vegetation, particularly floodplain forests and woodlands dominated by river red gum, black box and coolabah.
- Monitoring and evaluation have invested in collecting on-ground information to support the use of this tool, and in developing a 30-year archive based on historical LandSat imagery.

The MDBA does not have a formal monitoring program to inform social, cultural and economic outcomes. To date, the approach taken to evaluation has been opportunistic and eclectic, harvesting data from a diverse range of sources and integrating them for assessment.

Commonwealth Environmental Water Office

The Commonwealth Environmental Water Office developed the long-term intervention monitoring to specifically address obligations under the Basin Plan. Implemented in 2014, the long-term

intervention monitoring program had a five-year time scale and a budget of over $30 million. Following a review after its first five years, the program has now evolved to the Flow-MER program.

The Flow-MER program continues to involve assessment of ecosystem diversity, hydrology, stream metabolism, water quality, vegetation diversity, fish and generic diversity. Monitoring is undertaken at seven selected areas. Annual reporting on these select areas is used to evaluate the contribution of Commonwealth-held water to ecological outcomes. Annual Basin-scale evaluations attempt to address the contribution of Commonwealth water at the Basin scale.

Individual state programs

Individual states have different monitoring programs to meet their Basin Plan requirements and other needs, including but not limited to:

- The Victorian Government implemented the Victorian Environmental Flows Monitoring and Assessment Program in 2005, which has evolved to focus on intervention responses of fish and vegetation.
- The New South Wales Government has developed a specific program to meet Basin Plan requirements with a heavy focus on fish outcomes, groundwater monitoring using telemetered networks which track groundwater levels and in key areas, groundwater quality.
- The South Australia Government works closely with The Living Murray program to monitor fish, vegetation and waterbird condition and some intervention outcomes.
- The Queensland Government has taken a different approach and used a risk-based ecohydrological approach to assess environmental flow regimes.

Basin state governments are also responsible for monitoring water quality and issuing water quality alerts. State governments manage gauges across the system that collect continuous streamflow information and various water quality parameters. Water quality data from each jurisdiction is accessible online.

Joint monitoring programs

The Living Murray program, a joint partnership between the Australian Government and the governments of New South Wales, Victoria and South Australia, was first implemented in 2003 and has evolved to address objectives under the Basin Plan. The program largely involves condition and intervention monitoring across eight sites. The monitoring focuses on fish, vegetation and waterbirds, but it also includes some other indicators relevant to specific sites such as frogs. The annual budget for this program is approximately $4.5 million.

In 2015 the multi-jurisdictional Joint Venture Monitoring and Evaluation Program, overseen by a steering committee, was established under the Basin Officials Committee. Its objectives are to coordinate and integrate monitoring, evaluation and reporting activities between the parties to reduce duplication and enhance outcomes.

The Joint Venture Monitoring and Evaluation Program has an annual budget of approximately $1 million per year to invest in achieving joint objectives. The majority of budget has been invested in a major fish movement program, a fish genetic sampling program to assist with determining natural recruitment versus stocking, and the collection of on-ground data to support the ‘Stand condition’ assessment tool.

The Living Murray water quality monitoring program is managed by the MDBA to maintain a uniform system for measuring, analysing and presenting water data on the long-term health of the River Murray system. Under the Living Murray program, water samples are collected at regular intervals at 28 sites across the River Murray.

To what extent has monitoring and reporting supplied the information needed for evaluation?

Reporting

Jurisdictions are providing their Basin Plan Schedule 12 reporting annually, as required under the Basin Plan. The annual reporting is extensive and is made available on MDBA's website, providing transparent information on the full range of Basin Plan implementation activities and progress towards outcomes. This includes very detailed reporting under Matter 9.3 around the delivery of environmental water and its purpose. Annual reporting from jurisdictions is used for the Basin Plan annual report, produced by the MDBA. The annual report provides transparency and communication about the progress of implementation and early outcomes associated with the Basin Plan as well as state reporting requirements.

The Basin Plan 2017 Evaluation only used annual reporting for three of the ten annual reporting requirements. Subsequently, the 2017 evaluation recommended that Basin governments and the MDBA should review Basin Plan reporting to make it more relevant to adaptive management. Additionally, the 2019 Basin Plan monitoring, evaluation and reporting review identified that improvements are needed to ensure that Schedule 12 reporting is targeted and providing the most useful information for evaluation (Alluvium 2019).

A challenge with using reporting in the 2020 evaluation relates to the timing of reporting requirements. All five-yearly reporting is due in 2020. This makes it is difficult for the Basin Plan 2020 Evaluation to draw on five-yearly reports from other agencies.

Monitoring

Across the Basin, there is a mix of monitoring programs, including asset-scale and Basin-scale intervention monitoring, and asset, and catchment- and Basin-scale condition monitoring (Productivity Commission 2018).

MDBA's monitoring programs are focused on condition monitoring at the Basin scale. The Living Murray program includes elements of condition and intervention monitoring at icon sites along the Murray River. The Commonwealth Environmental Water Office's long-term invention monitoring program is focused on intervention monitoring at seven selected areas which are intended to support evaluation of water actions that are not monitored. State government programs vary between jurisdictions, ranging from focused intervention monitoring (Department of Environment, Land and Water Planning 2017) to substituting monitoring with a risk-based ecohydrological approach to assessing environmental flow regimes (McGregor et al. 2017).

Monitoring methods vary from traditional approaches describing population and community structure, to more novel techniques that target more specific biological processes such as fish

movement responses to flow. Newer techniques also include remote sensing that captures inundation regimes at large spatial scales.

As well as variability in approaches, the scale at which assets are defined is also variable (e.g. (Department of Environment, Land and Water Planning 2017; Department of Environment, Water and Natural Resources 2015; Department of Environment, Water and Natural Resources 2019) resulting in a variable patchwork of methods and scales. State agencies also have the need to monitor for purposes outside of the Basin Plan and, as such, they require some flexibility in the design of their monitoring programs.

There is evidence that pre-existing and new monitoring programs have aligned towards addressing objectives set under the Basin-wide environmental watering strategy, undertaking intervention monitoring, and using some common monitoring techniques (Department of Environment, Land and Water Planning 2017; Hale et al 2014). However, it has been identified that better alignment of the many monitoring programs across the Basin is necessary to ensure information gaps are filled and the necessary data is available to evaluate the effectiveness of the Basin Plan (Productivity Commission 2018; SARC 2019).

Some of the MDBA's Basin-scale condition monitoring has been found insufficient for telling a Basin-scale story for fish and vegetation condition (MDBA 2017c; MDBA 2017d).

For fish, the limited number of sites sampled under the Murray–Darling Basin Fish Survey , the lack of wetland sampling, and the lack of targeted sampling for small-bodied and threatened species has resulted in insufficient information to address a number of evaluation indicators, and has left the evaluation with a heavy focus on two of the most abundant large bodied species, Murray cod and Golden perch.

In some cases, monitoring from other programs has been used as a case study; however, inconsistencies in programs have made it impossible to integrate data sets. Understanding the contribution of the Basin Plan to fish populations has relied heavily on findings of the long-term invention monitoring program, and few case studies from other intervention monitoring programs. This has resulted in an incomplete understanding of the contribution of the Basin Plan to fish populations.

Since the 2017 evaluation, the MDBA has worked with technical experts to understand how to improve monitoring programs for Basin Plan purposes. At this stage, improvements are yet to be implemented.

For vegetation the Stand Condition Assessment Tool provides good information on the condition of trees on the floodplain and is able to demonstrate changes in condition at sites that receive water compared to those that do not.

However, the Stand Condition Assessment tool does not provide the ability to assess vegetation diversity and the condition of riparian vegetation. Further work is needed to refine the tool to address the riparian zone specifically. On-ground monitoring is required to address condition of understory vegetation and to monitor vegetation diversity. The Basin Plan 2020 Evaluation relies heavily on limited site-specific information and cannot draw strong conclusions at the Basin scale.

The South-East Australia Aerial Waterbird Survey is considered a good long-term data set and it has supplied enough information to assess if waterbird outcomes have been achieved in the 2017 and 2020 Basin Plan evaluations. However, the challenge for waterbirds, as with other ecological themes, is addressing the contribution of the Basin Plan to achieving outcomes.

The evaluations have been able to draw on The Living Murray program monitoring as well as some state monitoring to understand the influence of environmental water on waterbird populations. However, this information is spatially limited. The ability of current environmental monitoring to support the adaptive management of water resources is constrained by a range of issues including:

- the state of implementation of the Basin Plan, with key elements - like water resource plans and reviews and adjustments - yet to be implemented in full
- the tendency to favour pragmatic adaptation rather than applying program logic to develop targets, select indicators and sample design
- program fragmentation that compromises opportunities for integration
- limited capacity to realise the full value of monitoring data and information through constrained data and information management, reporting or decision-making processes.

The Basin Plan provides little guidance on monitoring and evaluation needs in regard to social, economic and cultural outcomes, and no formal monitoring framework. In the absence of an ongoing program under the Basin Plan to monitor social, cultural and economic outcomes, this evaluation has relied on data sources from agencies including Australian Bureau of Statistics (ABS), Australian Bureau of Agriculture and Resource Economics and Sciences, CSIRO and the Office of Registered Indigenous Corporations. The 2020 Evaluation also relies on the outcomes of the independent assessment of social and economic condition in the Basin conducted by the Independent Murray–Darling Basin Social and Economic Assessment Panel established by the Australian Government Minister responsible for water.

It is acknowledged that the Basin Plan 2020 Evaluation methodology for social, economic and cultural outcomes is different to that applied to the 2017 Evaluation, and therefore limits the ability to understand changes and trends. The Basin Plan 2020 Evaluation has instead focused on gathering baseline data and building internal capability for the Basin Plan 2025 Evaluation and 2026 review of the Basin Plan.

The Monitoring and Evaluation Working Group has been the formal channel for collaboration on monitoring and evaluation. This working group was established under the Basin Plan 2012 Implementation Agreement, recognising that joint effort is required to implement the Basin Plan monitoring and evaluation program.

As at November 2020, the Monitoring and Evaluation Working Group had held 23 formal meetings. The focus has been on reporting and evaluation requirements, and the successful annual reporting results presented above have been facilitated by the efforts of the group. The working group played a role in collaborating on the 2017 interim evaluation and has assisted in the Basin Plan 2020 Evaluation.

The 2019 monitoring, evaluation and reporting capability review identified that the Monitoring and Evaluation Working Group is not operating as effectively as needed (Alluvium 2019). The review

recommended the Basin governments develop a community of practice to improve monitoring, evaluation and reporting capability and exchange experiences (Alluvium 2019).

The review suggested that an annual conference may assist in improving capability. It would also provide a forum to exchange experiences across a broader scope of staff involved in monitoring, evaluating and reporting, outside the more restricted membership and more structured workplan agenda of the Monitoring and Evaluation Working Group (Alluvium 2019). An example of this type of annual conference is the knowledge conference held by NRM Regions Australia, which brings natural resource management practitioners together to share their learnings.

To what extent has the program for monitoring and evaluating the effectiveness of the Basin Plan contributed to adaptive management and improving the available scientific knowledge of the Murray–Darling Basin?

Monitoring

A systematic literature review of outputs from monitoring and research programs under the Basin Plan has identified more than 100 documents publicly available. The majority of these were technical monitoring reports, and a smaller number are communications products, technical research reports, and peer reviewed journal articles. These reports have been developed by a wide variety of monitoring and research providers across the Basin and documents have been published by more than ten agencies including government departments, research providers, and not-for-profit organisations. Project and science teams from a variety of monitoring agencies have also presented to various community and stakeholder groups. As just one example, at the Australian Society for Fish Biology Conference in 2019, there were seven conference presentations relating to Basin Plan monitoring and evaluation.

The majority of technical reports make recommendations regarding future management and or inferences about conceptual understanding. However, the specificity of these recommendations or inferences varies markedly. For example:

- Some recommendations detail specific elements needed in a hydrograph to achieve outcomes (e.g. Stewardson et al. 2014; Watts et al. 2014; Watts et al. 2015; Sharpe and Stuart 2018).
- Some provide details on monitoring requirements moving forward (e.g. Bloink and Robinson 2016; Wedderburn and Barnes 2016; Ye et al. 2017).
- Some address other Natural Resource Management actions required (e.g. Wedderburn et al. 2016; Wedderburn et al. 2019).
- Others make less specific statements inferring the need to continue environmental water (e.g. TLM 2016; Barmah).

In addition to this varying specificity, it is also important to note that these learnings and recommendations are most often buried in numerous highly technical reports, which results in information being inaccessible to many audiences.

This issue relating to the way in which learnings and adaptive management are reported was picked up by a review of the Commonwealth Environmental Water Office's long term invention monitoring program (Hart and Butcher 2018). The review identified the need to make monitoring and evaluation reports more accessible to a wider audience. While the review reported that interactions between monitoring and delivery staff resulted in considerable learnings that were transferring into improvements in the management of the Commonwealth's environmental water, there is a need for a more systematic approach to capturing lessons (Hart and Butcher 2018).

Despite a lack of systematic adaptive management documentation, adaptive management is occurring. In some cases, adaptive management occurs in real time, and researchers advise water managers based on what is occurring in the field (Sharpe and Stuart 2018; Watts et al. 2020). Outcomes of monitoring at specific sites have resulted in changes in the delivery of flows in subsequent water years (Watts et al. 2016). A review of the Living Murray monitoring program found that the data from the program underpins water planning for icon sites, and intervention monitoring informs event-based real-time management (Butcher 2019). There is limited evidence on slower adaptive management processes and how outcomes from particular events are expected to contribute to longer-term expectations and needs.

The volume of outputs produced indicates that monitoring programs intended to meet Basin Plan requirements are also contributing to scientific and other knowledge in the Murray–Darling Basin. There are some reviews of ecological relationships in the Basin for specific indicators or themes (e.g. Ellis et al. 2016; Department of Primary Industries 2015), which draw together a strong scientific evidence base, and we are aware that some work in collating a Basin-wide conceptual understanding is continuing (Koehn et al. in revision). The long term invention monitoring program review did however identify the need for an independent review of the quality of science being developed through its selected area reports. This review, in addition to a review of the Commonwealth Environmental Water Office's environmental water knowledge and research (EWKR) program started in November 2019, and the findings will be published in early 2021.

The Commonwealth Environmental Water Office's long term invention monitoring program review also identified the need for a Basin-wide database to collate data and information from all agencies relating to Basin Plan requirements (Hart and Butcher 2018). A multi-jurisdictional Basin Science platform is currently being developed and has the potential to meet this need. In the meantime, the Commonwealth Environmental Water Office's current Monitoring, Evaluation and Research Program (Flow-MER) is continuing the work undertaken through the long-term invention monitoring program and environmental water knowledge and research projects over three years until June 2022 while the independent review is undertaken. During this interim stage, some minor enhancements have been implemented through the Flow-MER. These enhancements include improvements in reporting requirements to assist in consistency and accessibility to the science being reported by the selected areas.

Evaluation

In terms of evaluation, the Basin Plan 2017 Evaluation identified twelve overarching recommendations to be addressed (MDBA 2017b). There has been no formal process for addressing these recommendations. As such, only some of them have been addressed and in an ad-hoc manner (see Appendix A for the implementation status of these recommendations). Key requirements to ensure recommendations are addressed is stakeholders' buy-in into the recommendations and clearer accountability.

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