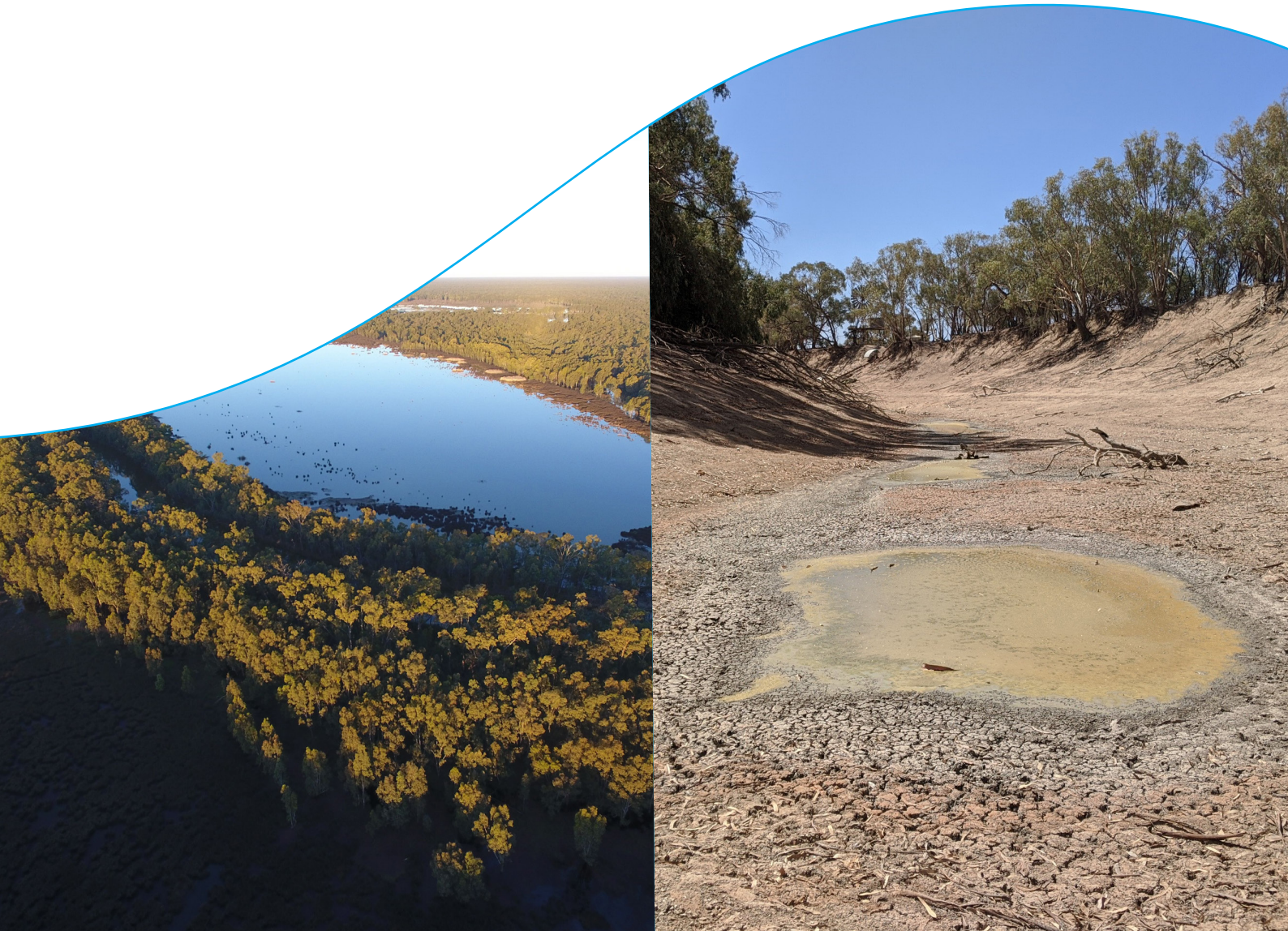
NSW GOVERNMENT

Natural Resources Commission

Final report

Review of the Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2016

November 2024



Enquiries

Enquiries about this report should be directed to:

Phone	(02) 9228 4844
E-Mail	nrc@nrc.nsw.gov.au
Postal address	GPO Box 5341, Sydney NSW 2001

Acknowledgement of Country

The Natural Resources Commission acknowledges and pays its respects to the Aboriginal nations, communities, people and traditional owners, past and present and future, for whom these waterways are significant. The Commission recognises and acknowledges that Aboriginal people have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. We value and respect their knowledge in natural resource management, and the contributions of many generations, including Elders, to this understanding and connection.

Cover photo: Vince Bucello/DCCEEW (left), Iain Ellis (right).

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List of acronyms and abbreviations

Act	the *Water Management Act 2000* (NSW)
ACCC	Australian Competition and Consumer Commission
ACT	Australian Capital Territory
ADWG	Australian Drinking Water Guidelines
AWD	Available water determination
Basin Plan	*Murray-Darling Basin Plan 2012*
BCS	Biodiversity, Conservation and Science Group within the Department of Climate Change, Energy, the Environment and Water
CEWH	Commonwealth Environmental Water Holder
CEWO	Commonwealth Environmental Water Office
Commission	the Natural Resources Commission
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DPE-Water	Former NSW Department of Planning and Environment – Water, referred to in this report as the Water Group
DPIE	Former Department of Planning, Industry and Environment
DPIRD – Fisheries	Department of Primary Industries and Regional Development – Fisheries
EWA	Environmental water allowance
GL	Gigalitre (unit of volume equivalent to one thousand million (1×10^9) litres
HEW	Held environmental water
ILUA	Indigenous Land Use Agreement
IQQM	Integrated Quantity and Quality Model
IVT	Inter valley trade
LALC	Local aboriginal land council
LGA	Local government area
LLS	Local Land Services
LTAAEL	Long-term average annual extraction limit

LTIM	Long-term intervention monitoring
LTWP	Long-term water plan
MER	Monitoring, evaluation and reporting
MDBA	Murray-Darling Basin Authority
ML	Megalitre (unit of volume equivalent to one million (1×10^6) litres
MLDRIN	Murray Lower Darling Rivers Indigenous Nations
NARCliM	NSW and Australian Regional Climate Modelling Project
NRAR	the Natural Resources Access Regulator
NSW	New South Wales
O&O document	*Objectives and Outcomes for river operations in the River Murray* document
The Plan	The *Water Sharing Plan for the NSW Murray and Lower Darling Regulated River Water Sources 2016*
PPM	Pre-requisite policy measures
R	Recommendation
the Regulation	*Water Management (General) Regulation 2018*
River operator	Means the operator of the water supply system for the water sources as defined in the dictionary of the *Water Sharing Plan for the NSW Murray and Lower Darling Regulated Rivers Water Sources 2016*
SDL	Sustainable diversion limit
SES	State Emergency Services
SRES	Special Report Emissions Scenario
Water Group	Department of Climate Change, Energy, the Environment and Water – Water Group

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Executive summary

The Natural Resources Commission (the Commission) has reviewed the *Water Sharing Plan for the Murray Lower Darling Regulated River Water Source 2016* (the Plan) as required under Section 43A of the *Water Management Act 2000* (the Act).

The Commission has assessed the extent that provisions in the Plan have contributed to achieving environmental, social, cultural and economic outcomes, and identified where changes to provisions are warranted. Given these opportunities for improvement, it is recommended that the Plan be replaced. The Plan expires 30 June 2026. There are some immediate actions required before expiry to address risks that require urgent attention in the Lower Darling-Baaka. These changes should be made via amendments to the Plan.

The Lower Darling-Baaka and Murray rivers are the foundation to some of NSW's most iconic landscapes. Water from the regulated rivers supports critical environmental assets, including extensive wetlands and floodplains that provide critical food, breeding and habitat resources. The Ramsar-listed NSW Central Murray Forests contain Australia's largest remaining redgum forest and the Menindee Lakes and Lower Darling-Baaka are part of the most ecologically important fish movement corridor in the Murray-Darling Basin.

The regulated rivers service major regional centres – such as Broken Hill and Albury – and vulnerable remote communities like Pooncarie and Menindee. The Plan underpins an agricultural industry worth over $2 billion and a growing tourism sector. Aboriginal people represent a significant sector of the population and have strong ongoing cultural and spiritual connections with the rivers and wetlands across the Plan area.

Environmental values in the region are under significant pressure from river regulation and development, with increasing threats from climate change. The severity of these threats has been highlighted by mass fish kills, poor connectivity and water quality and algal blooms in the Lower Darling-Baaka, which have triggered several independent reviews. The impacts of these events on the environment and town water supply have been felt strongly by communities.

Considering these and other issues, it is clear that Plan provisions are inadequate to support its objectives. There are several instances in which the Plan does not reflect the priorities of the Act, particularly the protection of fundamental ecosystem health. Key changes are needed to ensure flows are available to address risks around fish deaths and water quality, supported by clear governance arrangements. Provisions for environmental water can be made more flexible and optimised to maximise environmental benefits. Interjurisdictional agreements require review to ensure clarity and equity. State-wide issues also remain, including a lack of evidence that extraction limits are sustainable, poor consideration of climate change and limited outcomes for Aboriginal people.

Figure 1 provides a summary of the key opportunities to improve the Plan. The Commission has developed a detailed set of 38 recommendations (**Table 1**) to address these issues and improve the Plan. While all are important to address, the Commission has assigned a priority rating to each recommendation based on an assessment of the contribution of the recommendation to ensuring Plan outcomes, its impact on the Plan's ability to meet the priorities of the Act and the potential consequences of the issue not being addressed. The Commission has also considered the potential timing of the recommendations. The Commission recognises that some recommendations will require more time than is available before the Plan must be remade. These have been considered as 'long-term'

recommendations and it is recommended that amendment provisions are included in the Plan that allow them to be addressed during the life of the next Plan.

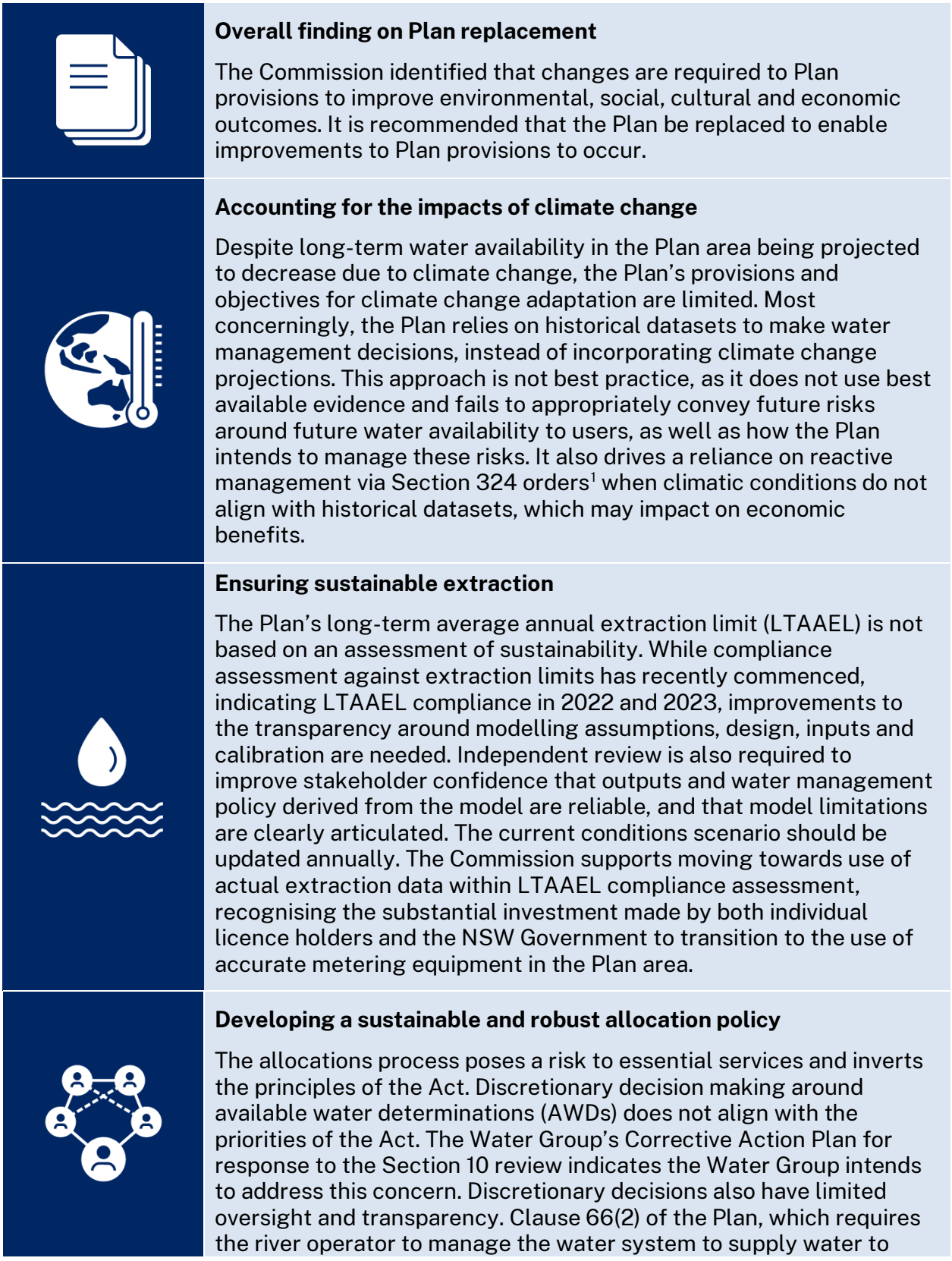
The Commission acknowledges that water management in the Plan area is complex given the water sharing arrangements in place with the Australian, Victorian and South Australian governments. As a result, it is not just the Plan that influences river operations. Intergovernmental agreements such as the Murray-Darling Basin Agreement also affect water management, including the operation of water infrastructure such as Menindee Lakes and Hume Dam. These factors have been considered in the advice.

A significant number of changes were made to the Plan in conjunction with the water resource planning process. For this review, the Commission assessed the version of the Plan in place at the commencement of the review (dated 14 July 2023). The Commission found several amendments made during the term of the Plan that may materially impact the Plan's ability to achieve Plan outcomes. As such, the Commission recommends the Department of Climate Change, Energy, the Environment and Water's (DCCEEW) Water Group (the Water Group) reinstate the previous Plan provisions unless it can demonstrate that equivalent outcomes can be achieved (**Table 2**).

The Commission identified several examples of good practice and positive outcomes, including the environmental benefits associated with protection of held environmental water (HEW) as a result of the roll-out of prerequisite policy measures (PPMs). Coordinated deliveries of planned and held environmental water have also provided significant environmental outcomes on the back of wet conditions in the Plan area.

The Commission is also aware of a significant volume of work being undertaken by the Water Group to improve the Plan's monitoring, evaluating and reporting (MER) framework. While some components of the MER framework have been finalised, other processes are still underway. Funding for the completion and implementation of the MER program will be critical to ensure Plan outcomes can be tracked. This will provide opportunities for adaptive management and greater transparency for stakeholders around Plan changes.

Figure 1: Key areas to improve Plan performance



[1] Section 324 of the Act allows the Minister to implement temporary water restrictions if satisfied that it is necessary to do so in the public interest (such as – but not limited to – to cope with a water shortage, manage threats to public health or safety or manage water for environmental purposes). The Minister may by order in writing, direct that for a specified period the taking of water from a specified water source is prohibited or subject to specified restrictions.

meet priority needs during a repeat of the period of lowest accumulated inflows, does not reference environmental needs. The allocations process does not specifically address the impact of climate change, lacking the flexibility to respond to conditions outside of the historical record. This has resulted in a reliance on reactive policy measures when conditions fall outside the historical average, including temporary water restrictions, the NSW *Extreme Events Policy*, or suspending the Plan in whole or in part. There is also a lack of clarity around decision making on the timing and volumes of water reserved for future priority needs.

Strengthening environmental protections in the Lower Darling-Baaka

The Lower Darling-Baaka has experienced several water quality and fish death events during the term of the Plan that have triggered various independent reviews. The Commission provided initial advice on provisions for the Lower Darling-Baaka to the Connectivity Expert Panel in June 2024. The Commission has outlined an approach for improving environmental outcomes, which are not being achieved under the current Plan. Key recommendations include amending the Plan before it expires to incorporate revised minimum daily flows and strengthen the Lower Darling Environmental Water Allowance (EWA), including making it available when Menindee Lakes are under NSW control and enabling EWA top-ups. The Commission also supports clarifying the implementation of the Lower Darling Restart Allowance.

There are also broader, whole-of-system actions relating to intergovernmental arrangements, infrastructure and other interventions that should be undertaken to support Plan provisions and outcomes. In the case of planned infrastructure such as new fishways, the replacement Plan should include amendment provisions to include operating requirements in the Plan.

Improved management of flood recession flows and greater flexibility in rates of rise and recession are needed to support water quality outcomes. Flows to and from other water sharing plan areas, which are critical to environmental outcomes in the broader region, are not adequately protected. This includes environmental water from the northern Basin entering the Plan area and flowing to the environmentally significant Great Darling Anabranch in the unregulated river.

Strengthening environmental protections in the Murray

The Murray Water Source (part of the River Murray System) and its floodplain hold significant environmental values, including Ramsar wetlands, which are currently not adequately reflected in plan objectives and provisions. There are several planned environmental water provisions in the Murray Water Source. While some changes have been made during the Plan period to improve these provisions, overall, the Plan still does not adequately prioritise the protection of the water source and its ecosystems in accordance with the Act.

Several factors, including borrowing and payback provisions and the absence of protections for return flows, contributed to limited use of the Barmah-Millewa EWA and overdraw for environmental purposes during the Plan period. There is a lack of clarity regarding provisions for managing water quality and algal events. Despite provisions related to the crediting, debiting, carryover and delivery of River Murray Increased Flows being added to the Plan in 2022, the role of the Southern Connected Basin Environmental Watering Committee in advising on flow delivery and protections for these flows remains unclear. PPMs designed to improve the efficiency and outcomes of HEW deliveries are delivering benefits but could be further optimised for environmental outcomes.

Restoring Aboriginal values and uses of water

Aboriginal communities have provided valuable insights for more than 20 years since the Act began. Despite this, the Commission has consistently heard from Aboriginal stakeholders that people are struggling to understand where the Plan is looking to achieve positive outcomes or benefit. Review findings reflect this and show the Plan has failed to deliver meaningful benefit to Aboriginal communities, particularly given that key strategies such as the allocation of water for native title and Specific Purpose Access Licences - Aboriginal commercial, community development and Aboriginal cultural have not been implemented. There is increasing evidence that Plan strategies are likely having adverse impacts to Aboriginal cultural values and uses, including fishing, through increases in the magnitude and frequency of fish kills, declining water quality and lack of connectivity. Prioritising the *NSW Aboriginal Water Strategy* is an important, currently undelivered, step in addressing some of these gaps. When the Plan can assign water to a social or cultural outcome, and protect that water from market pressures, there will be an improved balance in the sharing of water, and better alignment with the values and needs of Aboriginal communities.

Securing town water supply to meet future needs

Town water supply needs were likely to have been met for towns in the Murray Regulated Water Source over the Plan period. This was not always the case in the Lower Darling Regulated Water Source, with risks to Broken Hill's water supply requiring the construction of the Wentworth to Broken Hill Pipeline in 2019. This has strengthened water security for Broken Hill and delivered improved socioeconomic outcomes. The remote townships of Pooncarie and Menindee along the Lower Darling Regulated Water Source experienced a range of water quality issues impacting town water supply and domestic and stock use. Strategies are required to improve water quality in this water source for the environment and communities. Population and climate change projections for the Murray Regulated Water Source indicate future pressures on town water supply in the Albury, Greater Hume and Murray River council areas. Share components for local utility access licences and extraction limits should be revised to reflect this projected population growth.

Reducing the impact of flow constraints on environmental outcomes

Flow constraints are designed to protect landholders from low-level inundation but have also led to the decline of inundation-dependent ecosystems. As part of commitments under the Basin Plan, the NSW Government has developed the Reconnecting River Country Program to assess options for relaxing constraints to enable higher environmental flows and address adverse social and economic impacts, particularly to riparian landholders. If constraints are relaxed, Plan provisions will need to be amended to ensure this materially contributes to achieving environmental outcomes.

Aligning channel capacity sharing with the Act

When the river operator is unable to release enough water to meet all needs, it must share channel capacity based on the Plan's priority of extraction provisions. Amendments made in 2022 placed EWA water in the lowest priority category, to be shared with regulated river (general security) access licences. Providing the lowest priority for EWA releases potentially contradicts Section 5(3) of the Act, which prioritises water to protect the water source and its dependent ecosystems and basic landholder rights. The EWA should be given equivalent channel capacity priority to basic land holder rights (above all other extractive users) to be consistent with the priorities of the Act.

Table 1: Recommendations (R)

Priority 1	Priority 2	Priority 3

Note: Unless noted otherwise, recommendations are to be implemented in the replacement Plan. Some priority actions should be undertaken as soon as possible before the Plan expires – these are denoted with (A). Where it may not be possible to fully meet the recommendation by the time the Plan is remade, an amendment provision should be included to allow the recommendation to be fully implemented during the life of the Plan – these recommendations are denoted with (LT).

	Reverting Plan amendments
R1	The Water Group undo Plan amendments identified in **Table 2**.
	Accounting for the impacts of climate change
R2 (LT)	To identify where Plan environmental rules may be at risk of failing to deliver on their required purpose under changing water availability, the Water Group should model impacts under the baseline scenario (historical climate scenario) and climate change scenarios. The Water Group should revise Plan provisions, where this is required, to maintain environmental outcomes.
R3 (LT)	In recognition of the potential future shifts in climatic conditions, the Water Group should incorporate climate change projections into decision making and shift away from the use of historical data as the sole basis for water management decisions.
R4	To ensure that the modelled representation of hydrological processes reflects any observed changes over time, the Water Group should ensure the hydrological model is validated and recalibrated at least once every five years.
R5	The Water Group should: a) provide transparency on how climate change will be considered in redefining the lowest accumulated inflows b) revise Clause 66(2) to reflect that operations should be able to deliver higher priority needs based on projected climate and hydrologic conditions c) following the review of the period of lowest accumulated inflows, notify licence holders of potential reductions in the long-term average annual extraction that may occur as a result of climate change impacts.
	Ensuring sustainable extraction
R6 (LT)	The Minister should require the Water Group to develop and adopt a sustainable LTAAEL that: a) sets aside the water required to protect the water source and its dependent ecosystems b) enables the achievement of the Plan's environmental, social and cultural objectives c) establishes a limit framework that is responsive to the impacts of climate change d) is not reliant on the sustainable diversion limit (SDL) to achieve the Plan's environmental outcomes.
R7	To improve transparency of the assessment of LTAAEL compliance reports, the Water Group should transition to use actual metered data to validate the LTAAEL compliance process.
R8	The Water Group should modify actions taken to address SDL non-compliance by specifying that allocations for entitlements held by environmental water holders will not be reduced in 'make good' actions.
R9 (LT)	To improve transparency of the assessment of LTAAEL compliance reports, the Water Group should: a) ensure the current conditions model is updated annually b) clarify whether models used in the LTAAEL assessment of compliance have been independently reviewed and deemed fit for purpose c) provide visibility of any revisions and inclusions to the scenario models used in the LTAAEL assessment of compliance

	d) provide disaggregated extraction information for each modelled scenario and identify where modelled extraction is set as a static value e) undertake annual independent reviews of the current conditions scenario to ensure it best represents current level of extraction.
	Developing a sustainable and robust allocation policy
R10	The Plan should include a provision that requires the Minister to reconcile the Plan's lowest accumulated inflows against actual inflows and address any shortfall before issuing increased allocations.
R11	The Water Group should revise Clause 66(4) (review of lowest accumulated inflows) to include a requirement to not jeopardise critical environmental needs.
R12	The Water Group should revise Clause 66(2) (Maintenance of water supply) to require the river operator to be able to firstly supply sufficient water to protect the water source and its dependent ecosystems during a repeat of the period of lowest accumulated inflows.
R13	To improve transparency, the Water Group should clarify decision making related to the second-year reserve in the Plan.
R14	The Water Group should seek Basin Officials Committee agreement to review and address inequalities in the use of the shared resource arising from NSW and Victoria state-based allocation policies, particularly those that affect storage reserve volumes.
	Strengthening environmental protections in the Lower Darling-Baaka
R15 (A)	The Water Group should amend the Plan as a priority (before the Plan expires) to: a) incorporate updated minimum daily flows consistent with the Commission's advice, including provisions that allow the flexibility in their delivery based on water quality, water availability and ambient conditions b) clarify that the Water Quality Working Group can advise on variations to minimum daily flow requirements c) establish an active storage trigger to enable the Minister for Water to have discretion over delivery of minimum daily flows during drought periods with concurrence from the Minister for the Environment. *Note: NSW can implement these changes to give effect to revised management when the Menindee Lakes are under NSW control.* *Given minimum daily flows are also included in the Objectives and Outcomes document for river operations in the River Murray System document, which applies when Menindee Lakes, are under the direction of the Murray-Darling Basin Authority (MDBA) as a shared resource, Water Group should also consult the Basin Officials Committee and River Murray Operations Committee on revised minimum daily flows.*
R16 (A)	To improve the effectiveness of the Lower Darling EWA, the Water Group should amend the Plan as a priority (before the Plan expires) to: a) allow for the Lower Darling EWA to be available for use when the Lakes are under NSW control (i.e. when they fall below 480 GL until they next reach 640 GL) b) ensure there is clarity in the responsibility for managing the Lower Darling EWA (noting that the Water Quality Working Group has been responsible for directing the use of the Lower Darling EWA for the past three years) c) clarify that the primary purpose of the Lower Darling EWA is for managing water quality and blue green algae, but can be used for other environmental benefits when it is not needed for water quality and algal events d) enable top-up of the Lower Darling EWA allowance (up to 30 GL) when its account is approaching exhaustion with inflows to the upper lakes.
R17	The Water Group should seek Basin Officials Committee agreement to provide greater flexibility in the rates of rise and recession and codify these arrangements in the Plan's operating rules to ensure they do not hinder delivery of flow pulses for water quality outcomes while supporting ecological outcomes.
R18	The Water Group should seek Basin Officials Committee agreement on permanent arrangements to recredit all water for the environment originating from the northern Basin to formalise its protection in the southern Basin. These provisions should be incorporated into the replacement Plan and the Murray-Darling Basin Agreement.

R19 (A)	To strengthen governance arrangements to manage water quality, blue-green algae and risks of fish deaths in the Lower Darling Water Source, the Water Group should amend the Plan as a priority (before the Plan expires) to ensure that the role and functions of the Water Quality Working Group are included in the Plan. *Note: **R15** sets out proposed function of the Water Quality Working Group relating to advice on minimum daily flows.*
R20	To support the effectiveness of Plan provisions for the Lower Darling-Baaka, the Water Group should: a) Work with the Basin Officials Committee to: i. reduce or remove lower priority demands from the upper lakes, including shared resource demands that exceed minimum daily releases, to reserve the upper lakes for high priority commitments ii. codify that the management of the shared resource continues to maximise stored volumes in the upper lakes and expand the use of surcharging the upper lakes when appropriate, in turn highlighting the need for investment in infrastructure upgrades iii. redefine the volume of a priority storage reserve in the upper lakes, based on a water balance approach, which provides a drought reserve for human and environmental needs over an appropriate planning horizon b) implement complementary measures including infrastructure improvements and investigate other interventions, including but not limited to: i. repairing the dam safety constraint at Pamamaroo inlet regulator to reduce storage requirements ii. progress high priority fish ways to enable fish passage between the Lower Darling-Baaka, the upper lakes and the northern Basin (see Section 7.7) iii. modification of Weir 32 to support management of water quality risks and fish movement iv. metering and hydrometric upgrades at appropriate locations including long term funding arrangements. v. aerators to mix waters around the offtakes in Lake Wetherell and Pamamaroo vi. a breakwall barrier or curtain 'diversion' structure to reduce short-circuiting of water through Lake Pamamaroo.
R21	The Water Group should implement recommendations from the Expert Connectivity Panel to increase inflows into the Menindee Lakes, including revising trigger conditions, providing for connectivity EWAs and undertaking further analysis to determine an additional trigger to refill the lakes when necessary.
R22	To reduce reliance on the Lower Darling EWA and allow for greater responsiveness to the management of water quality events during a flood recession, the replacement Plan should include: a) clear water quality triggers for managing water with low dissolved oxygen during flood recession flows b) revised release rates for addressing water with low dissolved oxygen in the Menindee weir pool c) a requirement that the management of the flood recession flow is based on best available information, including water quality monitoring data.
R23	To strengthen the Lower Darling Restart provisions and ensure that the river operator has sufficient clarity when restarting the river, Water Group should ensure the Plan includes: a) clear water quality triggers for when the restart can commence to mitigate perverse water quality outcomes downstream b) specification of the Water Quality Working Group's role in guiding the river restart c) a requirement that the restart is based on best available information i.e. water quality monitoring data and relevant technical papers d) reporting requirements for the river restart to ensure transparency in outcomes of the river restart and clearly record any lessons learnt that may be applied for future events.
R24	As part of Plan replacement, the Water Group should recognise the interrelationship between the Lower Darling Water Source and the Great Darling Anabranch and establish provisions for flows down the Anabranch to support the Plan's connectivity and environmental objectives and to ensure consistency with the *Darling Anabranch Management Plan*.
R25	As part of Plan replacement, the Water Group should: a) incorporate replenishment flow provisions for Three Mile Creek (up to twice a year when water is available in Lake Wetherell, or a single delivery when Lake Wetherell falls below 75 percent capacity) b) develop and incorporate water quality triggers (based on existing water quality monitoring within Lake Wetherell) to inform delivery of flows down Three Mile Creek from Lake Wetherell c) consider an event-based monitoring program for flow events through Three Mile Creek

	d) engage with the Biodiversity, Conservation and Science Group (BCS), The Department of Primary Industries and Regional Development (DPIRD) – Fisheries and the Commonwealth Environmental Water Holder (CEWH) regarding opportunities for delivery of water for the environment along Three Mile Creek, including its protection.
R26	The Water Group should include an amendment provision in the replacement Plan that allows modification of operating rules for fishways to facilitate fish passage between the Lower Darling-Baaka, the Great Darling Anabranch, Menindee Lakes and the northern Basin.
	Strengthening environmental protections in the Murray
R27	To ensure that the needs of the environment, specifically the Barmah-Millewa Forest, are prioritised, the Water Group should: a) develop a transparent procedure for borrowing and payback of the Barmah-Millewa EWA that prioritises the needs of the environment consistent with the Act and reference this in the replacement Plan b) include a provision requiring for the NSW Environmental Water Manager be consulted on borrowing against the Barmah-Millewa EWA and concurrence from the Minister for the Environment for the borrowing of this water for regulated river (general security) access licences c) to support R27(b), develop a decision tree in consultation with BCS for using the allowance for other environmental purposes when it is not needed for watering the Barmah-Millewa Forest to improve the use and effectiveness of the allowance d) assess the feasibility of protecting Barmah-Millewa EWA return flows in consultation with the Basin Officials Committee and Victoria to improve the environmental benefits the allowance can provide e) in consultation with BCS, review why the Barmah-Millewa Overdraw provisions have not been used during the term of the current Plan and revise them in the replacement Plan so that they are fit for purpose.
R28	The Water Group should work with BCS to determine what rules are needed to meet the Plan's water quality objectives. The Water Quality Management Plan that the Plan refers to should also be updated to clarify the provisions that help manage water quality and algal events.
R29	To improve clarity regarding the calling on and protection afforded to River Murray Increased Flows, the Water Group should include the following in the replacement Plan: a) a requirement for the NSW Environmental Water Manager to consult and seek advice from the Southern Connected Basin Environmental Watering Committee when calling on River Murray Increased Flows b) a clause outlining that River Murray Increased Flows are not to be used for meeting water orders of consumptive users.
R30	To ensure that the Plan aligns with commitments under the Ramsar Convention of Wetlands of International Importance, the Water Group should ensure that the replacement Plan includes: a) objectives that list the internationally significant NSW Central Murray Forests b) strategies that contribute towards maintaining the ecological character of the Ramsar site c) specific provisions that provide for the required protection of the Ramsar site.
	Restoring Aboriginal water rights, values and uses
R31	The Water Group should work the Barkandji native title holders (and any future native title or Indigenous Land Use Agreement (ILUA) holders) to determine water requirements for the practice of native title rights in the Plan area.
R32	To improve accountability against cultural objectives, the Water Group should ensure the Plan's objectives, corresponding provisions and performance indicators are co-designed with Aboriginal stakeholders, reflect Priority 2 of the *NSW Water Strategy* and continue to align with the Act.
R33	To improve Aboriginal access licence uptake and use, the Water Group should work with the Aboriginal peoples of the Plan area to better understand their water needs and ensure alignment of licence types, use and conditions are reflecting these needs.
R34	To support improved economic outcomes from the Plan, the Water Group should work with Aboriginal communities to:

	a) better understand cultural obligations and amend the purposes for which Aboriginal access licences may be granted by recognising traditional trade practice, such as sale, exchange, gifting, and bartering of goods made from water provided under all categories of Aboriginal access licences b) explore further opportunities to enact all three sub-categories of Aboriginal access licence to support the Plan's Aboriginal cultural objectives.
R35	To support the Plan objective to maintain connectivity for cultural outcomes and review of Plan rules by Aboriginal water users, the Water Group should: a) include provisions specifying volumes that are being reserved, how they are being managed and their level of effectiveness in providing connectivity b) in the replacement Plan, establish Aboriginal cultural performance indicators and improve measurability of Aboriginal cultural outcomes for connectivity.
	Securing town water supply to meet future needs
R36	To ensure town water supply needs are provided for, the Water Group should: *For the Murray Regulated Water Source:* a) ensure share components for local utility access licences reflect projected population growth in Wentworth Council, Greater Hume Council and Albury City Council and sustainable limits are adjusted accordingly if required alongside other strategies to augment supply *For the Lower Darling Regulated Water Source:* b) consult local water utility managers for the Pooncarie and Menindee townships to consider how Plan provisions can provide adequate flows to maintain water quality for towns consistent with relevant standards.
	Reducing the impact of flow constraints on environmental outcomes
R37	To improve environmental outcomes that can be achieved in the event of constraint relaxation, the Water Group should: a) include provisions that identify the flow rates or flow levels related to normal operations and where environmental flows are being released within relaxed constraint flow corridors b) ensure provisions promote the release of environmental flows and that the river operator cannot unreasonably refuse to deliver environmental flows up to the relaxed constraint flow levels.
	Aligning channel capacity sharing with the Act
R38	To align with priorities under the Act, the Water Group should revise Clause 68 of the Plan to specify that planned environmental water (for example, EWA) holds channel capacity priority equivalent to basic landholder rights and above all other extractive users and ensure that held environmental water deliveries are treated equitably.

Table 2: Recommandations on amendements made over the term of the Plan (AR)

General	
AR1	To maintain consistency with the requirements of the Act, the Water Group should remove the recently added Clause 66(5) that states '*any amendments made under subclause (4) cannot substantially alter the long-term average annual amount of water able to be extracted under water access licences.*'
AR2	To ensure Plan outcomes are achieved, the Water Group should reinstate the following Plan provisions: a) Clause 41(3) of previous Plan – removal of the requirement that '*... the [LTAAEL] model... must be set to represent as closely as possible ...*' conditions and replacing with a note that the Water Group intends to update the model annually, removes legal obligations regarding model accuracy. b) Clause 66(1)(c-d) in previous Plan – removal of mandatory condition requirements for abandoned, replaced or decommissioned water supply works. A lack of clarity around requirements for decommissioning of works approvals may have an impact on compliance assessments and any subsequent regulatory action.
Amendment clauses	
AR4	To ensure the Plan can be amended to achieve outcomes, the Water Group should undo the following changes to amendment provisions in Part 12 of the Plan: a) removal of amendment provisions Clause 69 in previous Plan for varying the LTAAEL after the surrender or cancellation of a water access licence b) inclusion of amendment provision Clause 85(1)(d) for the conversion of regulated river (high security) licences to upstream unregulated river water sources c) inclusion of amendment provision Clause 85(4) to amend the Plan to facilitate extractions reaching the long-term limits.

1 Review background

1.1 Water sharing plans

Water sharing plans are statutory instruments under the Act. They prescribe how water is managed to support sustainable environmental, social, cultural and economic outcomes. They intend to provide certainty for water users regarding how available water will be shared over the life of the water sharing plan, which is typically 10 years unless extended.

The Plan commenced on 1 July 2016 and is due for extension or replacement by 30 June 2026. A suite of changes were made to the Plan in December 2022 in conjunction with the water resource planning process (**Chapter 2**).[2] The Commission has reviewed the version of Plan in place as at 14 July 2023.

1.2 The Commission's role in reviewing water sharing plans

The Commission has a role under Section 43A of the Act to review water sharing plans within five years of expiry, and report to the Minister on:

- the extent that a plan's water sharing provisions have materially contributed to the achievement of, or failure to achieve, environmental, social and economic outcomes
- if changes to plan provisions are warranted.

The Commission may recommend extending or replacing plans depending on its review findings. Section 43A(3A) of the Act requires the Commission to consider some potential compensation requirements resulting from recommended plan changes.[3] Under the Act, compensation is payable by the state to access licence holders only in certain circumstances[4] where water allocations under a water sharing plan are reduced.

The Commission's review must consider the water management principles,[5] including the water sharing principles, when reviewing plans. The Act is clear that water sharing is not about balancing uses and values – it is about first providing for the environment and second recognising basic landholder rights above other uses. It specifies that the:

a) sharing of water from a water source must protect the water source and its dependent ecosystems, and

b) sharing of water from a water source must protect basic landholder rights, and

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2 The *Commonwealth Basin Plan 2012* requires the development of water resource plans. Water resource plans draw heavily on water sharing plans and provide a framework and rule set on which to manage water resources within the Murray Darling Basin.

3 If a Commission report recommends changes to a plan that will reduce water allocations in relation to which compensation might be payable under Section 87AA of the Act, the Commission is to state in the report if the purpose of the proposed changes is: (a) to restore water to the environment because of natural reductions in inflow to the relevant water source, including changes from climate change or drought or (b) to provide additional water to the environment because of more accurate scientific knowledge demonstrating the amount previously allocated to the environment is inadequate.

4 As set out in sections 87 and 87AA of the Act. Section 87 states that compensation applies for certain reductions in water allocations arising during the initial (10-year) period of a water sharing plan, only where amendments are not already contemplated in that plan. Section 87AA makes clear that compensation applies to amendments to the Plan after its 10-year term. In addition, the Minister has an overriding discretion under Section 87 (but not under Section 87AA) to determine if compensation should be paid and, if so, the amount of any such compensation and the manner and timing of any payments.

5 Section 5 of the Act.

c) sharing or extraction of water under any other right must not prejudice the principles set out in paragraphs (a) and (b).[6]

Further, the water management principles should be prioritised in the order that they are set out above.[7] Water sharing plans must be based on evidence to achieve these outcomes.

1.3 The Commission's review process

In reviewing the Plan, the Commission aims to contribute to improved and more transparent water management. The Commission evaluates the achievement of Plan environmental, social, cultural and economic outcomes by:

- evaluating key risks to Plan outcomes under current Plan provisions
- independently assessing Plan performance, and alignment with the objects, principles and priorities of the Act
- identifying areas where Plan provisions can be improved to better achieve outcomes
- identifying new evidence and good practices to improve Plan design and performance.

The Commission's full evaluation framework is published on the website.[8]

1.3.1 Evidence used to guide the review

The Commission's review is evidence-based, informed by a range of sources, including:

- **Consultation** – targeted engagement with government agencies, community, Aboriginal and industry organisations.
- **Document review** – the Commission reviewed the Plan, its background document,[9] public reports and unpublished information from water management agencies. Relevant reports including but not limited to the Office of the NSW Chief Scientist & Engineer's independent *Review into the 2023 Mass Fish Deaths in the Darling-Baaka River at Menindee* and the NSW Government responses and the advice on improving hydrological connectivity provided by the Connectivity Expert Panel to the NSW Government.
- **Technical advice** – consultants provided technical advice and peer review.
- **Public submissions** – the Commission received 16 submissions. Non-confidential submissions are published on the Commission's website.[10] The Commission also reviewed stakeholder feedback made as part of the water resource planning process and the draft regional water strategy process through the 'What We Heard' documentation.

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6 Section 5 (3) of the Act states that '*In relation to water sharing —*
(a) sharing of water from a water source must protect the water source and its dependent ecosystems, and
(b) sharing of water from a water source must protect basic landholder rights, and
(c) sharing or extraction of water under any other right must not prejudice the principles set out in paragraphs (a) and (b)'.

7 Section 9(1) of the Act.

8 Natural Resources Commission (2022) *Review approach*

9 Murrumbidgee Regulated River Management Committee (2004) *Murrumbidgee Water Sharing Plan: Background document, Part A*, unpublished.

10 Natural Resources Commission (n.d.) *Water sharing plan reviews*

1.3.2 Relevant regional plans, policies, programs and agreements

In reviewing the Plan, the project team considered the following plans, policies and agreements in accordance with Section 43A(4)(b) of the Act:

- *NSW Water Strategy*
- *Western Regional Water Strategy* and the draft *NSW Murray Regional Water Strategy*
- Commonwealth legislation, including the *Water Act 2007* and *Basin Plan 2012* as these affect issues analysed as part of the review
- relevant interjurisdictional agreements such as the Murray-Darling Basin Agreement, and the *Objectives and outcomes for river operations in the River Murray,*[11] the *New South Wales and Victorian Operating Rules for the Barman-Millewa Forest Environmental Water Allocation 2021*, and the trial agreement on recrediting environmental water at Menindee Lakes, as these affect issues analysed as part of the review
- *NSW Murray and Lower Darling Surface Water Resource Plan* and other accompanying documentation, such as the *Murray-Lower Darling Water Quality Management Plan* and *Murray-Lower Darling Long-Term Water Plan*
- programs that form part of the suite of projects under the sustainable diversion limits adjustment mechanism, as these affect issues analysed as part of the review
- draft *Aboriginal Water Strategy*, noting that the Commission did not review it but received an update on program intent and progress from the Water Group[12]
- various NSW Government policies that impact water management in the Murray and Lower Darling-Baaka regulated system, including water allocation methodologies[13] and the *Extreme Events Policy*.[14]

11 Basin Officials Committee (2023) *Objectives and outcomes for river operations in the River Murray System*
12 In this report, the Water Group has been used to refer to DPE-Water, DPIE-Water and the current DCCEEW.
13 DPIE (2021) *Water Allocation Methodology - NSW Murray Regulated River Water Source*; DPE (2022) *Water Allocation in the Regulated Lower Darling*
14 DPE (2023) *Extreme Events Policy*

2 Plan amendments

In 2023, the Commission audited the Plan version effective from 21 June 2019.[15] In undertaking the Plan review, as detailed in this report, the Commission assessed the Plan version dated 14 July 2023 (the version in force when the review commenced) but also considered amendments that have been made over the life of the Plan and whether they have increased the likelihood of achieving outcomes.

The Plan has been amended five times since the original Plan was replaced on 1 July 2016 – three times by legislation and two times by Ministerial Amendment Orders.[16] The 23 December 2022 amendments substantially redrafted and amended the Plan, in part to comply with water resource plan requirements.[17] The changes made at that time were the most substantial revisions of the Plan since its introduction in 2003. The Commission notes that the water resource plan for the NSW Murray and Lower Darling surface waters was accredited by the Commonwealth Minister and commenced 18 May 2024 under the Commonwealth *Water Act 2007*.[18]

The Commission notes that several plans covering multiple water sources have been amended to include a provision that states '*any amendments made [in relation to a review of the lowest accumulated inflows] … cannot substantially alter the long-term average annual amount of water able to be extracted under water access licences*.'[19] The Commission considers this provision to be inconsistent with the Act's principles as it effectively limits the ability to provide for environmental and basic landholder rights water if it would reduce licenced extraction. Section 5(3)(c) of the Act clearly prioritises protection of the water source and its dependent ecosystems and basic landholder rights over licenced extraction. Therefore, this provision should be removed.[20]

The Commission has found several amendments that may materially impact the Plan's ability to achieve Plan outcomes and therefore should be reconsidered.

Recommendation R1 – Priority 2
The Water Group undo Plan amendments identified in **Table 2**.

15 Natural Resources Commission (2023) *Audit of the implementation of the Lachlan, Murrumbidgee and NSW Murray and Lower Darling regulated rivers water sharing plans*

16 *Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2016*

17 The Basin Plan requires that state and territory governments develop water resource plans, which specify how state-based water management, including water sharing plans, comply with Basin Plan requirements. The MDBA assesses water resource plans against requirements listed in Chapter 10 of the Basin Plan. These assessments usually lead to additional changes being required to the water resource plan, which usually includes changes to the water sharing plan. After the MDBA's review the water resource plan can be presented to the Commonwealth Minister for accreditation.

18 MDBA (2024) *New South Wales Murray and Lower Darling water resource plan*

19 For example, Clause 66(5) of the Plan.

20 Section 5 (3) of the Act states that '*In relation to water sharing —*
(a) sharing of water from a water source must protect the water source and its dependent ecosystems, and
(b) sharing of water from a water source must protect basic landholder rights, and
(c) sharing or extraction of water under any other right must not prejudice the principles set out in paragraphs (a) and (b)'.

3 About the Plan area

The Plan applies to the regulated sections of the bed and banks of the Murray Lower Darling River system that lie within the management jurisdiction of NSW. [21]The Plan covers two water sources:

- **The Murray Regulated River Water Source** (Murray Water Source) – which includes water between the banks of all rivers downstream of Hume Dam and from the Darling River at the northeast corner of Lot 11 DP 756952 to the South Australian Border.
- **The Lower Darling Regulated River Water Source** (Lower Darling Water Source) – which includes water between the banks of all rivers from the upper limit of the Lake Wetherell water storage (part of the Menindee Lakes system) downstream to the upstream limit of the Wentworth Weir Pool water storage (**Figure 2**).[22]

There are various unregulated streams within the Plan region that are influenced by regulated flows. Some of these unregulated streams are discussed in this review given their high dependence on flows from the regulated river, for example the Great Darling Anabranch. The Commission also undertakes reviews of unregulated water sharing plans and has completed reviews of the Murray and Murray Lower Darling unregulated water sharing plans in 2021[23] and 2022.[24]

The River Murray covers 2,500 kilometres from the eastern highlands of the Great Dividing Range to the Southern Ocean, forming the border between NSW and Victoria from its headwaters until it flows into South Australia just upstream of Renmark. Within NSW, the Murray River can be classified into three sections: the Headwaters, the Riverine Plains, and the Mallee.[25] The Edward–Wakool water management area is a large anabranch system of the River Murray with a complex network of interconnected streams, ephemeral creeks, flood runners and wetlands. [26]

The Lower Darling River System comprises the Lower Darling-Baaka River and the Great Darling Anabranch. During high flows, the Lower Darling-Baaka spills into the Anabranch approximately 55 kilometres south of the town of Menindee.[27]

At the head of this system, the Menindee Lakes receive inflows from the northern Basin via the Barwon-Darling River, which is diverted by the Main Weir to the north of town of Menindee. Main Weir fills Lake Wetherell, which in turn fills lakes Bijijie, Tandou and Pamamaroo. Lake Pamamaroo drains to Copi Hollow and then into Lake Menindee, followed by Lake Cawndilla. Lake Pamamaroo also has an outlet regulator for releases to Menindee weir pool. Lake Menindee has an outlet regulator, which returns water to the Lower-Darling Baaka. While Lake Cawndilla has an outlet regulator that releases water to Tandou Creek, Redbank Creek and the Great Darling Anabranch.[28]

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21 Murray Lower Darling Community Reference Committee (n.d.) *Guide to the Draft Water Sharing Plan for the NSW Murray - Lower Darling Regulated River Water Source*
22 Part1(4) of the Plan.
23 Natural Resources Commission (2021) *Final report: review of the Water Sharing Plan for the Murray Unregulated River Water Sources 2011*
24 Natural Resources Commission (2022) *Final report: review of the Intersecting Streams and Lower Murray-Darling unregulated water sharing plans*
25 Murray Lower Darling Community Reference Committee (n.d.) *Guide to the Draft Water Sharing Plan for the NSW Murray - Lower Darling Regulated River Water Source*
26 Department of Planning, Industry and Environment (2020) *Murray-Lower Darling Long Term Water Plan Part A: Murray-lower Darling catchment*
27 Murray Lower Darling Community Reference Committee (n.d.) *Guide to the Draft Water Sharing Plan for the NSW Murray - Lower Darling Regulated River Water Source*
28 *Ibid.*

Water management in the Plan area is complex given the water sharing arrangements in place with the Australian, Victorian and South Australian governments. As a result, it is not just the Plan that influences river operations. Intergovernmental agreements such as the Murray-Darling Basin Agreement also affect water management including the operation of water infrastructure including the Menindee Lakes and Hume Dam.

The Plan area spans the local Aboriginal land council (LALC) areas of Wilcannia, Menindee, Dareton, Balranald, Wamba Wamba, Deniliquin, Cummeragunja and Albury and district, and includes lands recognised under the native title of the Barkandji Traditional Owners (**Figure 3**). These lands are significant to all Aboriginal people who share a cultural and spiritual connection with the lands, including the waters and waterways that run through them. The importance and value of these connections has been well established over time and is well known by Aboriginal peoples and government agencies alike.

Aboriginal people represent a significant sector of the population in the Plan areas that are potentially impacted by the planning, development and implementation of the Plan. There is significant variation in the per centage of the total population identifying as Aboriginal and Torres Strait Islander, while the average population of Aboriginal people across the Plan areas is 6.6 percent, the proportion ranges from 2.3 percent in Federation Shire to 36.5 percent in Central Darling Local Government Area (LGA).[29]

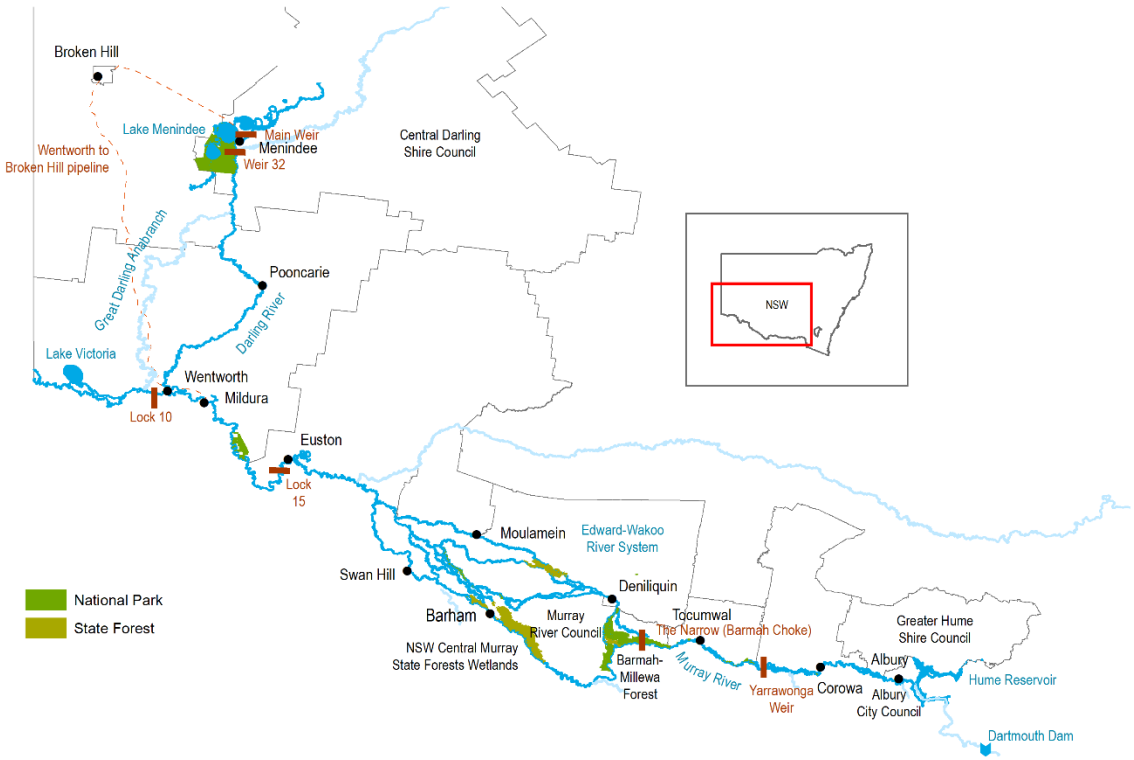

Figure 2: The Plan area, including LGAs

[29] Australian Bureau of Statistics (2023) *Data by region*

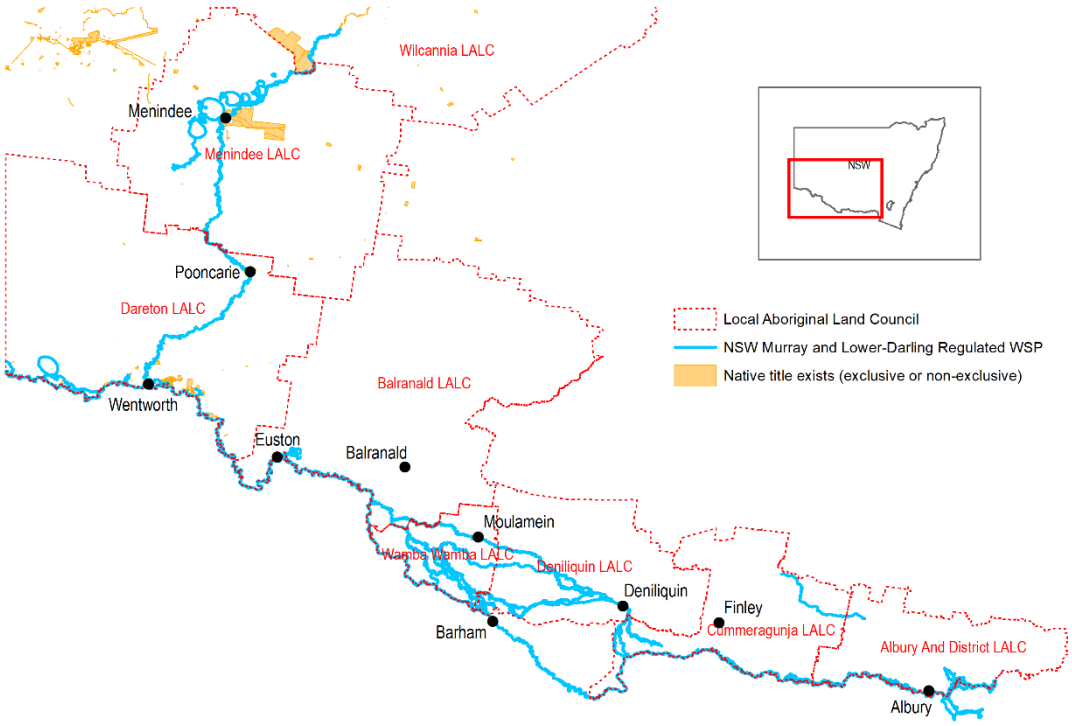

Figure 3: LALC and native title areas of the Plan area

The Murray–Lower Darling catchment supports a range of water-dependent ecosystems, including instream aquatic habitats, riparian forests, floodplain watercourses, woodlands and wetlands. The NSW Central Murray Forests (Millewa, Werai and Koondrook– Perricoota forests) are Ramsar sites (recognised under the Ramsar Convention).[30] The Millewa Forest contains the largest area of remaining river red gum in Australia. The semi-arid Lower Darling region is diverse with blackbox and to a lesser extent river redgum and coolabah woodlands fringe the ephemeral water courses and lakes.[31]

The *Western Regional Water Strategy* recognises the Barwon-Darling, Menindee Lakes and Lower Darling-Baaka as one of the '*most ecologically important fish movement corridors in the Basin*'.[32] The Lower Darling River and Menindee Lakes ecosystems provide habitat and food resources for many water-dependent species, including threatened ecological communities, threatened and endangered migratory waterbirds, and threatened native fish species. [33] Threatened or vulnerable fish species include flathead galaxias (*Galaxias rostratus*), purple-spotted gudgeon (*Mogurnda adspersa*), Murray hardyhead (*Craterocephalus fluviatilis*), silver perch (*Bidyanus bidyanus*), Murray cod (*Maccullochella peelii*), Macquarie perch (*Macquaria australasica*), trout cod (*Maccullochella macquariensis*), southern pygmy perch (*Nannoperca australis*), olive perchlet (*Ambassis agassizii*) and Murray crayfish (*Euastacus armatus*).[34] The lower Darling River and Menindee Lakes provide important breeding and recruitment habitats for native fish, with source populations from this area dispersing through large parts of the Murray-Darling Basin.[35]

Floodplain habitats in the Plan area support waterbird communities when flooded, including endangered Australasian bittern (*Botaurus poiciloptilus*) and regionally important

30 DPIE (2020) *Murray-Lower Darling Long Term Water Plan Part A: Murray-lower Darling catchment*
31 *Ibid.*
32 DPE-Water (2022) *Western Regional Water Strategy – Attachment 4*
33 DPIE (2020) *Murray-Lower Darling Long Term Water Plan Part A: Murray-lower Darling catchment*
34 *Ibid.*
35 *Ibid.*

populations of egrets, ibis, spoonbills and herons. Flooding in 2010-11 supported the breeding of around 50 species of waterbirds in the Barmah–Millewa forest, and the Menindee Lakes has supported over 222,000 waterbirds. This is equivalent to more than one per cent of the world's population of congregating freckled duck(*Stictonetta naevosa*), grey teal (*Anas gracilis*), pink-eared duck (*Malacorhynchus membranaceus*), red necked avocet (*Recurvirostra novaehollandiae*), sharp-tailed sandpiper (*Calidris acuminata*) and red-capped plover (*Anarhynchus ruficapillus*).[36] The Plan area also supports nine flow-dependent frog species that are wholly or partly reliant on flowing water for reproduction. This includes the NSW endangered southern bell frog (*Ranoidea raniformis*) and vulnerable Sloane's froglet (*Crinia sloanei*).[37]

There are many pressures on environmental values in the Plan area. Vegetation across the Plan area has declined in condition and extent due to a reduction in flood frequency and duration and an increase in land clearing. Frog populations are in decline across the Murray Lower Darling due to a range of pressures including hydrological change.[38] During the 2018-19 drought conditions and again in 2023 following a flood event, major fish deaths occurred in the natural drainage system of the Darling-Baaka's lowland catchment, also considered an endangered aquatic ecological community .[39] These events pose a significant threat to this ecological community and are a symptom of the stresses placed on this community by river regulation and development.

The Plan area includes nine LGAs (**Figure 2**), with a total population in 2021 of just over 120,000.[40] The upper catchment includes Berrigan Shire (pop. 8,768), Federation Shire (pop. 12,594), Albury City Shire (pop. 55,670) and Greater Hume Shire (pop. 10,883). The lower catchment includes Wentworth Shire (pop. 7,074), Central Darling Shire (pop. 1,812), Balranald Shire[41] (pop. 2,269), Murray River Shire (pop. 12,426) and Edward River Shire (pop. 9,073). By 2041, population growth is expected to be above the NSW average in Albury City Shire (1.6 percent), Berrigan Shire (0.61 percent) and Greater Hume Shire (1.07 percent).[42] At the same time, the townships of Menindee and Pooncarie are expected to experience negative population growth in future decades.

The Murray and Lower Darling rivers and Edwood and Wakool tributaries provide town water for several large centres and small towns across the Plan area. While town water is a relatively small proportion of total entitlement, the water supplies major regional centres such as Albury, Euston, Barooga, Deniliquin, Moama, Menindee, Pooncarie, Broken Hill and Howlong and is essential to community needs, socioeconomic prosperity and amenity. In 2019, the NSW Government established the Broken Hill pipeline and created a new licence under the Plan for Broken Hill to improve town water security.[43]

Although town water security in the Lower Darling-Baaka has improved with the construction of the pipeline, social impacts of low and cease-to-flow events in the Lower Darling-Baaka, recent fish kills and the impacts on the Menindee Lakes during the last drought have been felt strongly by local communities. Wentworth Council also raised the significant impacts on the community of Pooncarie due to poor connectivity and water quality and algal blooms in the Lower Darling water source (see **Chapter 10**).

36 DPIE (2020) *Murray-Lower Darling Long Term Water Plan Part A: Murray-lower Darling catchment*
37 *Ibid.*
38 *Ibid.*
39 NSW Department of Primary Industries (2007) *Endangered ecological communities in NSW: Lowland Darling River aquatic ecological community*
40 NSW Government (2024) *NSW Projections Explorer*
41 Note a proportion of Balranald Shire is situated in the Murrumbidgee Regulated water sharing plan area, which may affect population numbers.
42 NSW Government (2024) *NSW Projections Explorer*
43 Essential Water (2018) *Drought Management Plan for the water supply business in the Broken Hill Region*

Agriculture, forestry and fishing are the key industries across the region, with a gross value of production of nearly $2.2 billion,[44] and employing the highest percentage of persons across nearly all LGAs.[45] Balranald Shire had the largest percentage of people employed in agriculture at 34 percent. Healthcare and social assistance is the second highest employer across the region.[46] The large regional centre of Albury has broader industry employment, including retail. Irrigated agriculture is a significant contributor to local economies. The Murray Lower Darling is one of the larger irrigation areas in the Murray-Darling Basin, with a range of agricultural commodities produced including crops, livestock, dairy, fruit, nuts, grapes, and pastures for hay and silage.

Tourism is important to the local economy and is often linked to water availability. Inland waterways provide good locations for fishing, and national parks based on arid and wetland environments also attract tourists to the Lower Darling-Baaka.[47] In 2021, record numbers of visitors went to the region to see Menindee Lakes full for the first time in years. Many small townships play an important role in supporting tourism in the Western region by providing rest and re-supply opportunities. Water security and reliability are crucial for attracting people and businesses to the region and supporting the growing tourism industry.[48]

The diverse topography of the Plan area results in a large spatial variation in climatic conditions, ranging from temperate and alpine conditions in the east to semi-arid conditions in the west.[49] In the NSW Murray region, winter and spring rainfall and spring snowmelt provide critical inflows for Hume Dam. The Lower Darling-Baaka area is semi-arid with a highly variable climate, characterised by high summer temperatures, mild winters, low rainfall and very high evaporation rates.[50]

Rainfall in both water sources varies annually, with historical records for the Murray Water Source showing distinct dry and wet cycles, some spanning 10 to 20 years.[51] Persistent droughts in the Murray region have commonly and increasingly ended with significant rainfall events, including years of significantly above-average rainfall in 2010, 2016 and 2020.[52] Later in 2020 and beyond, the region experienced above-average rainfall and water storage in the southern Murray-Darling Basin significantly increased, declining from 37 percent in March 2020 to 69 percent at the end of November and spilling in 2022.[53]

The highest rainfall records for the Murray Water Source primarily occurred from the late 1940s to the early 1990s, a time of significant expansion in irrigated agriculture, as well as the wet period of 2010-2012.[54] Rainfall for the 18 months to October 2022 was recorded to be very much above average across much of the Murray Water Source[55] following a succession of *La Niña* events.[56]

44 Australian Bureau of Statistics (2021) Data by Region LGAs
45 *Ibid.*
46 *Ibid.*
47 MDBA (2022) *Lower Darling catchment*
48 DPE (2022) *Draft Western Regional Water Strategy – Consultation Paper*
49 *Ibid.;* DPE (2022) *Draft Regional Water Strategy – Murray*
50 DPE (2022) *Draft Western Regional Water Strategy – Consultation Paper*
51 DPE (2022) *Draft Regional Water Strategy – Murray*
52 DCCEEW (2024) *Baseline climate and hydrological assessment for the NSW Murray and Murrumbidgee regions - Regional Water Strategies Program*
53 *Ibid.*
54 DCCEEW (2024) *Baseline climate and hydrological assessment for the NSW Murray and Murrumbidgee regions - Regional Water Strategies Program*
55 Bureau of Meteorology (n.d.) *Recent and historical rainfall maps – provided for specified time period*
56 DCCEEW (2024) *Baseline climate and hydrological assessment for the NSW Murray and Murrumbidgee regions - Regional Water Strategies Program*

Climate records from the last 130 years indicate the Western Plan region has had lengthy dry and wet periods, including a comparatively dry period from the 1900s to 1940s, a comparatively wet period (1950s to 1990s), the Millenium Drought (2002-2010), followed by Tinderbox Drought (2017-2020), which saw a return to a mostly dry period for the first two decades of this century.[57]

Over the last 20 years, there has been a shift in the climate in the southern basin, with a trend of decreasing rainfall in autumn and early winter and an increase in temperatures.[58] The Millennium Drought was the longest and most severe drought recorded in the Murray Water Source, with inflows from 2006-2010 half of the previously recorded minimum.[59] The more recent Tinderbox Drought included one of the lowest 24-month rainfall periods across the region, with rainfall in the region 30 to 40 percent below average. The Tinderbox Drought took place against the backdrop of rising temperatures, increasing evaporation and record-low root-zone soil moisture.[60]

Similar shifts have occurred in the Lower Darling Water Source. Before 1940, the longest period the river stopped flowing at Walgett was for 270 days in 1902 and at Menindee Town/Weir 32 the river did not flow for 236 days in 1919-1920. In comparison, the river stopped flowing for 364 days at Walgett in the last drought.[61] The most recent drought has been the worst three-year drought on record and had significant impacts across the Western region, including no significant inflows into Menindee Lakes from 2017 to early 2020, with the lakes at less than 2 percent of capacity for over 12 months.[62] Issues related to the consideration of climate change in the Plan area are discussed in detail in **Chapter 4**.

57 DPE (2022) *Draft Western Regional Water Strategy – Consultation Paper*
58 DPE (2022) *Draft Regional Water Strategy – Murray*
59 *Ibid.*
60 DCCEEW (2024) *Baseline climate and hydrological assessment for the NSW Murray and Murrumbidgee regions - Regional Water Strategies Program*
61 DPE (2022) *Draft Western Regional Water Strategy – Consultation Paper*
62 *Ibid.*

4 Accounting for the impacts of climate change

Long-term water availability in the Plan area is projected to decrease as a result of climate change (**Section 4.1**). The Plan relies on historical datasets to make water management decisions, which is not best practice (**Section 4.2**). The Plan's provisions and objectives for adapting to climate change are limited, including how to prepare for or respond to the predicted impacts of climate change and improve system resilience (**Section 4.3**). Current approaches to manage water in the Plan:

- do not use best available evidence to guide decision making in water management
- do not convey risks of future water availability to water users, and how these risks are to be addressed and managed by the Plan
- rely on historical datasets to make water management decisions rather than building in climate change projections to better understand shifts in future water availability
- rely on Plan suspensions and Section 324 orders where water management based on historical datasets proves to be inappropriate based on climatic conditions.

While there will always be a need for adaptive action, water sharing plans and decision-making should better reflect future climate change projections, recognising that such an approach will provide for improved transparency of changes in seasonal water reliability for water users.

The revised Plan should better consider climate change given the projected changes in rainfall patterns and associated reduced runoff, temperature increases and higher rates of evapotranspiration.[63] Plan revisions should:

- ensure the Plan can achieve its desired outcomes given the projected changes to water availability informed by climate and hydrological modelling
- consider how water will be managed and shared equitably among all users, including the environment, as levels of water availability change with continuing or growing demand on water resources
- provide transparency and certainty for water users on how water will be managed under a future with reduced water availability.

4.1 Rainfall and water availability is projected to change

As part of the draft *Regional Water Strategy*, the Water Group undertook significant work around understanding projected climate change impacts in the Plan area, and the potential impacts to valley storages and water availability. The climate change modelling looked at three plausible climate scenarios and their respective implications for regional water resources:

- historical climate (approximately 130 years)
- long-term historical climate (10,000 years generated stochastically from 500 years of reconstructed paleoclimate data)

63 DCCEEW (2024) *Baseline climate and hydrological assessment for the NSW Murray and Murrumbidgee regions - Regional Water Strategies Program*

- dry future climate (20 years of climate model projections downscaled under the NSW and ACT Regional Climate Modelling Project (NARCliM 1.0 project)[64] (see **Box 1**).[65]

As part of the draft *Regional Water Strategy*, the Water Group also developed an interconnected model for the southern connected system, allowing for feedback loops between the Murray/Lower Darling, Murrumbidgee and Snowy models as part of the climate scenario modelling.[66]

The dry future climate scenario is the only scenario to include climate change modelling. The other two scenarios use historical datasets. The Commission does not support the use of historical climate data as the only means to project and develop water management strategies under a changing climate in the Plan area in future years (see **Chapter 4.2**).

The Commission has presented the results of the Water Group-assessed climate scenarios where this information is available. Where data was unavailable across the suite of climate scenarios, the Commission has clarified whether data from scientific publications was used. There are a range of climate models and climate scenarios being used to project climate change impacts, many of which can be extrapolated to the Plan area and have been published in scientific literature. The Commission has not sought to identify the 'best' climate change projection as part of the review, recognising that across the international scientific community there is no consensus on a single set of 'best' models, scenarios or techniques.

Assessing impacts on water availability using the historic, paleoclimatic and dry future climate scenarios[67] is a more robust approach to understand potential climate change impacts, as it can highlight potential risks to future water availability according to the 'baseline' using the historic climate scenarios and climate change using the dry future climate scenario.

By 2079, under the dry future climate scenario, catchments in the NSW Murray region could experience:

- changing rainfall patterns – with decreases in average winter rainfall of around 20 percent and an increase in summer rainfall of up to 17 percent[68]
- higher evapotranspiration – annual average evapotranspiration could increase by up to 5 percent.[69]

64 NARCliM 1.0 uses four global climate models, that are regionally downscaled using three regional climate models. All regional climate model simulations were performed at 10-kilometre resolution over Southeast Australia, embedded within the 50-kilometre resolution domain of the CORDEX Australasia region. Simulations were run for three 20-year periods: the recent past (1990–2009), near future (2020–2039) and far future (2060–2079) using the SRES A2 scenario. Taken from: Nishant, N, Evans, JP, Di Virgilio, G, Downes, SM, Ji, F, Kevin, KW, Cheung, KKW, Tam, E, Miller, J, Beyer, K, and Riley, M (2021) 'Introducing NARCliM1.5: Evaluating the Performance of Regional Climate Projections for Southeast Australia for 1950–2100', *Earth's Future*, 9.

65 Limitations and assumptions identified by the climate change modelling undertaken as part of the draft regional water strategies include: uncertainty in the climate and hydrological modelling meaning that trends identified cannot be used as firm predictions; and that the hydrological models used cannot reliably assess flood impacts and do not represent groundwater resources. Further limitations of the models used are outlined in DCCEEW (2024) *Baseline climate and hydrological assessment for the NSW Murray and Murrumbidgee regions - Regional Water Strategies Program*

66 DPE (2022) *Southern basin regional water strategy modelling - Factsheet*

67 This approach was undertaken by the Water Group through the regional water strategies.

68 DCCEEW (2024) *Baseline climate and hydrological assessment for the NSW Murray and Murrumbidgee regions - Regional Water Strategies Program*

69 *Ibid.*

Box 1: Background on the climate scenarios developed for the draft *Regional Water Strategy*[70]

Climate datasets and hydrological modelling developed for the draft regional water strategy program provide an updated understanding of the climate variability in the Murray and Lower Darling regions beyond recorded historical data.[71]

The historical climate scenario is based on approximately 130 years of recorded daily rainfall, temperature and evaporation data for 1889–2020. The scenario is useful to build an understanding of how the Plan responds under a repeat of recorded climate conditions.[72]

The long-term historical climate scenario is derived stochastically from historical daily climate data and reconstructed paleo climatic information. For example:

- 500 years' worth of climatic patterns detected in paleo records such as tree rings, river sediments, cave deposits and ice cores. This data shows that longer and deeper droughts have occurred prior to observed climate data as well as stronger wet periods, compared with the instrumental record
- records and scientific understanding about major climate drivers for the southern Murray-Darling Basin, including the Inter-Decadal Pacific Oscillation Index.

This scenario is useful to help understand how regional water resources would respond under a repeat of the extremes of droughts and wet periods that are possible in the historical record, based on the long-term past.[73]

The dry future climate scenario uses regionally downscaled, un-bias corrected, global climate model data from the NARCliM 1.0 project.[74] NARCliM 1.0 uses the 2010 Intergovernmental Panel on Climate Change Special Report Emissions Scenario (SRES) A2.[75] This scenario equates to approximately a 2.2 degree increase in average global temperature by 2079 (relative to 1980-1999). SRES A2 represented the most likely future scenario at the time of NARCliM 1.0 development, based on global emissions trajectory, and rate of population growth, economic growth and technological change.[76] The dry future climate scenario supports an understanding of how a drying climate would impact regional water resources and the performance of options identified for regional water strategies.

70 *Ibid*.
71 *Ibid*.
72 *Ibid*.
73 *Ibid*.
74 *Ibid*.
75 The Commission is aware that there have been updates to improve performance of NARCliM 1.0 to provide a continuous simulation as opposed to three simulations across 20-year periods, and to incorporate more than one emissions scenario SRES A2. This update is available as NARCliM version 1.5 and version 2.0. Further details on NARCliM 1.5 performance are available at Nishant, N, Evans, JP, Di Virgilio, G, Downes, SM, Ji, F, Kevin, KW, Cheung, KKW, Tam, E, Miller, J, Beyer, K, and Riley, M (2021) 'Introducing NARCliM1.5: Evaluating the Performance of Regional Climate Projections for Southeast Australia for 1950–2100', *Earth's Future*, 9; Further details on NARCliM 2.0 available at AdaptNSW (n.d.) *NARCliM2.0 is now available*; AdaptNSW (n.d.) *Climate Projections used on AdaptNSW*
76 AdaptNSW (n.d.) *Climate Projections used on AdaptNSW*; The SRES A2 has been identified as business as usual according to Nishant, N, Evans, JP, Di Virgilio, G, Downes, SM, Ji, F, Kevin, KW, Cheung, KKW, Tam, E, Miller, J, Beyer, K, and Riley, M (2021) 'Introducing NARCliM1.5: Evaluating the Performance of Regional Climate Projections for Southeast Australia for 1950–2100', *Earth's Future*, 9.

The implications of the dry future climate scenario compared to the historic scenarios in the NSW Murray Regulated Water Source is that, by 2079, the catchment could experience:

- reduced median daily flow at Doctors Point near Albury – the scale of reductions is more substantial for the dry future climate scenario (38 percent) when compared to the long-term historical scenario (no increase)[77]
- lower inflows into the NSW share of the shared Murray system storages, including significant reductions in inflow across much of the year, with the most impact experienced in the winter/spring traditional dam-filling period, compared to the historical and long-term historical scenarios (which are broadly similar)[78]
- a reduction in water availability for water entitlement holders – general security entitlement at the end of the average water year would reach 100 percent allocation approximately 20 percent of the time under the dry future climate scenario (compared to 60 percent under historical and long-term historical scenarios),[79] and high security entitlement would exceed 97 percent allocation 20 percent of the time under the dry future and historical climate scenario, and 70 percent of the time under the long-term historical climate scenarios[80]
- risks to town water supply – modelling has identified that Albury, Corowa, and Murray River Council may face water supply issues under a dry future climate scenario (see **Chapter 10**).

By 2079, under the dry future climate scenario, catchments in the Western region including the Lower Darling Regulated Water Source could experience:

- changes in rainfall patterns – average rainfall is projected to decrease in most months except February to April[81]
- higher evapotranspiration – potential evapotranspiration could increase by up to 5 percent, with the largest increases in winter and spring
- higher minimum and maximum temperatures – minimum and maximum temperatures are expected to increase by an average 2.1 degrees.[82]

The implications of the dry future climate scenario compared to the historic scenarios in the Lower Darling Regulated Water Source is that, by 2079, the catchment could experience:

- the number of freshes occurring every year is predicted to decrease by 32 percent and the duration of these flows when they do occur is expected to decline by 19 percent[83]
- there could be a 15 percent reduction in the frequency of average (1,000 ML per day) flow events in the Great Darling Anabranch[84]
- there could be a around a 22 percent increase in the time that the Menindee Lakes are under NSW control (i.e. when the volume in the lakes falls below 480 GL)[85]

77 DCCEEW (2024) *Baseline climate and hydrological assessment for the NSW Murray and Murrumbidgee regions - Regional Water Strategies Program*
78 *Ibid.*
79 *Ibid.*
80 *Ibid.*
81 DPE (2022) *Draft Western Regional Water Strategy – Consultation Paper*
82 *Ibid.*
83 DPE (2022) *Draft Western Regional Water Strategy – Attachment A: Background on the Western region, its water resources and climate*
84 *Ibid.*
85 *Ibid.*

- increased probability of the most recent drought (2017-2020) reoccurring, with no inflows into Menindee Lakes for 3 years or more[86]
- risks to town water supply – modelling has identified that Pooncarie may face water supply issues under a dry future climate scenario (see **Chapter 10**).

Changes in rainfall and evapotranspiration patterns may affect agricultural operations and crop selection, industry, town water supply, total dam inflows and the ability to optimally manage environmental releases across the Plan area.[87]

While the modelling work undertaken by the Water Group through the draft *Regional Water Strategy* provides projections beyond the scope of the Plan's ten-year term, it represents a substantial step forward and provides some transparency to stakeholders regarding potential risks to future water availability.

While the current projections describe the water availability challenges to 2079, the Commission has sought to highlight the importance of commencing management under a shifting climate in the next decade of the Plan.

Providing information on the potential hydrological impacts, based on the climate scenarios, allows water users to assess risks based on their reliance on river flows for basic landholder rights, and water access licence allocations. While the draft *Regional Water Strategy* provided transparency for licence holders regarding potential risk to water allocations under the dry future climate scenario, it did not identify the risks to delivery of planned environmental water.

Assessing potential environmental impacts is an important gap that requires clarification to ensure that the Plan can effectively achieve environmental outcomes under a future with reduced water availability.[88] The Commission understands that entitlement holders are better protected from the risk of climate change under water sharing plans, with larger risks of reduced water availability borne by planned environmental water, including water remaining in the system after water has been taken pursuant to basic landholder rights and access licences.[89]

As such, it is necessary to also model the impacts of the scenarios on the volumes of planned environmental water to identify where risks are exposed to water delivery, and as a result the environmental outcomes that can be achieved by the Plan. This will expose the risks to planned environmental water, and potentially identify the need for changes in management approaches or where Plan provisions may need to be revised to mitigate impacts to the environmental assets in the Plan.[90]

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86 DPE (2022) *Draft Western Regional Water Strategy – Consultation Paper*

87 DCCEEW (2024) *Baseline climate and hydrological assessment for the NSW Murray and Murrumbidgee regions - Regional Water Strategies Program*; DPE (2022) *Draft Western Regional Water Strategy – Consultation Paper*

88 DCCEEW (2024) *Baseline climate and hydrological assessment for the NSW Murray and Murrumbidgee regions - Regional Water Strategies Program*

89 Young, WJ, Bond, N, Brookes, J, Gawne, B and Jones, GJ (2011) *Science Review of the Estimation of and Environmentally Sustainable Level of Take for the Murray-Darling Basin*, a report to the MDBA from the CSIRO Water for a Healthy Country Flagship.

90 The Commission recognises that the Basin Plan scenario modelling was determined by simulating a reduction in consumptive water use and making an equivalent volume of water available for environmental use within the water sharing, water management rules and constraints prescribed under baseline conditions. Taken from MDBA (2012) *Hydrologic modelling to inform the proposed Basin Plan – methods and results*. Climate change impacts on planned environmental water may as such impact the effectiveness of any water recovery and the environmental outcomes that can be achieved through held environmental water. This has been highlighted by the CEWH: '*Water resource plan requirements under*

Recommendation R2 (LT) – Priority 1

To identify where Plan environmental rules may be at risk of failing to deliver on their required purpose under changing water availability, the Water Group should model impacts under the baseline scenario (historical climate scenario) and climate change scenarios. The Water Group should revise Plan provisions, where this is required, to maintain environmental outcomes.

4.2 The Plan only uses historic data to inform water management

Historically, water management decisions were made based on the best available observed climate and hydrological records. In the Plan area, hydrological models are calibrated and validated on historical data, thereby building into these models fixed representation of climate and hydrological processes. The Water Group advised that it uses the historic record when reviewing any Plan changes or water management decisions.

The use of historical data to underpin future water management relies on the assumption of 'stationarity', i.e., '*that natural systems will continue to fluctuate with an unchanging envelope of variability*'.[91] However, improved understanding of climate and hydrological sciences, including climate change impacts, calls in to question this assumption, as it is now known that changes to climate and hydrological relationships occur that modify the envelope of variability in ways not seen in the historic record.

These changes can impact, among other things, average and extreme rates of precipitation, evapotranspiration, rainfall-runoff relationships, and system losses during water delivery and changes to patterns of water delivery.[92] Limitations of the assumption of stationarity point towards the need for historical data to be considered in conjunction with climate change projections, to reflect and account for changes to climate non-stationary processes. This is particularly important where climate projections indicate water availability will shift beyond the historically predicted pattern of variability.

Hydrological systems can undergo abrupt shifts in their dynamics due to non-stationary tipping points. This means that hydrological models that have been calibrated and validated using historical data may not adequately simulate the flow volumes and runoff characteristics of climate events outside those that they have been tested on. Regular hydrological model evaluations and recalibrations are required to ensure the representation of hydrological relationships continue to be appropriate i.e., based on up-to-date data.

For example, the runoff decline during the Millennium Drought was unprecedented in the instrumental historical record.[93] The reduction in runoff was caused not only by lower

the Basin Plan (Section 10.26) stipulate that water resource plans must be consistent with the environmental watering plan and the Basin-wide environmental watering strategy. Any reduction of planned environmental water undermines the foundation of the Basin Plan and would require greater volumes of held environmental water to be recovered to meet the minimum set environmental objectives' (CEWH (2017) *Inquiry into the management, governance and use of environmental water*, Submission 7.

91 Milly, P, Betancourt, J, Falkenmark, M, Hirsch, RM, Kundzewicz, ZW, Lettenmaier, DP, and Stouffer, RJ, (2008) 'Stationarity Is Dead: Whither Water Management?', *Science*, 319, pp. 573-574.

92 *Ibid*.

93 Chiew, FHS, Potter, NJ, Vaze, J *et al*. (2014) 'Observed hydrologic non-stationarity in far south-eastern Australia: implications for modelling and prediction', *Stoch Environ Res Risk Assess*, 28: 3–15; Potter, NJ, Chiew, FHS and Frost, AJ (2010) 'An assessment of the severity of recent reductions in rainfall and runoff in the Murray–Darling Basin', *Journal of Hydrology*, 381:1–2, pp. 52-64

annual rainfall but also by changes in other climate characteristics[94] and dominant hydrological processes.[95] The challenges of managing the system under such a scenario is demonstrated in the Plan being suspended from 10 November 2006[96] to 19 August 2011.[97] The Commission notes that the Plan was not suspended during the review period.[98]

The use of historical data to predict future water availability in the Plan highlights large differentials when compared with trends in water availability under the long-term historical scenario and dry future climate scenario.[99] This results in potential overestimation of water availability where hydrological models only use the historical dataset. This may increase the need for Plan suspensions or temporary water restrictions, where inflows in the Plan area fall outside the range identified in the historical record (see **Chapter 4.3**).

It is no longer best practice to use historical data as the sole basis for projections of future water availability. There is consensus from a range of climate change models that the Murray and Lower Darling water sources will experience reduced runoff, changed rainfall patterns and increased evapotranspiration (see **Chapter 4.1**). Where these changed climatic conditions occur, and are unprecedented against the historical dataset, there may be a greater need for use of Plan mechanisms that do not provide longer-term signals on water availability, such as Section 324 orders or Plan suspensions.

Extreme events beyond those experienced in the historic record are expected to occur under climate change and management frameworks should be adapted to reflect and respond to these events. The Water Group should update approaches to water management decision-making, such as water allocations, to factor in current climate change projections, including evidence of climate and hydrologic non-stationarities.[100] The Commission notes that this is consistent with the *NSW Water Strategy*, which seeks under Priority 4 to undertake water resource management using '*the most up-to-date understanding of climate, including climate change and associated risks to water resources. This understanding is reflected in strategic planning and supports water management decisions.*'[101]

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94 Lack of any high rainfall years, change in rainfall seasonality and higher temperatures.

95 Reduced surface–groundwater connection and farm dams intercepting proportionally more water during dry periods (*Ibid.*).

96 *Government Gazette 137, Friday 10 November 2006*

97 *Government Gazette 90, Friday 16 September 2011*

98 The Tinderbox Drought (2017-2020) led to the Murray region of the Plan area being declared to be in 'Stage 2 – emerging drought' from May 2019 to July 2020 (see DPI (2021) *Murray Valley snapshot (2017-2020 drought)*). During this time general security licence holders received a zero percent allocation. In July 2020 the Murray Regulated Water Source drought stage was eased to Stage 1 – Normal Operations. The opening general security allocation was zero percent, but this increased to 2 percent later in the month. The Lower Darling region of the Plan area was declared to be in 'Stage 3 – severe drought' from October 2018 to December 2018; Stage 4 – Critical Drought from December 2018 to March 2019; eased to Stage 3 in April 2019; eased further to Stage 2 – Emerging Drought in May 2020 to March 2021; and finally to Stage 1 – Normal Operations in April 2021 (see DPI (2021) *Lower Darling snapshot (2017-2020 drought)*). As of July 2018, general security allocations were zero percent. In December 2018 a temporary water restriction was placed on all general security access licences. In March 2020 the temporary water restriction on general security access licences was repealed.

99 As highlighted through the climate change scenario modelling work undertaken for the regional water strategies.

100 Chiew, FHS, Potter, NJ, Vaze, J *et al*. (2014) 'Observed hydrologic non-stationarity in far south-eastern Australia: implications for modelling and prediction', *Stoch Environ Res Risk Assess*, 28: 3–15; Milly, P, Betancourt, J, Falkenmark, M, Hirsch, RM, Kundzewicz, ZW, Lettenmaier, DP, and Stouffer, RJ (2008) 'Stationarity Is Dead: Whither Water Management?', *Science*, 319, pp. 573-574; DCCEEW (2024) *Baseline climate and hydrological assessment for the NSW Murray and Murrumbidgee regions - Regional Water Strategies Program*

101 DPIE (2021) *NSW Water Strategy*

The Commission acknowledges that it is a substantial shift for the Water Group to move towards an approach that incorporates both historical data and climate change projections in water management decision-making, and that there are complexities of such an approach. As such, the Commission has not sought to identify the best path forward, recognising the challenges in implementation. However, using different operating rules for different conditions, i.e., rules that can be implemented under predicted wet versus predicted dry climatic conditions, may be warranted.

The Water Group advised that it will be commencing several projects considering how climate change and climate change variability is integrated within the water sharing plan framework. This includes commitments made under the review of the lowest accumulated inflows. At the time of this review, these initiatives had not been commenced by the Water Group.

Recommendation R3 (LT) – Priority 1
In recognition of the potential future shifts in climatic conditions, the Water Group should incorporate climate change projections into decision making and shift away from the use of historical data as the sole basis for water management decisions.
Recommendation R4 – Priority 2
To ensure that the modelled representation of hydrological processes reflects any observed changes over time, the Water Group should ensure the hydrological model is validated and recalibrated at least once every five years.

4.3 Provisions for climate change adaptation are limited

The Plan's provisions and objectives for climate change adaptation are limited, including how to prepare or respond to predicted impacts and improve resiliency for water users and the environment. Current Plan provisions that potentially allow for consideration of climate change include a review of the lowest accumulated inflows used for the AWD process. Shortcomings of the Plan include use of historical data in water management decisions, and a lack of climate change objectives to track the performance of the Plan.

Clause 66 of the Plan commits to a review of the lowest accumulated inflows by 30 June 2026.[102] Lowest accumulated inflows form a critical component of the allocations process and how water is shared by water users within the system (**Chapter 6**). The inclusion of Clause 66 in the Plan recognises that the use of the historical dataset as a means to define the lowest accumulated inflows in the Plan is no longer best practice. However, it is not clear how the review will factor in climate change projections, or the improved understanding of changes to water availability.[103]

Clause 66(5) of the Plan specifies that any changes made as a consequence of the review, '*cannot substantially alter the long-term average annual amount of water able to be extracted under water access licences*'. The Commission does not support this clause, which is in direct contrast to best available evidence of future water availability in the Plan area. Currently, evidence points towards a need to manage water under a future of reduced water availability. This clause is inconsistent with the water sharing principles of the Act

[102] Clause 66 of *Amendment Order 2022* of the Plan.
[103] An improved understanding was developed as part of the regional water strategies and via the broader scientific literature.

and may therefore be invalid (see **Chapter 6**). Further, Section 59 of the Act gives the Minister full discretion for how to determine AWDs. Clause 66(5) would appear to 'fetter' the Minister's discretion, which may also make the clause invalid.

As part of the lowest accumulated inflow review, the Water Group should revise Clause 66(2), which restricts the operator to managing '*the water supply system in such a way that water would be able to be supplied during a repeat of the period of lowest accumulated inflows*'.[104] Given this provision is to ensure supply to high priority licence categories, including town water supply, best practice decision-making should be integrated into system operation. The Commission would support the revision of this Plan provision to require the operator to manage the water supply system consistent with expected climate and hydrologic conditions.

The NSW Government's *Extreme Events Policy*[105] and *Incident Response Guide*[106] outline how water allocations will be prioritised in periods of drought or unacceptable water quality. This policy and guide represent a substantial improvement on earlier arrangements, with no prior transparency on how water is prioritised during periods of water scarcity. However, in its current form, it acts as a reactive policy for individual events to account for climate variability, not projections of climatic conditions that may occur because of climate change.[107]

The historically unprecedented events that have been managed using the *Extreme Events Policy*, Plan suspensions and Section 324 orders are expected to occur with greater frequency in future years if the management approach is not changed. While there will always be a need for adaptive management, and tools to allow decision-makers to manage to the prevailing climatic conditions, the use of historical datasets to make decisions may result in the more frequent triggering of these water management mechanisms. This approach does not provide the certainty for water users that was intended under the water sharing plan framework. The Plan provisions should enable the management of projected reductions in water availability due to climate change, with decision-making using historical datasets and climate change projections to provide transparency to water users of seasonal water availability.

The long-term extraction limit recognises the effect of climatic variability on the availability of water, in accordance with Section 20(2)(c) of the Act.[108] However, it is not based on a determination of the volume of water needed to protect the environment and dependent ecosystems and is based on a subset of historic data excluding the Millenium and Tinderbox Droughts. The LTAAEL and planned environmental water provisions should be based on an assessment of environmental needs and reflect environmental water needs under current and future climate conditions. The shortcomings of some of the current environmental Plan rules are outlined in **Chapters 7** and **8**.

Additionally, the LTAAEL should factor in the full suite of climate scenarios and recognise that the future climate is uncertain and further work is required to mitigate against a changing climate. This should be part of an adaptive management approach. The Plan maintains the water above the LTAAEL is identified as planned environmental water for the

104 Minimum inflows are defined by information held by the Water Group prior to 1 July 2004 and as such remove the impact of new record lowest accumulated inflows that occurred during the Millenium and Tinderbox droughts.
105 DPE (2023) *Extreme Events Policy*
106 DPIE (2020) *NSW Murray and Lower Darling Surface Water Resource Plan Incident Response Guide – Schedule G*
107 NSW DPE (2023) *Extreme Events Policy*
108 Note 4 in Clause 27(4) of the Plan.

environment. However, if the LTAAEL is based on extraction from a period with greater water availability than is likely in the future, there is a risk that less water will be available for the environment (see **Chapters 5** and **6**).

The Commission recognises that the Plan sits within the broader umbrella of the Basin Plan, where long-term average sustainable diversion limits took into consideration an assessment of the environmentally sustainable level of take.[109] The environmentally sustainable level of take was informed by detailed hydrological modelling.[110] However, the legislated sustainable diversion limits were not based on scientific determinations of environmental needs[111] and do not achieve the majority of the hydrological targets required to represent a 'sustainable level of take'.[112] In addition, climate change was not accounted for in the sustainable diversion limits.

The Basin Plan's strategy for addressing reduced water availability includes adapting to future changes through regular monitoring and review, for example:

- the 2026 Basin Plan review must have regard to climate change risk management
- regular review of the environmental watering priorities (annually) and environmental watering strategy (at least five-yearly), which may be updated at any time
- the 2026 review of the Basin Plan includes evaluation criteria for protection of water-dependent ecosystems including resilience to climate change.[113]

It is best practice to manage water availability using best available information, including incorporating climate change projections and historical datasets in water management decision making. Building this into the Plan will provide transparency for water users.

Recommendation R5 – Priority 2

The Water Group should:

a) provide transparency on how climate change will be considered in redefining the lowest accumulated inflows

b) revise Clause 66(2) to reflect that operations should be able to deliver higher priority needs based on projected climate and hydrologic conditions

c) following the review of the period of lowest accumulated inflows, notify licence holders of potential reductions in the long-term average annual extraction that may occur as a result of climate change impacts.

109 MDBA (2011) *The proposed 'environmentally sustainable level of take' for surface water of the Murray-Darling Basin: Method and outcomes*

110 MDBA (2019) *Climate change and Murray-Darling Basin Plan, MDBA Discussion Paper*

111 Walker, B (2019) *Murray-Darling Basin Royal Commission Report*

112 Young, WJ, Bond, N, Brookes, J, Gawne, B, and Jones, GJ, (2011) *Science Review of the estimation of an environmentally sustainable level of take for the Murray–Darling Basin*. A report to the Murray-Darling Basin Authority from the CSIRO Water for a Healthy Country Flagship.

113 Adapted from Figure 7 of MDBA (2019) *Climate change and Murray-Darling Basin Plan, MDBA Discussion Paper*

5 Ensuring sustainable extraction

A fundamental role of a water sharing plan is to establish limits on the volume of water that can be extracted by licensed users. The Plan contains two limits, which operate concurrently: the NSW limit established through the LTAAEL; and the Basin Plan limit established through the SDL.

Setting these limits is critical. An extraction limit that is too high will potentially not set aside adequate water for the environment and may limit the ability of the Plan to meet the key requirements of the Act.[114] Overly restricting extractions may limit water users' ability to use available water resources and impact the economic and social opportunities within Plan communities.

The SDL and LTAAEL are defined and assessed differently. They:

- cover different water sources
- have different water use exclusions
- are assessed using different approaches with different compliance triggers.

The Water Group's extraction limits document[115] provides a detailed comparison of the SDL and LTAAEL and outlines how compliance with the limits is assessed and the key differences between the limits.

SDLs are reviewed through other Murray-Darling Basin processes, with past reviews undertaken by MDBA and the CSIRO. This chapter focuses on the NSW Murray and Lower Darling Regulated Rivers LTAAELs, as these represent the extraction limits devised and specified by NSW in the Plan. Key issues identified regarding the Plan LTAAELs include that:

- LTAAELs are not based on an assessment of environmental sustainability (**Section 5.1**)
- LTAAEL compliance is not transparent or based on actual extraction data (**Section 5.2**)
- Extraction limit compliance actions may impact environmental outcomes (**Section 5.3**).

5.1 LTAAELs are not based on an assessment of environmental sustainability

The LTAAELs are not based on an evaluation of environmental needs. There has not been a specific assessment of whether the Plan's LTAAELs meet the objects of the Act, including protecting the health of water-dependent ecosystems. As outlined in Plan provisions, the LTAAELs represent the total long-term extractions that could occur at specific points in time based on levels of development and water management rules. This is useful for identifying whether there has been growth in extractions above what occurred historically but does not limit extractions to levels that ensure achievement with the Plan's objectives.

It is the Commission's understanding that these LTAAELs were set in 2004 as an interim Cap only, to prevent further growth in water use and ensure that the health of water

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114 Section 5 (3) of the Act states that '*In relation to water sharing —*
(a) sharing of water from a water source must protect the water source and its dependent ecosystems, and
(b) sharing of water from a water source must protect basic landholder rights, and
(c) sharing or extraction of water under any other right must not prejudice the principles set out in paragraphs (a) and (b)'.

115 DPIE (2021) *Extraction Limits – How the extraction limits work and differences*

sources and their dependent ecosystems did not deteriorate further. The intention was that these interim limits would be assessed and revised over time as better information became available to assess their sustainability and adequacy for meeting the objectives and priorities of the Act. However, a sustainability assessment has never been undertaken for the LTAAELs. The Commission's view is that the LTAAELs should be based on a maximum level of extraction that protects, over the long-term, the water source and its dependent ecosystems in addition to the Plan's environmental, social and cultural objectives.

Further, the extent to which the long-term average annual flow is being preserved in the Plan, and any impact of current river operational rules on the 'surplus' water made available for the purpose of ecosystem health, is yet to be established. Stakeholders have previously stated that river operations have shifted in recent years, with rivers being run to more efficiently deliver water to irrigators. This may be a reflection of the *WaterNSW Act 2014*, which defines the functions and objectives of WaterNSW, where a principle objective is '*to capture, store and release water in an efficient, effective, safe and financially responsible manner*'.[116] This legislative driver for efficiency by the river operator may potentially result in less 'surplus' water for the environment. As highlighted in **Chapter 4** projected reductions in inflows due to climate are more likely to impact on environmental surplus water rather than reductions in water made available for extraction.

The environmental flow rules and the EWA are excluded from the LTAAEL. The adequacy of these rules to meet the requirements of the environmental assets in the Plan is discussed in **Chapter 7**, with the Commission noting that several improvements could be made to achieve improved environmental outcomes.

To address these issues, the Water Group should undertake a scientifically based process to identify the needs of the water sources and their dependent ecosystems and establish LTAAELs based on protecting these needs from extraction. Environmental water requirements established under the Long Term Water Plan provide the best available scientific evidence on these needs.[117] In addition, the LTAAELs should be responsive to the potential impacts of climate change outlined in **Chapter 4**.

The LTAAELs establish limits on extractions under the Plan and are a key component to measure if the economic and environmental objectives are achieved.[118] The legislative settings for establishing the LTAAELs are set out in the Act[119] and the Plan.[120]

The LTAAELs are not fixed numbers but are assessed using models. They vary as additional years are added to the simulation and as model or scenario updates incorporate best available information. This is because the LTAAELs are estimated under Plan provisions[121]

116 Section 6(1a) of the *WaterNSW Act 2014*.
117 DPIE (2020) *Murray-Lower Darling Long Term Water Plan Part B: Murray-Lower Darling planning units*
118 See Clauses 8(1), (3), and 9(1-3) of the Plan.
119 Section 8F requires the auditing of compliance with the long-term extraction limit under a water sharing plan; Section 20(2)(a) requires the bulk access regime established by a water sharing plan to recognise and be consistent with any limits to the availability of water that are set (whether by the relevant management plan or otherwise) in relation to the water sources to which the regime relates; and Section 8(1A)(b) requires a water sharing plan to commit water as planned environmental water in at least two ways, including by reference to the long-term average annual commitment of water as planned environmental water.
120 Clause 12 of the Plan establishes the components of the bulk access regime, whereby water allocations are to be adjusted where there is an increase in the LTAAEL; Clause 16 of the Plan sets out provisions impacting the establishment and maintenance of planned environmental water where any water not committed beyond the LTAAEL or as planned environmental water due to provisions outlined in the Plan is to be available for environmental outcomes; Clause 27 to 29 sets out the inclusions, exclusions, calculation and assessment of LTAAEL along with Clause 33 that outlines actions to be taken where there is a non-compliance with LTAAEL.
121 DPIE (2021) *Extraction Limits – How the extraction limits work and differences*

as the long-term average extraction simulated by a hydrological computer model approved by the Minister.[122] The Plan outlines that the LTAAELs are to be calculated and assessed for compliance for each water source separately.

The Murray Water Source extraction limit is the lesser of long-term annual extractions that are simulated to occur under two modelled scenarios that represent levels of development, water use behaviour and water management rules that existed at specific points in time, minus 17,800 ML per year:[123]

- **Cap conditions scenario** – generally reflects irrigation development, operation and management rules as at 1993/94[124]
- **Plan conditions scenario** – reflects water storages and water use development in place in the 2000/01 water year; basic landholder rights and access licence share components in place on 1 July 2004;[125] Plan rules in place on 1 July 2004; and the level of development of plantation forestry in place on 1 July 2009.[126]

The Lower Darling Water Source extraction limit is the lesser of the long-term average annual extraction from the two model simulations, minus 35,500 ML per year.[127] The requirements are the same as the Murray water source except the basic landholder rights and access licence share component that existed on 1 July 2004 is increased by 47,800 unit shares.[128] The reductions to the LTAAEL volumes (i.e. minus 17,800 ML per year and minus 35,500 ML per year) represent the volumes of water that have been committed as environmental water under the Act, which does not count towards extraction limits.

- **Plan conditions scenario** – reflects water storages and water use development in place in the 2000/01 water year; basic landholder rights and access licence share components in place on 1 July 2004;[129] Plan rules in place on 1 July 2004; and the level of development of plantation forestry in place on 1 July 2009.[130]

The Plan establishes that the LTAAEL for each water source is to exclude:

- share components of access licences under a 71U dealing
- allocations assigned under a 71T or 71V dealing into the Plan area

122 Clause 27(4) of the Plan.

123 The 17,800 ML per year subtracted under Subclause (2) is the estimated long-term extraction associated with the 100,000 unit shares of supplementary water access licence purchased under the Living Murray Program. The taking of water under this licence will not be accounted for against the long-term average annual extraction limit.

124 The Cap represents the target established under the Murray Darling Basin Agreement, which is used to manage diversions (or extraction) to levels occurring with 1993/94 irrigation infrastructure and management rules; Under the Cap, Basin states, including NSW, provided data to the MDBA on the volume of water taken each year compared to the annual Cap targets. The MDBA then assessed whether extractions were less than or greater than the annual Cap target. Compliance action was taken where there was a debit of 20 percent or more against the long-term Cap limit. With the introduction of water resource plans, States will transfer from Cap compliance to reporting on SDL. SDL compliance responsibilities have moved to the Inspector-General of Water Compliance from the 2020-21 water year (MDBA (n.d.) *Compliance with limits on water use*); Cap compliance reporting will remain in force until it is repealed by the Murray Darling Basin Ministerial Council. When it is repealed, the LTAAEL will still need to be less than or equal to the Cap (DPIE (2021) *Extraction Limits – How the extraction limits work and differences*).

125 This represents the version of the Plan that was in place as at 1 July 2004.

126 See Clause 27 of the Plan.

127 The 35,500 ML per year is the estimated long-term extraction associated with the 250,000 unit shares of supplementary water access licence purchased under the Living Murray Program. The taking of water under this licence will not be accounted for against the long-term average annual extraction limit.

128 Clause 27 (3)(ii). The 47,800 unit shares were issued after July 2004 as part of the arrangements that replaced the replenishment flow provisions for the Great Darling Anabranch.

129 This represents the version of the Plan that was in place as at 1 July 2004.

130 See Clause 27 of the Plan.

- water for the environment as outlined in the environmental flow rules (River Murray Increased Flows) and EWA rules.[131]
- the supplementary water access licence purchased under the Living Murray Program.[132]

The Act further stipulates that water savings in a system and water committed as licensed environmental water under the Act[133] is not to be factored into the extraction limit.[134] The Commission notes that the majority of held environmental water has not been committed as licenced environmental water under the Act.[135]

Recommendation R6 (LT) – Priority 1

The Minister should require the Water Group to develop and adopt a sustainable LTAAEL that:

a) sets aside the water required to protect the water source and its dependent ecosystems

b) enables the achievement of the Plan's environmental, social and cultural objectives

c) establishes a limit framework that is responsive to the impacts of climate change

d) is not reliant on the SDL to achieve the Plan's environmental outcomes.

5.2 LTAAEL compliance is not transparent or based on actual extraction data

The Water Group is responsible for implementing LTAAEL provisions in the Plan, including annual assessments of compliance with extraction limits in accordance with Plan provisions.[136] According to the Water Group this includes developing the procedures to implement LTAAEL provisions and providing associated modelling services.[137]

LTAAEL compliance is used to trigger responses that control growth in extractions that may arise from increased river operational efficiency, changes in water user behaviour, river operators or water management policy.

The Commission understands that improved understanding of floodplain harvesting extraction volumes are yet to be accounted for and considered by the Murray and Lower Darling Regulated Rivers LTAAELs. The Water Group advised that it is in the process of developing floodplain management plans for the Murray River Valley with associated

131 Clause 26 of the Plan.
132 Clause 28 (2) of the Plan. 100,000 unit shares in the Murray Water Source and 250,000 unit shares in the Lower Darling Water Source.
133 Licensed environmental water as defined in Section 8(1)(b) of the Act as (i) water that is committed by an adaptive environmental water condition under Section 8B, 8C, 8D or 63B or (ii) taken or permitted to be taken under a licence of an environmental subcategory, or (iii) taken or permitted to be taken under a licence of a class prescribed by the regulations for the purposes of this paragraph.
134 Section 8F(4) and (5) of the Act.
135 The majority of HEW in the Plan area is not committed as licenced environmental water under Section 8(b) of the NSW *Water Management Act* (995,992 ML). There are a small number of licences in the Plan area committed as adaptive environmental water as defined in Section 8(b) of the Act (this is identified as statutory HEW in the Held environmental water licences register), specifically 32,528 ML, but no licence entitlement with an environmental subcategory. Source: *Held environmental water licences register*. Accessed October 2024.
136 Interview: DPIE, 24 June 2020.
137 Interview: DPIE, 17 June 2020.

declared floodplains.[138] The Water Group indicated that this process will allow it to determine any risks to the water source occurring due to floodplain harvesting and take of overland flow. The Commission supports the incorporation of all legal water take, including previously unmetered extractions, such as floodplain harvesting, into the modelled estimate of the LTAAELs. The Commission notes that the inclusion of floodplain harvesting volumes might trigger actions that reduce allocations to ensure compliance with the LTAAELs.

According to the Plan, actions to address LTAAEL non-compliance are triggered when modelled long-term extractions based on the current conditions scenario:

- exceeds the lowest extraction limit set by the Cap conditions scenario or the Plan scenario by 3 per cent or more, or
- exceeds the average of the Cap conditions scenario and the Plan scenario, or
- exceeds the extraction limit established by the Cap conditions scenario.[139]

The current conditions scenario, as outlined in the Plan,[140] is a hydrological model that should be updated annually to best reflect current:

- water storages and development
- basic landholder rights, access licence share components, and plantation forestry
- Plan rules in place.

The MDBA is the custodian of the hydrological model used to simulate the Plan area.[141] This model is referred to as the Source Murray Model. This model relies on data inputs from NSW and Victorian tributaries, which are supplied from equivalent models operated by the states. The MDBA developed an LTAAEL scenario for the Source Murray Model at the request of NSW[142] to undertake compliance assessments in the Plan area.

To date, the Water Group has published two LTAAEL compliance assessment reports covering the period 2021-23.[143] It is unclear whether the Plan was compliant prior to 2021 as no assessment was undertaken. A lack of implementation of Plan LTAAEL provisions, means the Water Group may not have determined whether 'growth in use' adjustments were required under the Plan. Adjustments to address growth in use are important to limit adverse environmental impacts to ecosystems and adverse impacts to downstream users.[144]

The two completed LTAAEL assessments found extractions in the Plan area to be compliant with the long-term limits. However, these compliance assessment reports are only high-level summaries of the assessment process. The Commission has the following concerns:

- The LTAAEL compliance assessments have not modelled or evaluated the Cap scenario. The Water Group has justified this by stating that '*previous work undertaken by MDBA demonstrated that the Cap model had materially higher diversions than models using WSP*

138 DCCEEW (n.d.) *Southern floodplain management plans*
139 Clause 29 of the Plan.
140 Clause 28 of the Plan.
141 DPE-Water (2022) *LTAAEL compliance for the NSW Murray and Lower Darling Regulated Rivers Water Sources*
142 *Ibid.*
143 *Ibid.*; DPE-Water (2023) *LTAAEL compliance assessment for the NSW Murray and Lower Darling Regulated Rivers Water Sources*
144 DPIE-Water (2021) *Floodplain Harvesting- why is reform vital?*; DPIE-Water (2021) *An overview of legal limits*

rules and development',[145] leading to the assumption that the '*Cap scenario diversions will be greater than WSP scenario diversions*'.[146] This approach is not compliant with requirements in the Plan.

- The Water Group advised that it does not intend to implement a full current conditions model update each year. As the validity of LTAAEL assessments rely on the current condition model representing current conditions as accurately as possible, this approach does not comply with the intent of the Plan.
- It is unclear whether the LTAAEL modelling has excluded environmental flow rules, EWA rules and licensed environmental water as required by the Plan and the Act respectively.[147]
- While guidelines are available detailing some of the criteria that have been used to select the scenario models used for assessing compliance with LTAAEL,[148] there is no requirement or transparency around whether the scenario models used for LTAAEL assessment have been independently reviewed, or are fit for purpose based on observed data.[149] Clarity on the models used for assessment, including revisions made to the model, Plan scenario and current conditions scenarios since model accreditation would improve transparency for stakeholders. The importance of independent assessment of LTAAEL models and assurance has been outlined previously by the Commission as part of its audits and response to the Section 10 review, and by the Inspector General of Water Compliance.[150]

Transparency in these compliance assessments could be strengthened by disaggregating the modelled scenario limits into each form of take and identifying where modelled take is set as a static value.

In addition, the Commission has overarching concerns regarding the approach applied to LTAAEL compliance. As specified by Plan requirements, LTAAEL compliance is undertaken by comparing two modelled scenarios over the long term. This framework leads to the following issues:

- The model's ability to be responsive to real world changes, identify growth in use and the validity of the compliance assessment are dependent on whether the current conditions scenario appropriately simulates real-world current levels of extraction. While the current conditions scenario should be updated on an annual basis to best reflect current levels of development, water user behaviour and water management rules,[151] it is the Commission's understanding that there is no independent review, verification or accreditation of these updates to determine whether the changes are fit for purpose, or the overall model performance.

145 DPE-Water (2022) *LTAAEL compliance for the NSW Murray and Lower Darling Regulated Rivers Water Sources*

146 *Ibid.*

147 Information provided by DCCEEW indicates that LTAAEL compliance can include water for non-consumptive purposes, stating that the Commonwealth has requested that NSW not formally recognise licensed water despite this being a requirement of the Act (DPIE (2021) *Extraction Limits – How the extraction limits work and differences*)

148 DPE (2022) *Guidelines to select scenario models for assessing compliance to long-term average annual extraction limits*

149 DPE-Water *(2022) LTAAEL compliance for the NSW Murray and Lower Darling Regulated Rivers Water Sources*; DPE-Water (2023) *LTAAEL compliance assessment for the NSW Murray and Lower Darling Regulated Rivers Water Sources*

150 Natural Resources Commission (2023) *Final report - Audit of the implementation of the Lachlan, Murrumbidgee and NSW Murray and Lower Darling regulated rivers water sharing plans*; Inspector-General of Water Compliance (2023) *Sustainable Diversion Limit Compliance Statement for 2021-2022*

151 Note Clause 28 states that '*It is intended that the Department's current conditions hydrological computer model will be extended each water year and used to calculate long-term average annual extraction under this clause.*'

- The accuracy of the model representation for simulating changes in water use should be given equal weighting to the accuracy of metering equipment to measure extractions. However, while multiple safeguards are being rolled out to improve metering accuracy, including tamper proof meters, installation by duly qualified persons, and independent oversight by the Natural Resources Access Regulator (NRAR), there are no similar safeguards that promote accuracy of the representation of extractions in the annual current conditions scenario model updates.
- There is no independent agency or group to ensure models and model scenarios reflect best available information. Stakeholders cannot independently verify that the level of extractions produced by the modelled scenarios is appropriate, or whether they are fit for purpose to identify growth in use reducing stakeholder confidence in the LTAAEL assessment compliance framework.
- There is no requirement to assess the accuracy of the model against the actual extraction data collected for the period in question.

Given the significant investment by water users and the NSW Government in the metering reforms, it would be a reasonable progression in water management planning and compliance to use actual metered extraction data to inform, track and validate modelled extraction and ensure actual extraction complies with long-term limits.

This approach would align with the SDL compliance assessment framework undertaken as part of the Basin Plan, which requires the use of annual actual take (extractions) as part of the assessment process.

Recommendation R7 – Priority 2
To improve transparency of the assessment of LTAAEL compliance reports, the Water Group should transition to use actual metered data to validate the LTAAEL compliance process.
Recommendation R9 (LT) – Priority 3
To improve transparency of the assessment of LTAAEL compliance reports, the Water Group should: a) ensure the current conditions model is updated annually b) clarify whether models used in the LTAAEL assessment of compliance have been independently reviewed and deemed fit for purpose c) provide visibility of any revisions and inclusions to the scenario models used in the LTAAEL assessment of compliance d) provide disaggregated extraction information for each modelled scenario and identify where modelled extraction is set as a static value e) undertake annual independent reviews of the current conditions scenario to ensure it best represents current level of extraction.

5.3 Extraction limit compliance actions may impact environmental outcomes

If an assessment of extraction limits demonstrates non-compliance, the Plan outlines a series of actions to be taken to address the growth in use. Clause 33 identifies that the Minister can reduce future allocations for supplementary water access licences and then regulated river (general security) access licences.

These corrective actions do not distinguish between access licences held by environmental water holders and all other extractive licence holders. This means that actions to address over-extraction and comply with extraction limits (established for the purpose of providing for environmental needs) affect both water that contributes to over-extraction and water that provides for environmental needs and does not contribute to over-extraction.

These actions perversely impact on HEW in any LTAAEL and SDL non-compliance actions. In particular, SDL 'make good' measures are contradictory as HEW is excluded from the total consumptive take determined under the SDL.[152] This means that to address SDL non-compliance, all entitlement holders (including HEW) within a licence category are reduced equally, even though volumes associated with HEW are not counted as an extraction and do not contribute to growth in use. This approach impacts HEW reliability, and potentially environmental outcomes, without contributing towards improving SDL compliance, and is an inefficient method of addressing growth in use.

Recommendation R8 – Priority 2
The Water Group should modify actions taken to address SDL non-compliance by specifying that allocations for entitlements held by environmental water holders will not be reduced in 'make good' actions.

[152] MDBA (2022) *Sustainable Diversion Limit Accounting and Reporting Framework*

6 Developing a sustainable and robust allocation policy

A fundamental role of water sharing plans is to specify rules for the allocation of water to licensed users. The Plan establishes rules to allocate the volume of water that can be extracted under access licences each year, given a range of climatic conditions. Allocation processes provide an opportunity to facilitate compliance with the Act's water sharing principles. While the LTAAEL seeks to provide long-term sustainable water management (**Chapter 5**), the allocations assessments provide flexibility for annual and sub-annual decision-making to ensure the water sharing is undertaken as intended by the Act and Plan. Allocation processes can be broadly separated into two components:

- **Resource assessments** – which determine the volume of water available for allocation to consumptive users. Resource assessments are undertaken by the MDBA in the Murray water source and when the Menindee Lakes are operated as a shared resource. The MDBA distributes bulk entitlements to relevant jurisdictions based on sharing provisions established in the Murray-Darling Basin Agreement. The MDBA also provides jurisdictions with an assessment of the minimum expected inflow to the major storages. The MDBA estimates volumes associated with transmission, evaporative and operational losses.
- **AWDs** – which are a regular process, usually undertaken twice per month until full allocations are achieved.[153] A portion of the resource is reserved to secure high priority needs over a defined planning horizon of up to 24 months in the Murray[154] and 12 months in the Lower Darling. Existing commitments, including carryover and losses related to the Edward-Wakool system, are accounted. The remainder of the resource is then allocated to licence holders in line with the Plan's allocation priorities.

Assessment of allocations commences on 1 July, based on the duration of the planning horizon. A determination is made on whether a reserve needs to be provided to assure allocations for high priority licences can be provided in the subsequent year. Reserves for high priority licences for the subsequent year are generally not established at the commencement of the water year but rather progressively built as inflows occur.

This chapter focuses on the use of the allocations process to manage extraction in a sustainable and robust manner. The Commission found that the allocations process creates risk to essential services and inverts the principles of the Act. A key issue that should be addressed in the replacement Plan is to reduce the need for reactive policy measures in response to drought conditions. This should be achieved by operationalising climate risks into the allocation policy to ensure allocations can respond to a range of feasible climate conditions and not just a repeat of the historic record.

153 DPIE (2021) *Water Allocation Methodology - NSW Murray Regulated River Water Source*; DPE (2022) *Water Allocation in the Regulated Lower Darling*

154 DPIE (2021) *Water Allocation Methodology - NSW Murray Regulated River Water Source*

6.1 Allocations are not based on assessment of the Act's principles

Section 9 of the Act imposes a duty[155] that compels '*all persons exercising functions … to give priority to …*' the water sharing principles to protect the water source and its dependent ecosystems and basic landholder rights.[156] As the allocations process is a function under the Act, the Section 9 duty requires both the Water Group and WaterNSW to give priority to the water sharing principles in the order specified during resource assessments and AWDs.

Making AWDs depends on a range of policies and procedures that sit outside the Plan, as well considerable discretionary decision-making. Several measures outside of the Plan provisions have been adopted to improve alignment with the priorities outlined in the Act. One example is the specification of the 'second-year reserve' discussed in **Section 6.5**. However, additional processes are needed to ensure that water allocations are made consistent with the Act's principles.

Some cases where the Act's principles may call for changes in the water allocation policy, which are not included in the water allocation methodologies,[157] include:

- allocations to the Barmah-Millewa EWA (the Barmah-Millewa Allowance) should have a higher priority than general security allocations[158]
- reducing water for environmental needs in the event of a supply shortfall to prioritise critical human needs. The Commission notes instances in other plan areas where supply shortfalls have led to water being borrowed from higher priority needs to meet lower priority needs[159]
- a process for ensuring water for the second-year reserve is secured throughout the year creating a risk it may not be met.

The Commission acknowledges the *Corrective Action Plan*,[160] which the Water Group has agreed to implement in response to the Section 10 review.[161] This includes the development of a framework with overarching guidance and an updated review method to promote the principles and increase assurance that the principles of the Act have been given effect. The Commission has provided feedback to the Water Group as part of the Section 10 review outlining that discretionary decision-making within the AWD process does not align with the priorities of the Act. The Commission notes that the *Corrective Action Plan* identifies that steps to resolve current issues raised regarding the AWD process are to include:

- scoping of the Commission's concerns regarding the AWD process

155 Section 9(1)(b) of the Act.

156 Section 5 (3) of the Act states that '*In relation to water sharing —*
(a) sharing of water from a water source must protect the water source and its dependent ecosystems, and
(b) sharing of water from a water source must protect basic landholder rights, and
(c) sharing or extraction of water under any other right must not prejudice the principles set out in paragraphs (a) and (b)'.

157 DPIE (2021) *Water Allocation Methodology - NSW Murray Regulated River Water Source*; DPE (2022) *Water Allocation in the Regulated Lower Darling*

158 Clause 55 of the Plan.

159 Natural Resources Commission (2022) *Final report Audit of the implementation of the Namoi, Gwydir and Macquarie regulated water sharing plans*

160 DPE-Water (2023) *Corrective Action Plan – Review of the activities of the department under Section 10 of the Water Management Act 2000*

161 Under Section 10 of the Act, the Minister is to review the work and activities of the Water Group at intervals of not more than five years. This is to ensure that the Water Group has '*been effective in giving effect to the water management principles of this Act and the State Water Management Outcomes Plan*'. The Water Group completed a Section 10 review for the period of July 2017 to December 2022 in 2023. (Information taken from DPE-Water (n.d.) *Statutory reporting*).

- collaboratively working with the Water Group and other relevant agencies to resolve these concerns.[162]

The Commission notes that this work program is yet to commence.

6.2 Clause 66(2) of the Plan does not reference environmental needs

Clause 66(2) of the Plan requires the river operator to manage the water supply system to supply water to meet priority needs during a repeat of the period of lowest accumulated inflows. The 'priority needs' include basic landholder rights, full allocation for domestic and stock access licences, local water utility access licences and full allocation for several higher priority sub-categories of high security access licences. An allocation of 0.97 ML per unit share must be able to be provided to the remaining high security sub-categories in the Murray and 1 ML per unit share in the Lower Darling. Clause 66(2) does not explicitly identify the needs of the environment.

The Commission considers that Clause 66(2) should be amended to provide consistency with the Act's principles by explicitly specifying that the needs of the water source and its dependent ecosystems must be provided for during the period of lowest accumulated inflows.

Recommendation R12 – Priority 2

The Water Group should revise Clause 66(2) (Maintenance of water supply) to require the river operator to be able to firstly supply sufficient water to protect the water source and its dependent ecosystems during a repeat of the period of lowest accumulated inflows.

6.3 Different approaches used by NSW and Victoria result in inequities

The MDBA provides bulk allocations to NSW and Victoria in accordance with the Murray-Darling Basin Agreement, which are then allocated to water users based on state allocation policies. NSW and Victoria apply different approaches for managing risk particularly during drought conditions.[163] Victoria implements a more conservative minimum inflow period of three months to promote the reserve required to meet priority needs.[164] NSW applies a minimum inflow of 12 months or more to allow for larger allocations to general security users.[165]

NSW and Victoria hold equal shares of storage space in Hume and Dartmouth dams. Inflow is attributed to these storage components equally. However, when one state's storage component is full, excess spills into the other state's storage component. Victoria generally maintains a larger reserve for priority needs and the storage component is therefore more likely to spill into NSW's storage component. The different approaches taken to risk management in the shared resource can create inequalities in the bulk allocations.

162 DPE-Water (2023) *Corrective Action Plan – Review of the activities of the department under Section 10 of the Water Management Act 2000*
163 Interim Inspector-General of Murray–Darling Basin Water Resources (2020) *Impact of lower inflows on state shares under the Murray–Darling Basin Agreement*
164 Northern Victoria Resource Manager (n.d.) *How seasonal determinations are made*
165 DPIE (2021) *Water Allocation Methodology - NSW Murray Regulated River Water Source*

Recommendation R14 – Priority 3

The Water Group should seek Basin Officials Committee agreement to review and address inequalities in the use of the shared resource arising from NSW and Victoria state-based allocation policies, particularly those that affect storage reserve volumes.

6.4 The lowest accumulated inflow assumption increases supply shortfall risks

The AWD process identifies the total resource pool that can be allocated by combining stored water volumes with the lowest accumulated inflow volume assumed to occur until the end of the water year. Any water from the total resource pool that is in excess of current commitments can be allocated to licence holders.[166]

Assuming the lowest accumulated inflow in addition to actual storage levels allows for larger opening allocations and reduces the volume required to be stored to secure the second-year reserve. However, if the inflow does not occur as assumed, there can be an increased risk of shortfall for priority needs. These shortfalls can impact critical needs, including environmental, basic landholder rights, domestic and stock and local water utilities. The Commission notes instances in other plan areas where supply shortfalls have led to water being borrowed from higher priority needs for lower priority needs.[167]

Both the Millenium and Tinderbox droughts resulted in inflows that were lower than the assumed inflow in the regulated Murray water source.[168] Further, evidence suggests the risks to supply shortfalls will increase going forward under a drying climate (**Chapter 4**). Risks associated with these assumptions are amplified when the assumed inflow is not based on best available data, including climate change data, or reconciled against actual inflows (**Chapter 4**).

6.4.1 The inflow sequence should incorporate the best available inflow data

The lowest accumulated inflow sequence is simulated using a hydrologic model over a repeat of the historical record. In 2014, an amendment to the Plan[169] restricted the lowest accumulated inflows calculation to be based on data held by the Water Group before 1 July 2004,[170] removing the impact of new record lowest accumulated inflows that occurred during the Millennium and Tinderbox droughts.

However, the lowest accumulated inflow calculation is undertaken by the MDBA, which operates the hydrological model for the Plan area. The MDBA evaluates the lowest accumulated inflow sequence as the 99th percentile lowest inflow over the last 100 years of data, an approach that is likely more conservative than that specified in Plan provisions. Plan provisions should be amended following the Water Group's lowest accumulated

166 DPIE (2021) *Water Allocation Methodology - NSW Murray Regulated River Water Source*; DPE (2022) *Water Allocation in the Regulated Lower Darling*
167 Natural Resources Commission (2022) *Final report Audit of the implementation of the Namoi, Gwydir and Macquarie regulated water sharing plans*
168 DPIE (2021) *Water Allocation Methodology - NSW Murray Regulated River Water Source*
169 *Water Management Amendment Act 2014 No 48* ss 2.7 (1-4)
170 Clause 66 (1) of the Plan.

inflows review[171] to reflect requirements adopted and implemented for determining the minimum inflow.

6.4.2 The inflow sequence should incorporate best available climate data

Climate modelling has shown the Murray and Lower Darling catchments to be highly vulnerable to climate change,[172] simulating periods of substantially lower inflow than observed in the historical record.[173] There is growing consensus that past hydrological records are not a reliable indicator for future extreme events, including droughts that result in minimum inflows.[174]

However, the allocations policy outlined in the Plan and expanded upon in the Water Group's Water Allocation Methodologies[175] (the methodologies) do not specifically address the impact of climate change. The focus of the methodologies is to guide river operators during 'normal' operating conditions. The methodologies embed static assumptions that lack flexibility and cannot respond to conditions outside of the historical record. When these conditions arise, reactive policy measures are implemented, when in the public interest to do so, including by announcing temporary water restrictions (under a Section 324 order), activating the *NSW Extreme Events Policy*, or suspending the Plan in whole or in part.

While these measures can prevent access to account water and prioritise dwindling supplies for critical needs, they do not address the primary cause of overallocation (i.e. allocating more than what is stored in dams) and often licence holders will maintain their overallocated account balances.

In addition, each of these policy responses are applied in an *ad hoc* manner, creating uncertainty for business operations and the water market. The Commission notes that, due to this uncertainty, these policy responses are generally not supported by water users. Instead, the replacement Plan should seek to operationalise and incorporate climate risks into the allocation policy to ensure allocations can respond to a range of feasible climate conditions and not only a repeat of the historic record. This approach will reduce the need for reactive policy measures in response to drought conditions.

Allocations policies in other states tend to be more conservative, often adopting more extreme planning scenarios to mitigate the reliance on reactive policy responses.[176]

6.4.3 Assumed lowest accumulated inflows should be reconciled

The assumed lowest accumulated inflow is considered as an additional reserve of water that is yet to be stored in the reservoir. The assumed inflow is allocated to licence holder accounts in the opening allocation, with the expectation that the inflow will occur to replace the water allocated. This approach increases the supply shortfall risk when the

171 The Water Group is developing a method underpinned by stochastic climate datasets to review the 'period of lowest accumulated inflows'. This work will inform changes to the accounting process for conducting AWDs. The Office of the NSW Chief Scientist & Engineer is providing independent advice on the method for the minimum inflows review. This advice is due to be finalised in March 2025.

172 DCCEEW (2024) *Baseline climate and hydrological assessment for the NSW Murray and Murrumbidgee regions - Regional Water Strategies Program*; DPE (2022) *Draft Regional Water Strategy – Murray*

173 *Ibid.*

174 *Ibid.*; Devanand, A, Leonard, M, and Westra, S (2020) *Implications of Non-Stationarity for Stochastic Time Series Generation in the Southern Basins,* pilot study undertaken by Adelaide University.

175 DPIE (2021) *Water Allocation Methodology - NSW Murray Regulated River Water Source*; DPE (2022) *Water Allocation in the Regulated Lower Darling*

176 Interim Inspector-General of Murray–Darling Basin Water Resources (2020) *Impact of lower inflows on state shares under the Murray–Darling Basin Agreement*

assumed inflow does not occur as expected and when these inflows have been allocated to water users. Evidence suggests that in other valleys the river operator has implemented a practice of borrowing water from critical needs to supply the shortfalls in non-critical needs.[177] The Commission notes that Plan provisions do not exclude this practice in the Plan area.

The allocation process does not require reconciliation of actual volumes of water received with those anticipated. The Water Group indicated that, if a shortfall is identified, a pause on any new allocations or a restriction on general security water balances is put in place until the assumed lowest accumulated inflow amount is restored.[178] However, the Plan should be amended to require reconciliation of inflows, identification of these shortfalls and responsive actions until the shortfall has been restored.

Recommendation R10 – Priority 1
The Plan should include a provision that requires the Minister to reconcile the Plan's lowest accumulated inflows against actual inflows and address any shortfall before issuing increased allocations.

6.4.4 Clauses limiting the review of the period of lowest accumulated inflows should be changed

The Commission acknowledges recent Plan amendments[179] that require a review of the period of lowest accumulated inflows by the date of expiry of the Plan on 30 June 2026. However, the amendment provisions permit changes to the lowest accumulated inflow that are reasonably necessary to '*not jeopardise the critical needs of basic landholder rights, domestic and stock access licence holders and local water utility access licence holders*',[180] without considering environmental needs as required by the Act's principles.

In addition, the Plan identifies that the review *'cannot substantially alter the long-term average annual amount of water able to be extracted under water access licences.*'[181] While a note in the Plan recognises that changes can still be made that affect the long-term average extraction if the Minister is satisfied it is in the public interest to do so,[182] the Commission considers this clause to be inconsistent with the Act and recommends it be removed (see **Chapter 2** and **AR1**). In effect this clause indicates that changes that may be necessary to ensure that basic landholder rights and local water utility needs are met can only be made if they do not affect extractive usage. This reverses the priorities of the Act. Further, it implies climate change considerations cannot be implemented in the Plan if they affect extractive use.

Recommendation R11 – Priority 1
The Water Group should revise Clause 66(4) (review of lowest accumulated inflows) to include a requirement to not jeopardise critical environmental needs.

177 Natural Resources Commission (2022) *Final report Audit of the implementation of the Namoi, Gwydir and Macquarie regulated water sharing plans*
178 Natural Resources Commission (2023) *Final report Audit of the implementation of the Lachlan, Murrumbidgee and NSW Murray and Lower Darling regulated rivers water sharing plans*
179 Clause 66(3) of the Plan.
180 Clause 66(4) of the Plan.
181 Clause 66(5) of the Plan.
182 Clause 66 notes of the Plan.

6.5 Discretionary decisions have limited oversight or transparency

The MDBA undertakes the resource assessment calculations on behalf of the states and is responsible for several of the discretionary decisions including estimates of storage evaporation losses, transmission losses and operational losses.

The Water Group allocates the volume of water specified by the MDBA's bulk allocation according to the Plan's provisions. The Plan's high-level allocation provisions provide some discretionary decision-making to the Water Group and river operators.[183] This flexibility is generally needed to allow the Water Group and river operators to respond to changes in climate, hydrology and water user behaviour.

The Water Group has improved transparency around some of these discretionary decisions through publication of the allocation methodologies.[184] In addition, regularly published AWDs,[185] WaterNSW's stakeholder updates and the annual general purpose water accounting reports[186] provide details on some of the discretionary decisions made.

Discretionary decisions can have a significant impact on the achievement of Plan outcomes. In particular, the Act's Section 9 duty requires these decisions to prioritise protection of the water source and dependent ecosystems, as well as basic landholder rights. There is a lack of transparency related to whether discretionary decision-making appropriately implements the Section 9 duty. Detailing discretionary decisions in the Plan, improving decision-making transparency, and strengthening oversight can improve the allocations process.

In particular, the Plan should provide greater transparency on decision making processes related to specification and building of the second-year reserve, including identifying monthly targets for building the second-year reserve. The Plan should specify details such as the planning horizon, total reserve volume required and monthly accumulation targets, as well as requirements for adherence to these targets. Current operations only set aside the second-year reserve at the discretion of the Water Group.

As identified in **Section 6.1**, resolution of issues regarding discretionary decision making within the AWD process is identified as a corrective step in the *Water Group's Corrective Action Plan*[187] in response to the Section 10 review. While the corrective action plan identifies that the Water Group will work to identify and collaboratively address the Commission's concerns regarding the AWD process,[188] this work program is yet to commence.

Recommendation R13 – Priority 2
To improve transparency, the Water Group should clarify decision making related to the second-year reserve in the Plan.

183 Clauses 42-44, Division 1, Part 8 of the Plan
184 DPIE (2021) *Water allocation methodology: NSW Murray Regulated River Water Source*
185 DPIE (n.d.) *Available water determinations*
186 DPE-Water (n.d.) *NSW General Purpose Water Accounting Reports*
187 DPE-Water (2023) *Corrective Action Plan – Review of the activities of the department under Section 10 of the Water Management Act 2000*
188 *Ibid.*

7 Strengthening environmental protections in the Lower Darling-Baaka

The Lower Darling-Baaka has experienced several water quality and fish death events during the Plan period that have triggered various independent reviews. The most recent review of Lower Darling-Baaka fish deaths at Menindee by the Office of the NSW Chief Scientist & Engineer recommended that the Plan's statutory water sharing plan review be brought forward and '*focus on the adequacy of Plan provisions for meeting environmental and water quality objectives.*'[189]

The Connectivity Expert Panel[190] requested the Commission provide its initial water sharing plan review analysis regarding the Lower Darling-Baaka, including an approach for determining the volume of a priority storage reserve, which may be used to inform revisions to the Menindee Lakes trigger.[191] This advice was prepared in collaboration with water quality, algae and fish ecology experts with knowledge of the Lower Darling-Baaka and its water needs.[192] The advice was provided to the Panel to inform its final report and shared with the Minister for Water in July 2024. A copy of this advice is available on the Commission's website.[193]

The Commission's advice describes how the Plan is not adequately meeting its environmental (including water quality and connectivity) objectives and outlines an approach for improving environmental outcomes in the Lower Darling-Baaka through changes to Plan provisions (see **Figure 5**). The advice includes detail on provisions for improving river health in the Lower Darling-Baaka that were most relevant to the Panel's scope, specifically, revisions to minimum daily flows (**Section 7.1.1**) and the Lower Darling EWA (including top-ups) (**Section 7.1.2**). The Lower Darling Restart Allowance is also discussed given interest from the Panel in this provision (**Section 7.1.3**).

The Commission's advice to the Connectivity Expert Panel also recognised that changes to northern Basin water sharing plans and other interventions, including infrastructure improvements, are also required to improve outcomes in the Lower Darling-Baaka (**Section 7.1.4**). It seeks to recognise the institutional complexities of the management of Menindee Lakes and the Lower Darling-Baaka, including the various instruments, agreements and approvals that contribute to a complex operating environment[194] that requires broader reform than just changes to water sharing plans (see **Figure 6**).

This chapter provides a summary of the Commission's advice already published. However, the advice did not discuss in detail, items relevant to this review that expand on other opportunities to strengthen provisions for the environment in the Lower Darling-Baaka. This includes provisions relating to the Great Darling Anabranch. While the Anabranch is part of the unregulated Lower Darling, it is dependent on flows from the regulated river water

189 Recommendation 1.3 of Office of the NSW Chief Scientist & Engineer (2023) *Independent review into the 2023 fish deaths in the Darling-Baaka River at Menindee*

190 The Connectivity Expert Panel was convened by the Minister for Water to provide advice on the adequacy and potential improvements to rules in the NSW Northern Basin water sharing plans that might materially impact on hydrological connectivity. The Panel's final report was submitted to the Minister for Water in July 2024.

191 This trigger seeks to increase inflow into the Menindee Lakes, when needed, by restricting the take of floodplain harvesting in upstream valleys of the northern Basin.

192 The Commission engaged Dr Darren Baldwin, Rivers and Wetlands; Iain Ellis, Millewa Pumping; and Dr Simon Mitrovic, University of Technology Sydney to inform its advice on the Lower Darling-Baaka.

193 Natural Resources Commission (2024) *Improving outcomes in the Lower Darling-Baaka River: advice to the Connectivity Expert Panel*

194 For example, there is a lack of transparency regarding trade arrangements in the Lower Darling-Baaka when the lakes are under NSW control.

source, specifically Lake Cawndilla and the Lower Darling-Baaka (when flows exceed 9,000 ML per day) and forms part of a pilot for recrediting held environmental water originating from the northern Basin.

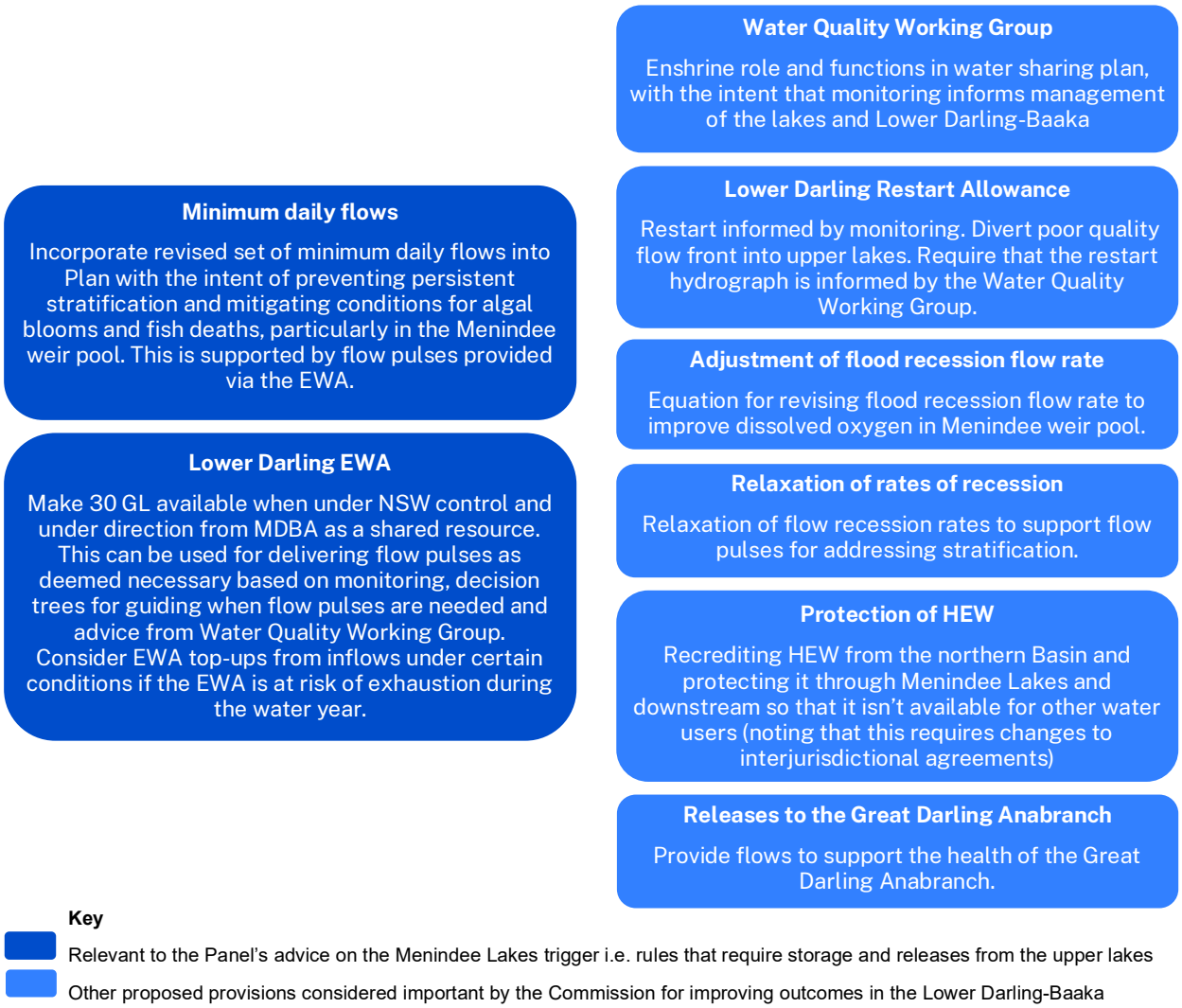

Figure 4: Proposed suite of provisions for improving environmental outcomes in the Lower Darling-Baaka and Great Darling Anabranch

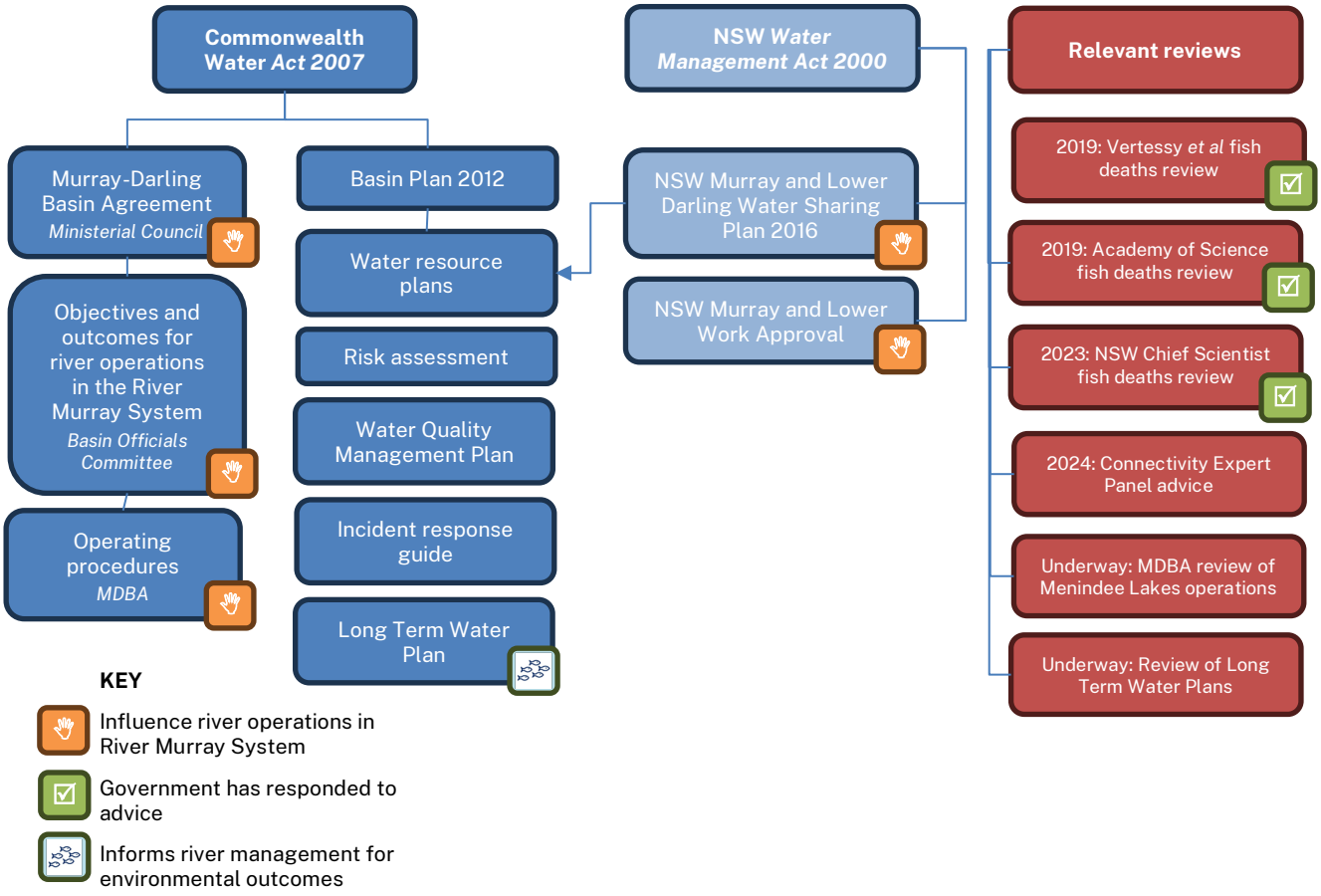

Figure 5: Complex institutional and operating environment

7.1 Outline of advice to the Connectivity Expert Panel

The Commission's advice to the Panel is summarised in this section, including proposed revisions to minimum daily flows, the Lower Darling EWA and Lower Darling Restart Allowance.[195]

Proposed minimum daily flows and Lower Darling EWA require a minimum of 204.4 GL per year (not including losses and potential top-ups of the EWA). This is an additional 108.8 GL per year more than existing minimum daily flow requirements when the lakes are under NSW control (additional 78.1 GL of minimum daily flow per year plus 30 GL EWA) and does not reflect evaporative losses.

The Commission's recommendations are intended to be delivered as a package, for example, changes to the Lower Darling EWA are intended to be undertaken in combination with revision to minimum daily flows, otherwise a larger EWA would likely be required to maintain suitable water quality year-round, particularly during high-risk periods (protracted low flows and during summer). It is also the intent that these provisions are to be adaptively managed based on new information and as infrastructure improvements are progressed. The Commission also acknowledges that condition monitoring once proposed minimum

195 In addition, the advice to the Panel also relates to inadequacies of the 195 GL Menindee Lakes trigger for meeting priority needs of the Lower Darling-Baaka; outlines a transparent, evidence-based approach to identifying the volume of a priority storage reserve and provides insights from storage reserve scenario analysis.

daily flow rates are implemented will support refinements to minimum daily flow requirements over time.

The Commission's advice, while focusing on water quality concerns in the Menindee town weir pool, have also been developed with consideration of benefits along the length of the Lower Darling-Baaka.

7.1.1 Updated minimum daily flows should form part of the Plan

Existing minimum daily flow requirements, which sit outside of the Plan in the NSW Murray and Lower Darling Work Approval and *Objectives and Outcomes for river operations in the River Murray* document (O&O document) are outdated, having been in place for over two decades.[196] They are not adequate for supporting the basic river health of the Lower Darling-Baaka, including mitigating risks of water quality events that can increase risk of fish mortality.

Latest information regarding the environmental needs of the Lower Darling-Baaka should underpin minimum daily flows, including knowledge gained from recent river operations aimed at mitigating persistent thermal stratification in the Menindee weir pool (upstream of Weir 32). Changes to minimum daily flows and ensuring these revised minimum daily flows should form part of the Plan. There may be circumstances where the proposed minimum flows are higher than necessary to support water quality and ecological condition. These circumstances will be advised by the Water Quality Working Group based on monitoring data and ambient conditions (see **R15**). The Commission understands that minor short-term variations around proposed minimum daily flow rates due to operational constraints and processes could occur.

Ongoing collection of data as the revised minimum flows are implemented over coming years will help to refine the operating rules and minimum flow requirements at any one time. Similarly, reductions in minimum flow requirements that can be realised using flow pulses will also be informed by monitoring over time.[197]

Proposed minimum daily flows are as follows:

- November-March: 750 ML per day
- April and October: 500 ML per day
- May-September: 200 ML per day

The proposed minimum daily flows (measured at the Darling River upstream of Weir 32 gauge (425 012)) are within the flow thresholds for baseflow environmental water requirement flow categories for the Darling River upstream of Weir 32, as described in the *Murray-Lower Darling Long Term Water Plan*.[198]

For high-risk periods for persistent thermal stratification (considered November-March), the Commission proposes minimum daily flows more than double the existing minimum (750 ML per day versus 350 ML per day), but also acknowledges there will be

196 While not currently a Plan provision, minimum daily flows are considered within the scope of the Commission's review as they are a key strategy for contributing towards the Plan's environmental, water quality and connectivity objectives. They are also considered an important mechanism, if appropriately designed, to manage the effects of climate change when combined with flow pulses.

197 The NSW Government has previously established the benefits of pulsing water in the Lower Darling in for mitigating blue-green algal events and flush the system. Mitrovic, S, Hardwick, L and Dorani, F (2011) Use of flow management to mitigate cyanobacterial blooms in the Lower Darling River, Australia, *Journal of Plankton Research,* 33(2): pp. 229-241.

198 DPIE (2020) *Murray-Lower Darling Long Term Water Plan Part B: Murray-Lower Darling planning units*

circumstances where this higher flow rate will not always be required and hence there is a need for flexibility, with releases informed by monitoring.

In addition to being based on best available information, the following actions are important for updated minimum flows to be effective:

- Clarification that releases should be made from the upper lakes to ensure mixing through the Weir 32 weir pool – where releases are made from is critical to their effectiveness as is the quality of releases to support basic river health, recovery and resilience in the Menindee weir pool.[199]
- Adequate consideration of the ratio of releases from the upper lakes relative to Lake Menindee given the 'blocking' effect of Lake Menindee releases on flow through the Menindee weir pool, which can result in lentic conditions (standing water) in the river reach upstream of the junction with Menindee Creek.
- Flexibility in the delivery of proposed minimum daily flows, including release rates to support flow variability and where releases are made from based on antecedent, climatic and water quality conditions and to support dispersal of native fish, for example golden perch (*Macquaria ambigua*).
- Plan rules incorporating seasonal and event-based triggers to better manage water quality and other risks including providing for flow pulses to respond to poor water quality conditions.
- Adaptive management and revisiting rules if/when new infrastructure such as permanent fishways are installed and/or new information is provided including real time water quality data.

The Commission recognises there will be periods (for example, during droughts) where revised minimum daily flows cannot be met, noting this has occurred during the term of the Plan and this risk is heightened with climate change. In these circumstances, it would be appropriate to have an active storage trigger (based on prioritising critical human drought supply needs) to enable the Minister for Water to exercise discretion over minimum daily flow releases. Concurrence from the Minister for the Environment should also be required to deviate from minimum daily releases.

A process should be established for these events requiring concurrence between the Minister for Water and the Minister for the Environment to determine the revised volume of water available for the environment, allowing for consideration of critical human needs. During these events the Menindee/Lower Darling Water Quality Working Group should advise on appropriate release rates.

[199] Releases from Lake Menindee bypass the majority of the weir pool, where water quality issues are more prevalent.

Recommendation R15 (A) – Priority 1

The Water Group should amend the Plan as a priority (before the Plan expires) to:

a) incorporate updated minimum daily flows consistent with the Commission's advice, including provisions that allow the flexibility in their delivery based on water quality, water availability and ambient conditions

b) clarify that the Water Quality Working Group can advise on variations to minimum daily flow requirements

c) establish an active storage trigger to enable the Minister for Water to have discretion over delivery of minimum daily flows during drought periods with concurrence from the Minister for the Environment.

Note: NSW can implement these changes to give effect to revised management when the Menindee Lakes are under NSW control.

Given minimum daily flows are also included in the Objectives and Outcomes document for river operations in the River Murray System document, which applies when Menindee Lakes, are under the direction of the Murray-Darling Basin Authority (MDBA) as a shared resource, Water Group should also consult the Basin Officials Committee and River Murray Operations Committee on revised minimum daily flows.

7.1.2 Management of the Lower Darling EWA can be improved

The Lower Darling EWA (Clause 64 of the Plan) is intended for managing water quality in the Lower Darling-Baaka. The Commission's advice to the Connectivity Expert Panel highlights the inadequacies of the 30 GL Lower Darling EWA,[200] consistent with the findings of the Office of the NSW Chief Scientist & Engineer's review of the 2023 fish deaths.[201] The Commission also notes the:

- exhaustion of the Lower Darling EWA in two consecutive water years[202]
- importance of making the allowance available when the Menindee Lakes are under NSW control (not just a shared resource as is currently the case)
- need for top-ups of the allowance account.

The Lower Darling EWA is currently only available when the lakes are being managed as a shared resource (i.e. when combined storage exceeds 640 GL until the lakes fall below 480 GL). The EWA was not available at the time of the 2018-19 fish deaths when the lakes were under NSW control. Given water quality can deteriorate during protracted low flow conditions, which can occur when the lakes are being managed by NSW, the EWA should also be available during these times. This is consistent with a recommendation from the water resource plan development process in 2018-19 to make the EWA available when the lakes are under NSW control.

Topping up the account with inflows is considered more efficient than a larger allowance given the high evaporative losses that can be incurred at Menindee Lakes. In addition, adoption of updated minimum daily flows would help to reduce the risks of water quality and blue-green algae events in the Lower Darling-Baaka. Topping up the allowance account (to a maximum of 30 GL) when it is approaching exhaustion should be prioritised

200 Natural Resources Commission (2024) *Improving outcomes in the Lower Darling-Baaka River: advice to the Connectivity Expert Panel*

201 Office of the NSW Chief Scientist & Engineer (2023) *Independent review into the 2023 fish deaths in the Darling-Baaka River at Menindee*

202 In both instances, the Lower Darling EWA was exhausted before the end of each water year.

over other water orders to ensure the account is available for managing water quality and blue-green algal events. The Plan should stipulate the trigger for top-ups, for example, when the account falls to 10 GL.

The Commission acknowledges that at the time its advice was submitted to the Panel in June 2024, there was a significant blue-green algae event affecting the Lower Darling-Baaka, which impacted both the environment and communities along the length of the river. The Lower Darling EWA was again exhausted when this event occurred.

Had the Plan allowed for top-up of the Lower Darling EWA (given inflows to the lakes), the EWA would have been available to manage this event. Instead, a flush comprising around 42 GL of Commonwealth HEW, which was considered a trial for improving connectivity between the northern and southern Basin,[203] was released from the upper lakes to provide for connectivity and improve river health.[204] The Commonwealth and state governments agreed to protect this water along the length of the Lower Darling-Baaka and reiterated the need for enduring reforms to improve connectivity.

The May-June 2024 blue-green algae event demonstrates the importance of including mechanisms in the Plan that allow for topping up the Lower Darling EWA. In addition, allowance releases should be made from the upper lakes if they are to be effective in managing water quality events in the Menindee weir pool. Therefore, the allowance would need to be reserved in, and released from, the upper lakes.

Changes to the Lower Darling EWA provisions combined with inclusion of proposed minimum daily flows (see **Section 7.1.1** and **Recommendation R14**) should be made a priority and given effect as part of Plan amendments before the Plan expires.

Recommendation R16 (A) – Priority 1

To improve the effectiveness of the Lower Darling EWA, the Water Group should amend the Plan as a priority (before the Plan expires) to:

a) allow for the Lower Darling EWA to be available for use when the Lakes are under NSW control (i.e. when they fall below 480 GL until they next reach 640 GL)

b) ensure there is clarity in the responsibility for managing the Lower Darling EWA (noting that the Water Quality Working Group has been responsible for directing the use of the Lower Darling EWA for the past three years)

c) clarify that the primary purpose of the Lower Darling EWA is for managing water quality and blue green algae, but can be used for other environmental benefits when it is not needed for water quality and algal events

d) enable top-up of the Lower Darling EWA allowance (up to 30 GL) when its account is approaching exhaustion with inflows to the upper lakes.

203 Australian Government Department of Climate Change, Energy, the Environment and Water (2024) *Media release: now is time for an enduring solution to protect the northern and southern Basin, 25 June 2024*

204 This release commenced on the 29 May 2024.

7.1.3 Implementation of the Lower Darling Restart Allowance can be clarified

The Lower Darling Restart Allowance[205] is intended to protect the first 60 GL of inflow to Menindee Lakes once the Darling River upstream Weir 32 (gauge 425012) has ceased to flow for ten consecutive days. It is not necessary to store this amount in the lakes constantly as with the minimum flow allowance. This rule has not yet been triggered as the Lower Darling-Baaka has not ceased to flow given wetter conditions over the period that the provision has been in place.

The restart volume of 60 GL is adequate based on previous river restarts (March 2020) and advice from experts. However, improvements are needed to the current clauses related to the restart allowance, including:

- water quality triggers (relating to dissolved oxygen, water temperatures and thermal stratification)[206] for when conditions are suitable for commencing the restart i.e. to avoid perverse impacts of delivering poor water quality water as part of the restart
- the importance of clear guidance for the flow restart for river operators, including the role of the Water Quality Working Group in informing the restart flow hydrograph
- consideration of water quality risk associated with a restart, including the importance of monitoring the flow front both into Menindee Lakes (Lake Wetherell) and downstream. A poor-quality flow front may require diversion and mixing in the upper lakes before releases downstream commence. Water quality triggers based on dissolved oxygen and temperature should inform when it is suitable to commence the restart
- there should be greater transparency in the outcomes of the river restart, including documentation of lessons learnt to inform adaptive management of future river restarts.

Recommendation R23 – Priority 2

To strengthen the Lower Darling Restart provisions and ensure that the river operator has sufficient clarity when restarting the river, Water Group should ensure the Plan includes:

a) clear water quality triggers for when the restart can commence to mitigate perverse water quality outcomes downstream

b) specification of the Water Quality Working Group's role in guiding the river restart

c) a requirement that the restart is based on best available information i.e. water quality monitoring data and relevant technical papers

d) reporting requirements for the river restart to ensure transparency in outcomes of the river restart and clearly record any lessons learnt that may be applied for future events.

205 Clause 72 of the Plan.

206 Baldwin, D (2021) *Planning for restarting rivers to minimise harm to native fish and other aquatic biota in the Murray-Darling Basin*. A report prepared for the NSW Depart of Primary Industries - Fisheries

7.1.4 Recommendations on intergovernmental arrangements, infrastructure and other interventions

The Commission's advice to the Connectivity Expert Panel also relates to broader whole-of-system management approaches in line with recommendations of the Office of the NSW Chief Scientist & Engineer's Independent review into the 2023 fish deaths in the Darling-Baaka at Menindee.

These recommendations relate to issues such as intergovernmental arrangements, infrastructure and other interventions. These recommendations can have a substantial impact on Plan outcomes and should be considered with any relevant changes made to provisions of the replacement Plan.

Some potential infrastructure changes that do not appear to be part of existing programs or part of the NSW Government's detailed response to the fish deaths review should be considered a high priority. For example, replacement of Weir 32 with a gated structure could assist with enabling drawdowns of the Menindee weir pool in response to algal blooms and stratification. Improving the operability of Weir 32 could also assist in refining releases from the upper lakes during periods of lower water availability. Modifications to Weir 32 would also help to facilitate fish passage which is important for managing the biomass in the weir pool.

In addition, the Commission supports the Connectivity Expert Panel's recommendations around increasing inflows into the Menindee Lakes, including revising trigger conditions, providing for connectivity EWAs and undertaking further analysis to determine an additional trigger to refill the lakes when necessary.

Recommendation R20 – Priority 2

To support the effectiveness of Plan provisions for the Lower Darling-Baaka, the Water Group should:

a) Work with the Basin Officials Committee to:
   i. reduce or remove lower priority demands from the upper lakes, including shared resource demands that exceed minimum daily releases, to reserve the upper lakes for high priority commitments
   ii. codify that the management of the shared resource continues to maximise stored volumes in the upper lakes and expand the use of surcharging the upper lakes when appropriate, in turn highlighting the need for investment in infrastructure upgrades
   iii. redefine the volume of a priority storage reserve in the upper lakes, based on a water balance approach, which provides a drought reserve for human and environmental needs over an appropriate planning horizon

b) implement complementary measures including infrastructure improvements and investigate other interventions, including but not limited to:
   i. repairing the dam safety constraint at Pamamaroo inlet regulator to reduce storage requirements
   ii. progress high priority fish ways to enable fish passage between the Lower Darling-Baaka, the upper lakes and the northern Basin (see Section 7.7)
   iii. modification of Weir 32 to support management of water quality risks and fish movement

iv. metering and hydrometric upgrades at appropriate locations including long term funding arrangements.

v. aerators to mix waters around the offtakes in Lake Wetherell and Pamamaroo

vi. a breakwall barrier or curtain 'diversion' structure to reduce short-circuiting of water through Lake Pamamaroo.

Recommendation R21 – Priority 2

The Water Group should implement recommendations from the Expert Connectivity Panel to increase inflows into the Menindee Lakes, including revising trigger conditions, providing for connectivity EWAs and undertaking further analysis to determine an additional trigger to refill the lakes when necessary.

7.2 Governance for water quality, blue-green algae and fish death events need clarification

The Menindee/Lower Darling Water Quality Working Group (the Working Group) was established in 2022 in response to several water quality events in the Murray-Darling Basin. The group operates under a Terms of Reference. It does not currently have a legal remit under the Plan for managing water quality, blue-green algae and fish death events but played a critical role in the decision-making around river operations in the lead-up to, during and following the March 2023 fish deaths.

The Commission acknowledges the important role of the group and supports enshrining its role and functions in the Plan and ensuring there is a clear distinction between the remit of this group, the NSW Environmental Water Manager and Murray Lower Darling Environmental Water Advisory Group.[207]

The Plan currently includes a note that '*at the commencement of this Plan, the Minister has conferred the lead role in managing environmental water allowances established under water sharing plans to the NSW Department of Planning and Environment – Office of Environment and Heritage.*'[208] While notes do not have the legal standing of a Plan clause, it should be clear that the Minister has conferred responsibility for managing the Lower Darling EWA to the Water Quality Working Group. The group has directed the use of this allowance over three consecutive water years (2022-23, 2023-24 and 2024-25) based on water quality monitoring. The replacement Plan should clarify who is responsible for managing the Lower Darling EWA given arrangements in recent years.

During the Plan review, the Commission heard from agency staff that there are some issues with the Working Group that should be addressed. Most notably that decisions for managing water quality events are made on a consensus basis, but in some circumstances, it may be difficult to reach consensus. In these instances, it would be appropriate for the Chair of the Working Group to make management decisions and direct river operators based on the best available information, while being transparent with the Minister and external stakeholders around any key risks or uncertainties.

207 Part 10, Division 3, Clause 65 of the Plan requires the NSW Environmental Water Manager to consult the Murray Lower Darling Environmental Water Advisory Group or relevant government agencies when taking actions (in managing environmental water allowances) established under the Plan.

208 Note listed under Part 10, Division 3, Clause 65 of the Plan.

The Commission understands that the workload of the Working Group at times has been significant i.e. managing water quality and making decisions daily for consecutive weeks. It is hoped that refinements to Plan provisions will help to alleviate some of the decision-making that the group has been involved in to date, but the group will still play a critical role in providing advice on an event basis.

The composition of the group is currently considered overly large and could be refined to streamline its ongoing role in managing water quality events in the Lower Darling-Baaka. However, as a minimum there must be the following representation:

- Chair – this is currently and should continue to be the Water Group
- Water Group
- BCS
- DPIRD Fisheries
- WaterNSW
- MDBA
- CEWH
- Community representative
- Local government representative
- Aboriginal representative
- Independent water quality specialist.

The Plan provisions relating to the role and functions of the Menindee/Lower Darling Water Quality Working Group should include the following as a minimum:

- The Minister can delegate the identification and management of water quality and blue-green algae events and associated impacts to the Water Quality Working Group, and the use of the Lower Darling EWA.
- Advice developed by the Water Quality Working Group for managing water quality events and blue-green algae must be based on best available information (this information is to be made available on the Water Group's water quality dashboard).
- If the Water Quality Working Group cannot reach consensus on the appropriate actions for managing water quality events and blue-green algae, the Chair is to decide in the best interests of the health of the river and its dependent ecosystems, and clearly document and communicate any risks and uncertainties with the Minister and external stakeholders.
- If a water quality event or algal bloom is predicted or detected the river operator must operate the system consistent with the directions of the Water Quality Working Group.
- The Water Quality Working Group is to advise on the use of the Lower Darling Restart Allowance including the restart hydrograph (see **Section 7.3**).
- The Water Quality Working Group must report on the outcomes of water quality management interventions on an event basis.

Recommendation R19 (A) – Priority 2

To strengthen governance arrangements to manage water quality, blue-green algae and risks of fish deaths in the Lower Darling Water Source, the Water Group should amend the Plan as a priority (before the Plan expires) to ensure that the role and functions of the Water Quality Working Group are included in the Plan.

*Note: **R15** sets out proposed function of the Water Quality Working Group relating to advice on minimum daily flows.*

7.3 Managing flood recession flows for water quality outcomes

The operating arrangements for flood recession flows (20,000 ML per day to 8,000 ML per day In the Lower Darling downstream Menindee, i.e. when receding from overbank down to regulated flow conditions in the Lower Darling-Baaka) currently sit outside of the Plan in the work approval and operating procedures. They do not offer the flexibility needed to manage a flood recession to mitigate perverse water quality outcomes such as low dissolved oxygen associated with blackwater events, which can lead to fish deaths.

Low dissolved oxygen during flood events can occur when elevated levels of dissolved organic carbon leach into the water column from organic matter that enters the river from the floodplain, which is consumed by microorganisms.[209] The depletion of oxygen as part of this process poses a risk to native fish and other aquatic biota and can be exacerbated by elevated temperature. This was observed at several locations in the Murray-Darling Basin, including in the Lower Darling-Baaka during the 2022-23 floods.

Given the rigidity of current operating rules, management of these events has relied on actively managing incoming flows by mixing poorer quality water in Lake Wetherell with water in other lakes (for example, Pamamaroo) and using water for the environment, including planned environmental water (i.e. Lower Darling EWA), to improve water quality in the Lower Darling-Baaka as was done with releases made in late February-March 2023.[210] The replacement Plan provides an opportunity to prescribe flood recession operating rules based on water quality and link these rules to the Plan's water quality objectives. Specifically, water quality monitoring can be used to inform the management of flood recession flows and mitigate the risk of water with low dissolved oxygen (hypoxia).

With an improved water quality monitoring network, rules could be established for flood recession flows based on longitudinal profiling of dissolved oxygen at locations in the Menindee weir pool.

209 Whitworth, KL, Baldwin, DS and Kerr, JL (2012) 'Drought, floods and water quality: drivers of a severe blackwater event in a major river system (the southern Murray-Darling Basin, Australia', *Journal of Hydrology*, 450-451, pp. 190-198.

210 DPE (2023) *Water Quality Update – 2 March 2023*

Recommendation R22 – Priority 2

To reduce reliance on the Lower Darling EWA and allow for greater responsiveness to the management of water quality events during a flood recession, the replacement Plan should include:

a) clear water quality triggers for managing water with low dissolved oxygen during flood recession flows

b) revised release rates for addressing water with low dissolved oxygen in the Menindee weir pool

c) a requirement that the management of the flood recession flow is based on best available information, including water quality monitoring data.

7.4 Rates of rise and recession limit the management of water quality events

Many of the rules that apply to the operation of Menindee Lakes and flow releases to the Lower Darling-Baaka sit outside of the Plan but can directly influence the outcomes that can be achieved by the Plan and its provisions. One key example is the rates of rise and fall, which are prescribed in the O&O document.[211]

According to the guide to the original Plan,[212] specifying rates of rise and fall was intended to:

- ensure that the natural cues aquatic fauna respond to are maintained
- mitigate the risk of riverbank slumping, which can affect riparian vegetation and contribute to pool sedimentation which can smother aquatic habitat and contribute to water quality issues such as turbidity.

Rates of rise and fall exist across several regulated rivers, but the evidence base of those adopted for the Lower Darling-Baaka is unclear. The guide to the original Plan (dating 2002) indicates that the rates of fall were intended to be applied following '*extended periods of high flow greater than three weeks.*'[213]

The guide to the original Plan also indicates there was an intent to '*monitor and record the effect of [implementing the rates of fall].*' This presumably would have required river operators to inspect and record any observations of bank slumping. However, to the Commission's knowledge, there are no records of observations associated with rates of rise and fall. Further, they have been unchanged for over two decades.

During the Plan review, the Commission heard that the prescribed rates of rise and fall can hinder the management of water quality events by constraining changes in release rates. River operators and water managers require greater flexibility to manage the river to optimise environmental outcomes, including managing water quality and blue-green algae. For this reason, the rates of rise and fall should be relaxed, and sites downstream monitored for any evidence of bank slumping on an event basis to help determine if there is a threshold that may result in bank slumping.

211 Table 11 and 12 in the O&O document set out the fall and rise in flow rates at the Weir 32 gauge.
212 Murray Lower Darling Community Reference Committee (2003) *Guide to the draft water sharing plan for the NSW Murray-Lower Darling Regulated River Water Source, Appendix 1*, unpublished.
213 *Ibid.*, p. 45.

Rates of rise and fall should also reflect best available information including improved understanding of environmental water requirements. For example, the *Murray-Lower Darling Long Term Water Plan* includes a Murray cod nesting environmental water requirements, which aim to protect nesting sites by avoiding rapid changes in water levels during the September-November nesting season, which may cause adults to abandon nests or desiccation of nests.[214] The long term water plan indicates that during the nesting season the maximum rate of fall is 1 percent per day.[215]

There should be a requirement in the Plan for environmental water requirements to be considered when making releases to the Lower Darling-Baaka, including changes in rise and fall of releases.

Recommendation R17 – Priority 1

The Water Group should seek Basin Officials Committee agreement to provide greater flexibility in the rates of rise and recession and codify these arrangements in the Plan's operating rules to ensure they do not hinder delivery of flow pulses for water quality outcomes while supporting ecological outcomes.

7.5 Environmental water from the northern Basin may not be protected

The Commission strongly supports the recrediting of water for the environment originating from the northern Basin[216] when it enters Menindee Lakes and does not support the reregulation of this water for downstream consumptive use. Protecting this water through the southern Basin would be consistent with the Plan's connectivity and other environmental objectives.

The recent northern and southern Basin connectivity trial involving around 42 GL of held environmental water was an important step in the protection of this water originating from the northern Basin that required Basin states to agree on protecting HEW entering Menindee Lakes through the southern Basin. At its February 2024 meeting, the Basin Officials Committee recognised the decline in the condition of the Menindee Lakes System and Lower Darling-Baaka and directed the Water Liaison Working Group to expedite the trial to protect held environmental water.[217] The trial, which commenced late May 2024 and ran through June 2024, is recognised in the Water Group's *Building the pathway to improved northern Basin connectivity* document,[218] which was released following the Connectivity Expert Panel's final report.

Protection of HEW does not just require changes to the Plan. It also requires changes to the Murray-Darling Basin Agreement. Specifically, changes to the way water in Menindee Lakes is shared between states in the southern Basin. Under Clause 94(c) of the Murray-Darling Basin Agreement, NSW and Victoria are entitled to use half the water entering the Menindee Lakes from the Darling River, subject to the prior entitlement of NSW to use water from the Menindee Lakes Storage as provided in Clause 95. The Agreement does not explicitly exclude water for the environment originating from the northern Basin from the

214 DPIE (2020) *Murray-Lower Darling Long Term Water Plan Part B: Murray-Lower Darling planning units*
215 Table 13 *Ibid*.
216 HEW is currently protected via the active management mechanism through the northern Basin tributaries (selected water sources) and the Barwon-Darling into Menindee Lakes.
217 MDBA (2024) *Basin Officials Committee communique –February 2024*
218 DCCEEW (2024) *Building the pathway to improved northern Basin connectivity*

shared resource. This is a significant issue that requires resolution given it erodes the potential environmental benefits associated with this water.

While this issue is yet to be addressed in the Agreement, the Water Group could potentially use Plan provisions to protect the NSW share of this water from take until it reaches the border with South Australia, therefore contributing to connectivity objectives and environmental outcomes in the Lower Darling-Baaka. The Water Group could also develop appropriate protections for when the Lakes are under NSW control thereby demonstrating the NSW Government's commitment to northern-southern Basin connectivity.

The Commission understands that a focus of the MDBA's review of the operation of Menindee Lakes is the protection and transfer of environmental flows from the northern Basin to the southern Basin, including when water in the Lakes is not a shared resource.[219] Where the water in the Lakes is under NSW control, NSW could in theory implement a mechanism to protect held environmental water originating from the northern Basin.

The Commission understands that two consecutive PPM reviews have recommended that '*the Water Group develop a policy on PPMs from the Menindee Lakes System when under NSW control*.' This policy should clarify the recrediting of environmental water.

Recommendation R18 – Priority 1

The Water Group should seek Basin Officials Committee agreement on permanent arrangements to recredit all water for the environment originating from the northern Basin to formalise its protection in the southern Basin. These provisions should be incorporated into the replacement Plan and the Murray-Darling Basin Agreement.

7.6 Flows to the Great Darling Anabranch are not well supported in the Plan

The Great Darling Anabranch (the Anabranch), which has significant environmental values, is part of the Lower Murray-Darling Unregulated Water Source, to which the recently gazetted *Water Sharing Plan for the Lower Murray-Darling Unregulated River Water Source 2024* (the unregulated Plan) applies. It describes the Anabranch as including '*the channel of the anabranch, associated lakes, and Redbank Creek downstream of Cawndilla Channel and Tandou Creek*'.[220] The unregulated plan's significant wetlands map includes the Anabranch lakes.[221]

The Anabranch is highly dependent on flows from the regulated river (Lower Darling Water Source, notably releases from Lake Cawndilla and the Lower Darling-Baaka during high flows) to support its environment values. However, this is not explicitly recognised in the unregulated Plan. Domestic and stock needs are serviced via the Anabranch Pipeline System, which is managed by Anabranch Water.[222] Commissioning the pipeline in 2008 reduced the need for replenishment flows down the Anabranch and reinstated its

219 Terms of Reference for the MDBA's review of the operation of Menindee Lakes, approved by the basin Officials Committee June 2024.
220 Schedule 5: Dictionary in the *Water Sharing Plan for the Lower Murray-Darling Unregulated River Water Source 2024*
221 DCCEEW (2024) *Significant wetlands map version 1: Water Sharing Plan for the Lower Murray-Darling Unregulated River Water Source 2024*
222 Anabranch Water is responsible for providing domestic and stock water to 43 landholders along the Great Darling Anabranch. This water is sourced from both the River Murray and the Lower Darling-Baka depending on conditions in the Lower Darling-Baaka.

ephemeral nature.[223] Other sources of water to the Anabranch include overland flows from the Lower Darling-Baaka and, in the lower reaches, backwater from the Murray River and connected groundwater sources.[224]

The *Murray-Lower Darling Long Term Water Plan* recognises the significant changes in the flow regime of the Lower Darling-Baaka and associated impacts on the Anabranch and Anabranch lakes. Most notably, a 68 percent reduction in bankfull flows that are important for supporting connectivity with the Anabranch.[225] It also identifies the significant risk to floodplain wetlands (i.e. the Anabranch lakes) given environmental water volumes are not adequate for providing larger flow events of sufficient duration to inundate these areas to support native vegetation and waterbird breeding.

The regulated Plan is also silent on how water is shared with the Anabranch to support the Plan's connectivity and other environmental objectives and does not include any specific strategies for the provision of flows to the Darling Anabranch. The O&O document also lacks specific objectives, outcomes and rules relating to the Anabranch, but has a mechanism to include relevant objectives. Providing clarity around water sharing from Lake Cawndilla between the Anabranch and the Lower Darling-Baaka will be important if a proposal to modify the Penellco channel to enable delivery of flows from Lake Canwdilla to the Lower Darling-Baaka proceeds.[226]

During the Plan period, the Anabranch received HEW and surplus flows (operational water). These flows provided for connectivity with the River Murray, including the first connection in around five years (in 2021). This was important for dispersal of golden perch,[227] with recent research highlighting the important role of the Anabranch in connecting the golden perch nursery in Lake Cawndilla with the River Murray.[228] Plan rules should aim to support these flow events and ensure that environmental water deliveries down the Anabranch are not reregulated in the River Murray. Complementary measures such as fishways at the Lake Cawndilla outlet and Packers Crossing would also contribute to improved outcomes by supporting fish movement.

While not part of the recent trial of shepherding HEW from the northern Basin through to the southern Basin (May-June 2024), there is an opportunity for this water to be delivered down the Anabranch in the future. Plan rules should facilitate this to occur and provide the environmental water holder with the confidence that HEW from the northern Basin will be protected through the southern Basin.

The Anabranch has been subject to several red and amber alerts for blue-green algae during the Plan period, but there are currently limited mechanisms to manage these events. Depending on storage levels in Lake Cawndilla and future projects that seek to connect Cawndilla with the Lower Darling-Baaka, there may be opportunities to deliver flushing flows from the lake for mitigating blue-green algae, but this requires further research and must be considered in the broader context of reforms to improve the health of the Lower Darling-Baaka.

223 The Darling Anabranch Pipeline and Environmental Flows project sought to return the Great Darling Anabranch (around 460 kilometres stretch of water course) to a more natural ephemeral system.
224 DPIE (2020) *Murray–Lower Darling Long Term Water Plan, Part A: Murray–Lower Darling catchment*
225 *Ibid*.
226 The Penellco Channel enhancement seeks to regrade the Penellco Channel, which was originally constructed to deliver water from the Lower Darling-Baaka to Tandou farm to the south of Lake Cawndilla, to deliver water from the lake to the Lower Darling-Baaka.
227 CEWH (2022) *Lower Darling / Baaka flow and Great Darling Anabranch update 2– for 2021-22*
228 Stuart, I, Fanson, B and Thiem, J (2024) *Native fish movement in the Great Darling Anabranch 2022–23*, a report for the Darling Anabranch Adaptive Management Monitoring Program and CEWH.

Recommendation R24 – Priority 2

As part of Plan replacement, the Water Group should recognise the interrelationship between the Lower Darling Water Source and the Great Darling Anabranch and establish provisions for flows down the Anabranch to support the Plan's connectivity and environmental objectives and to ensure consistency with the *Darling Anabranch Management Plan*.

7.7 The Plan should include amendment clauses for new fishways

The Commission supports new fishways for facilitating fish passage between the Lower Darling-Baaka, Menindee Lakes (particularly the upper lakes) and the northern Basin. The NSW Government's detailed response to the Office of the NSW Chief Scientist & Engineer's fish deaths review indicates that a business case for permanent fish passage in the Menindee Lakes and Lower Darling–Baaka below Menindee is being progressed.[229]

The Commission supports this important step towards permanent fishways and recognises that it may be possible for new fishways to be installed and operational during the term of the replacement Plan. These fishways will require flows to pass through them to facilitate fish movement. For this reason, the Commission considers it important that the replacement Plan includes an amendment clause enabling the operating requirements of these new fishways to be included in the Plan. This will strengthen accountability for the provision of flows through the fishways, so they operate effectively.

For example, the *Water Sharing Plan for the Tweed River Area Unregulated and Alluvial Water Sources 2023* sets a precedence for inclusion of operating rules for supporting fish movement. Clause 40A of the Tweed Plan includes operating rules for the Bray Park Weir fish ladder. Clause 40A(2) specifies the target flow rates to be passed through the fish ladder based on the water storage level of Clarrie Hall Dam.

Recommendation R26 – Priority 3

The Water Group should include an amendment provision in the replacement Plan that allows modification of operating rules for fishways to facilitate fish passage between the Lower Darling-Baaka, the Great Darling Anabranch, Menindee Lakes and the northern Basin.

7.8 Three Mile Creek replenishment flow provisions are not in the Plan

Three Mile Creek is located to the east of the Lower Darling-Baaka. It exits Lake Wetherell approximately 10 kilometres upstream from Menindee Main Weir and flows southwest to connect with the Talyawalka Creek south of the town of Menindee. The Talyawalka Creek continues west to the Lower Darling-Baaka, with another effluent (Charlie Stones Creek) exiting the Talyawalka Creek at the Pooncarie Road crossing and flowing south a further 20 kilometres before itself terminating at the Lower Darling-Baaka. The Three Mile Creek watercourse is generally shallow but contains several broad pools such as Three Mile Waterhole, which retain water for 6-12 months after the creek stops flowing. Both Three

229 DCCEEW (2024) *NSW Government response: Office of Chief Scientist and Engineer independent review into the 2023 fish deaths in the Darling–Baaka River at Menindee*

Mile Creek and the Three Mile Waterhole are listed in the *Murray Lower Darling Long-Term Water Plan*,[230] but environmental water requirements are yet to be developed for the watercourse.

Three Mile Creek typically flows via releases from Lake Wetherell, which is part of the regulated Lower Darling Water Source. Three Mile Creek is part of the Lower Murray-Darling Unregulated Water Source, to which the recently gazetted *Water Sharing Plan for the Lower Murray-Darling Unregulated River Water Source 2024* (the unregulated Plan) applies.

Landholders along Three Mile Creek access domestic and stock water from the creek via a Lake Wetherell inlet regulator which has a maximum structural capacity of approximately 98 ML per day when Lake Wetherell is at full storage capacity.[231] This capacity reduces as storage level falls. Unlike other regulated water sharing plans that include replenishment flow provisions for unregulated water sources, these arrangements are not codified in the Plan.

The Commission understands there is a longstanding arrangement between the NSW Government and landholders along Three Mile Creek to provide for replenishment flows up to two times a year where water is available in Lake Wetherell, and under direction from the NSW Water Group.[232] These arrangements are reflected in the *Menindee Operations and Maintenance Manual*.[233] The manual also specifies that stock and domestic flows are only to be provided once a year when water levels in Lake Wetherell are below 75 percent capacity, and connection with the Lower Darling-Baaka is to be avoided during low flow conditions in the Lower Darling-Baaka to mitigate the risk of poor quality water from Three Mile Creek entering the Lower Darling-Baaka.[234]

CEWH advised there have been fish strandings in Three Mile Creek when the regulator is closed following delivery of stock and domestic flows. As part of the replacement Plan, the Water Group should consider mitigating these risks by slowing flow recession when stock and domestic flows are to be ceased to prolong opportunities for fish to retreat to deeper water in the Three Mile Creek system. This allows for more natural attrition of fish that remain within the system.

The Water Group should also consider how water quality risks in Three Mile Creek and connection with the Lower Darling-Baaka can be managed, including the potential for temporary monitoring in the lead up to and during replenishment flows. Ideally there would be suitable water quality triggers for provision of flows down Three Mile Creek to mitigate water quality risks and this should be codified in the replacement Plan.

CEWH also advised it is exploring the potential for delivery of HEW down Three Mile Creek. Protection of these flow events and recrediting (where the HEW originates from the northern Basin) will be important to formalise in the replacement Plan.

230 DPIE (2020) *Murray-Lower Darling Long Term Water Plan Part B: Murray-Lower Darling planning units*
231 Based on advice from WaterNSW, the outlet regulator capacity in the State Water (2013) *Menindee Operations and Maintenance Manual*, *Version 1.0* (unpublished) is incorrect.
232 Menindee Lakes Storage design of works – Three Mile Creek, 9th August 1961.
233 State Water (2013) *Menindee Operations and Maintenance Manual*, *Version 1.0*, unpublished.
234 By closing the regulator as soon as the flow down Three Mile Creek reaches Pooncarie Road.

Recommendation R25 – Priority 2

As part of Plan replacement, the Water Group should:

a) incorporate replenishment flow provisions for Three Mile Creek (up to twice a year when water is available in Lake Wetherell, or a single delivery when Lake Wetherell falls below 75 percent capacity)

b) develop and incorporate water quality triggers (based on existing water quality monitoring within Lake Wetherell) to inform delivery of flows down Three Mile Creek from Lake Wetherell

c) consider an event-based monitoring program for flow events through Three Mile Creek

d) engage with BCS, DPIRD Fisheries and CEWH regarding opportunities for delivery of water for the environment along Three Mile Creek, including its protection.

8 Strengthening environmental protections in the Murray

The River Murray System and its floodplain hold significant environmental values. The entire length of the river downstream of Hume Dam is an endangered ecological community and there are several internationally and nationally significant wetlands situated in the valley, many of which are dependent on flows from the regulated river. Some of these wetlands span NSW and Victoria, and hence NSW and Victorian planning instruments and associated provisions, and intergovernmental agreements apply.

The Plan includes broad and targeted environmental objectives. The broad objective seeks to '*protect and contribute to the enhancement of the ecological condition of the water sources and their water-dependent ecosystems over the term of this Plan*'.[235] The Plan's targeted objectives relate to the protection and contribution to enhancement of:

- the recorded distribution or extent, and the population structure, of target ecological populations,[236] notably Murray cod, flat headed galaxias, southern pygmy perch, trout cod, golden perch and silver perch, native vegetation (river red gum and black box) and high diversity hotspots and significant habitat
- longitudinal and lateral connectivity within and between water sources to support target ecological processes[237]
- water quality within target ranges for the water source (as defined in the *Water Quality Management Plan for the NSW Murray and Lower Darling Water Resource Plan Area SW8*[238]) to support water-dependent ecosystems and ecosystem functions.

The Plan also includes an objective '*to support environmental watering … to contribute to maintaining or enhancing ecological condition in streams, riparian zones, dependent wetlands and floodplains*'.[239]

Strategies within the Plan are intended to achieve these objectives. However, issues with Plan provisions and external factors mean that objectives are not always realised and in some cases Plan provisions are inconsistent with these objectives and the priorities of the Act.

Changes have occurred to the Plan's environmental provisions since the original Plan was replaced in 2016 that have provided some improvements to planned environmental water provisions. However, evidence remains that the Plan still does not adequately prioritise the environment. Some Plan provisions limit the environmental benefits that can be achieved.

All water in the river is important for supporting environmental values and achieving environmental outcomes. This includes operational water, consumptive water orders, planned environmental water (rules-based) and environmental water holdings. Planned environmental water provisions in the Murray Water Source include the:

- Barmah-Millewa Allowance
- Barmah-Millewa Overdraw
- Murray Additional Allowance

235 Section 8(1) of the Plan.
236 Section 8(2)(a)(i) of the Plan.
237 Section 8(2)(a) (ii) of the Plan.
238 NSW Department of Industry (2020) *Water quality management plan for the NSW Murray and Lower Darling water resource plan area SW8*
239 Section 8(2)(b) of the Plan.

- River Murray Increased Flows.

While it is difficult to apportion the contribution of Plan provisions to environmental outcomes,[240] this chapter attempts to identify where planned environmental water provisions have contributed to the Plan's environmental objectives and associated outcomes (where information is available).[241] It also indicates where improvements can be made to deliver better outcomes for the NSW Murray River Water Source, surrounding unregulated river water sources (that are dependent on and connected to the regulated river water source) and their water-dependent ecosystems. Key issues explored here include:

- provisions are inconsistent with the priorities of the Act (**Section 8.1**)
- limited use of the Barmah-Millewa Allowance during the term of the Plan, including factors contributing to its limited use (**Section 8.2**)
- inadequate consideration of obligations for maintaining the ecological character of Ramsar listed wetlands (**Section 8.3**)
- the contribution of planned environmental water provisions to instream benefits, including water quality objectives is difficult to assess (**Section 8.4**)
- a lack of clarity regarding consultation on the delivery of River Murray Increased Flows and their protection under the Plan (**Section 8.5**)
- expanding PPMs to support efficient and effective environmental water deliveries (**Section 8.6**).

8.1 The Plan is inconsistent with the Act's priorities

When the original Plan was developed, the Committee overseeing it indicated there was limited knowledge of the hydrological requirements of threatened species. As a result '*the requirements of aquatic threatened species were not instrumental in the Committee's decisions regarding the environmental flow rules*'.[242] However, the Committee states that it attempted to maintain or restore critical elements of the natural flow regime considered important for the health of aquatic ecosystems.

Improved knowledge of environmental flow requirements provides an opportunity to ensure the Plan is consistent with the water sharing principles of the Act, which requires that the '*sharing of water from a water source must protect the water source and its dependent ecosystems*' and neither this, nor sharing of water for basic landholder rights, must be prejudiced by sharing or extraction of water under other rights.[243]

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240 There is a lack of monitoring of the effectiveness of environmental provisions. In addition, concurrent releases may 'mask' the effects of some environmental provisions, for example, bulk irrigation deliveries as noted in Growns, I and Reinfeld, I (2014) 'Environmental flow management using transparency and translucency rules', *Marine and Freshwater Research*, 65, pp. 667-673.

241 At the time of this Plan review, the Water Group in consultation with BCS was analysing the achievement of environmental water requirements in NSW regulated rivers, including the NSW Muray and Lower Darling-Baaka. This information was not available in time for this Plan review but should inform the Water Group's replacement Plan process and future water sharing plan reviews.

242 Murray Lower Darling Community Reference Committee (2003) *Guide to the draft water sharing plan for the NSW Murray-Lower Darling Regulated River Water Source, Part A*, unpublished, p.12.

243 Section 5 (3) of the Act states that '*In relation to water sharing —*
(a) sharing of water from a water source must protect the water source and its dependent ecosystems, and
(b) sharing of water from a water source must protect basic landholder rights, and
(c) sharing or extraction of water under any other right must not prejudice the principles set out in paragraphs (a) and (b)'.

The Commission considers that, consistent with Section 5(3) of the Act, the Plan must first ensure that there is adequate water at the necessary times to protect the water sources and their dependent ecosystems. This requires that the Water Group, in consultation with other agencies such as BCS and DPIRD Fisheries, clearly identify the fundamental ecosystem health needs of the water sources (based on best available evidence) and ensure that the Plan protects them.

Evidence indicates that the Plan's environmental provisions currently do not adequately prioritise or protect fundamental ecosystem health. Examples of where the Plan is inconsistent with the Act include:

- uncertainty that the LTAAEL is sustainable (see **Chapter 5**)
- Plan rules that restrict the use of the Barmah-Millewa Allowance and the environmental benefits it can provide (see **Section 8.2**)
- inadequate consideration of obligations for maintaining the ecological character of Ramsar listed wetlands (see **Section 8.3**)
- uncertainty over how Plan rules contribute towards the management of water quality and algal events (see **Section 8.4**).

In addition, there are provisions intended to provide environmental benefits that sit outside of the Plan. Like the Lower Darling Water Source, minimum daily flow targets (minimum planned regulated releasers) for Hume Dam in the upper River Murray System (NSW Murray Water Source) are part of the O&O document for river operations in the River Murray System.[244] With rules sitting outside of the Plan, it is difficult to assess the cumulative benefits that the suite of provisions provide.

8.2 Limited use of the Barmah-Millewa Allowance and overdraw for environmental purposes

The Barmah-Millewa Allowance has been in place for over two decades, predating the Plan, and was designed to support flooding of the Barmah-Millewa Forest. Both NSW and Victoria have a Barmah-Millewa Allowance. The arrangements are specified in interjurisdictional agreements and the *NSW and Victorian Operating Rules for the Barmah-Millewa Environmental Water Allocation 2021*. The Plan establishes the rules for the managing the NSW Barmah-Millewa Allowance.

Each year a volume up to 75,000 ML is credited to the NSW Barmah-Millewa Allowance, which can be accrued up to 350 GL.[245] Crediting of the allowance account is linked to Victorian seasonal allocations and triggers based on inflows to Hume Reservoir.[246]

The allowance can be used at the discretion of the NSW Environmental Water Manager, who may order water to be released and debited from the Barmah-Millewa Allowance to provide environmental outcomes in the Barmah-Millewa Forest. Water in the allowance can also be used for other environmental purposes if it is not required for watering the Barmah-Millewa Forest.[247]

244 Section 2.3 of the Basin Officials Committee (2023) *Objectives and outcomes for river operations in the River Murray System* sets out minimum daily planned releases for supporting environmental assets and ecosystem functions between Hume Reservoir and Yarrawonga Weir. Minimum targeted releases from Hume Dam are 600 ML per day while the minimum daily flow target at Doctor's Point is 1,200 ML per day.
245 Clause 56 and Clause 59(2) of the Plan.
246 Clauses 56(1)(a) and (b) of the Plan.
247 Clause 58(3) of the Plan.

The Barmah-Millewa Allowance was used twice during the Plan period (see **Table 3**). Both deliveries were made during wet periods:

- The 2016-17 event comprised 282 GL of planned and held environmental water delivered as part of a multi-site watering event along the Murray River. The Barmah-Millewa Allowance accounted for around 30 percent of the environmental water delivery. Millewa Forest was one of the sites watered during the event, with natural flows providing flood conditions early in the year and environmental flows largely delivered during flood recession to sustain water levels for colonial waterbird nesting cycles.[248]
- The 2021-22 event was also a multi-site event comprising planned and held environmental water, totalling 222.8 GL. The Barmah-Millewa Allowance accounted for around 22 percent of the environmental water delivered.

Given the limited use of the allowance during the Plan period and combined deliveries with other types of environmental water, it is difficult to assess the effectiveness and extent to which this provision supported the health of the Barmah-Millewa Forest and other environmental values. Nonetheless the two deliveries during the term of the Plan did contribute towards environmental outcomes in the Millewa Forest (NSW), as outlined in **Table 3**.

Data collected as part of The Living Murray-funded condition monitoring program indicates that the native fish community and populations of the Barmah-Millewa Forest have declined since the last watering event that included water from the Barmah-Millewa Allowance (2021-22). Reporting for 2022/23 indicates that hydrological conditions have supported introduced species, including common carp and goldfish, particularly in semi-permanent habitats, and resulted in very low recruitment of native small-bodied and juvenile large bodied species during that year.[249] It also indicates a need to examine the causal factors driving the decline in native fish populations and communities, including the forest's watering regime and whether changes are needed. This information is vital not only for improving use of HEW, but also planned environmental water, including the Barmah-Millewa Allowance.

Other interventions are also important, particularly for supporting the recovery of small-bodied native fish species. A Millewa fish recovery strategy has been developed for the reintroduction of some of these species in 2024-25.[250] This strategy is also important for considering how to restore key parts of the flow regime to support ecosystem health.

BCS advised that, during Plan period, rules and other factors affected the use of the allowance by the NSW Environmental Water Manager in the Millewa Forest. Specifically:

- borrowing and payback provisions in the Plan, while benefiting consumptive users, impacted on the availability of the allowance for environmental watering events (these issues are further discussed in **Section 8.2.1**)
- constraints associated with the Barmah Choke (the Narrows) impacted on opportunities for environmental water deliveries during the term of the Plan. Flow delivery constraints at the Narrows limit the volume of water for the environment that can be delivered to a maximum of 22,000 ML per day at the Millewa Forest.[251] Above this, there is a risk of large-scale flooding across private land. Flow constraints mean that environmental water deliveries often alternate between Millewa (NSW) and Barmah (Victoria) forests

248 Office of Environment and Heritage (2018) *Intervention Flow Monitoring, Millewa Forest 2016-17*
249 Raymond, S, Duncan, M, Tonkin, Z and Robinson, W (2023) *Barmah-Millewa Fish and Crayfish Condition Monitoring (2007-2023)*, unpublished report for the MDBA.
250 DPE and National Parks and Wildlife Service (2023) *Millewa Fish Recovery Strategy*
251 DPE – Environment and Heritage Group (2023) *Millewa Forest Fish Recovery Strategy*

as desired flood depth and duration for floodplain vegetation cannot be achieved in both forests at the same time.[252] Constraints relaxation that is intended to improve environmental outcomes is further discussed in **Chapter 11**.

- HEW deliveries were favoured above use of the Allowance because return flows of HEW (and River Murray Increased Flows) are protected via PPMs (see **Section 8.2.2**). However, return flows of Barmah-Millewa Allowance are not protected. This lack of protection acts as a disincentive for the use of the allowance and potentially limits environmental outcomes that could be realised from re-use of the allowance.
- The NSW and Victorian Operating Rules for the Barmah-Millewa Environmental Water Allocation 2021 require that releases of the NSW and Victorian Barmah-Millewa Allowances are shared between the two states i.e. an equal split. This impacts on deliveries of the NSW Barmah-Millewa Allowance to the Millewa Forest.

The Commission's analysis focuses on issues within scope of the water sharing plan review, notably the borrowing and payback rules and the lack of protection of Barmah-Millewa Allowance return flows. However, the Commission notes that some of these issues also sit within other interjurisdictional agreements, most notably the Murray-Darling Basin Agreement and O&O document.

The Commission also notes that the Barmah-Millewa overdraw account, which is also intended to provide for environmental outcomes in the Barmah-Millewa Forest, has not been used during the term of the Plan according to general purpose water accounts.[253] Delegation of decision-making regarding the use of the overdraw was assigned to the NSW Environmental Water Manager as part of Plan amendments, but it has not yet been used.

Table 3: Environmental watering events during the Plan period that include water from the Barmah-Millewa Allowance

Water year	Event description	Environmental water used	Outcomes[254]
2016-17	Multi-site event that included delivery of flows to the Millewa Forest (NSW) following a natural flood event. Environmental water delivery to Millewa Forest was intended to maintain water heights in wetlands to support waterbird breeding and promote connectivity between the floodplain and river to support fish populations.[255]	282.2 GL delivered, comprising:[256] - 40,700 ML The Living Murray - 107,481 ML Commonwealth HEW - 84,032 ML Barmah-Millewa Allowance	Natural flooding, which was prolonged with environmental water delivery (including planned environmental water), supported thousands of colonial and migratory waterbirds, with breeding recorded at six monitoring sites in the Millewa Forest during waterbird surveys undertaken in 2016-17. The highest number of breeding pairs was recorded in Reed Beds wetland complex. Environmental water delivery helped to extend inundation at an appropriate height for protecting

252 Goulburn-Broken Catchment Management Authority (2024) *Barmah Forest seasonal watering proposal 2024-25*
253 NSW DCCEEW (2024) *General Purpose Water Accounting Report NSW Murray Catchment 2022-23*,
254 Borrell, A, Liefting, A and Webster, R (2017) *Monitoring Waterbird Activity in Millewa Forest 2016-2017*; Office of Environment and Heritage (2018) *Intervention Flow Monitoring, Millewa Forest 2016-17*; DPE (2023) *General Purpose Water Accounting Report NSW Murray Catchment: 2021-22*; Ecology and Heritage Partners (2022) *TLM Condition Monitoring 2021/22 - waterbirds: Barmah-Millewa Forest, Victoria and NSW*
255 Office of Environment and Heritage (2018) *Intervention Flow Monitoring, Millewa Forest 2016-17*
256 Volumes from Table 1 in NSW Office of Environment and Heritage (2018) *Intervention Flow Monitoring, Millewa Forest 2016-17*

		- 50,000 ML River Murray Increased Flows	fledglings and nests and provided foraging areas. Although this was a successful waterbird breeding event, it was recorded as smaller than previous events, possibly given the significant flooding and waterbird breeding across catchments. The watering event also provided for connectivity and fish passage, and supported vegetation outcomes across the icon site, including a positive response from Moira grass (*Pseudoraphis spinescens*) in the Moira Lake area.
2021-22	Multi-site event which included delivery of flows to the Millewa Forest (NSW) following a natural flood event.	222.9 GL delivered, comprising:[257] - 37,826 ML The Living Murray - 112,171 ML Commonwealth HEW - 47,893 ML Barmah-Millewa Allowance - 25,000 ML River Murray Increased Flows	The multi-site watering event achieved environmental outcomes in the Barmah National Park, Murray Valley Regional Park and Gulpa Creek. Successful waterbird breeding was recorded at several sites, with many waterbodies supporting an extended breeding season due to the extent and duration of inundation. Waterbird monitoring in 2021-22 recorded the highest abundance and species richness at sites in the Millewa Forest (NSW) across seasons compared to Barmah Forest sites (Victoria). Two sites in the Moira Precinct of the Millewa Forest Group (Red Beds South and Duck Lagoon) recorded the highest species richness of waterbirds, with 28 species recorded. Condition monitoring in the Barmah-Millewa Forest indicates the occurrence of six common frog species has increased in the icon site, particularly barking marsh frog (*Limnodynastes fletcheri*) whose occupancy has increased across the icon site over the past five years. Significant flooding in Spring 2022 may have contributed to this result.

8.2.1 Borrowing and payback provisions require review

Based on consultation, the Commission understands that consumptive users have benefited from the Plan's borrowing and payback provisions. These provisions allow:

- **Borrowing:** river operators borrow against the Barmah-Millewa Allowance in times of low water availability i.e. when AWDs for regulated river (general security) access licences in the Murray Water Source are less than 0.3 ML per unit share, or 0.5 ML per

[257] Volumes based on data provided by BCS from its environmental watering database.

unit share where 'exceptional circumstances' apply.[258] Allowance that is carried over from the previous water year is debited first, then water that was credited to the allowance account in the current water year.

- **Payback:** the operator is only required to pay back the allowance when the AWD for regulated river (general security) access licence holders is equal to or exceeds the triggers for borrowing.[259] The account can go up to four years without being credited for water borrowed.[260] During the Plan period, there was a window of three years before the Barmah-Millewa Allowance account was repaid, with up to 296.1 GL sitting in the borrowed account in 2019-20 before being repaid the following water year (see **Appendix 1**). This means that the NSW Environmental Water Manager had limited allowance to use during dry years.

The borrowing rules in the Plan are rigid and do not adequately consider whether borrowing of the allowance poses significant risks to meeting the environmental needs of the Barmah-Millewa Forest. They also limit the use of the Allowance for other environmental purposes if the needs of the Barmah-Millewa Forest have been met.

In addition, there is no requirement for consultation with the NSW Environmental Water Manager or concurrence from the Minister for the Environment before proceeding to debit the Barmah-Millewa Allowance to borrow water for regulated river (general security) access licences. There is a note in the Plan (under Clause 57(3)) that Victoria and NSW consult with one another regarding decisions to borrow but given this is a note it is not a legislated requirement.

Repayment of water borrowed from the Allowance is also an important issue given the water that is available for use in the Barmah-Millewa Forest depends on what has been withdrawn.[261] BCS advised that the current rules impacted its ability to draw on the allowance when it was needed, while other stakeholders called for the payback provisions to be lifted above the current triggers. Murray Irrigation Limited called for the payback trigger to be raised, specifically to when regulated river (general security) allocations reach 70 percent.[262] Its rationale for this proposed change was associated with the significant environmental water holdings in the Murray that have emerged since the allowance was first established.

The Commission understands there may be circumstances where borrowing against the allowance is feasible, but this should not be at the expense of the needs of the environment, particularly given the environment has primacy under the Act. Further, raising payback triggers could potentially constitute an erosion of planned environmental water if it impacts on availability of the Allowance for environmental purposes. Reductions in planned environmental water are not allowed under Section 10.28 of the Basin Plan.

258 Clauses 57(2)(a) and 57(2)(b) of the Plan; Clause 54 of the Plan defines 'exceptional circumstances' as '*the average November water availability for the four years up to, and including, the current water year is less than 0.5 ML per unit share for all regulated river (general security) access licences in the Murray Water Source.*'

259 Clause 56(3) of the Plan.

260 Clause 57 (3) of the Plan requires that if water has been debited from the Barmah-Millewa Allowance in four consecutive water years, the Minister may determine that the debit under Subclause (2) is not to occur in the fifth consecutive water year.

261 NSW DCCEEW (2024) *General Purpose Water Accounting Report NSW Murray Catchment 2022-23*,, p.58.

262 Murray Irrigation Limited (2024) *Submission to the review of the NSW Murray and Lower Darling Regulated Rivers Water Sharing Plan, 23 February 2004.*

8.2.2 Barmah-Millewa Allowance return flows should be protected

Return flows can provide a range of environmental benefits for the River Murray, including but not limited to providing water for downstream environmental needs and supporting riverine productivity. This is because flows that result in inundation of the floodplain provide a range of benefits for the floodplain and the river by transporting dissolved organic carbon and nutrients from the floodplain back into the river.

Currently, HEW and River Murray Increased Flows contribute to these environmental benefits, as their return flows are protected from take via PPMs (see **Section 8.6**). However, Barmah-Millewa Allowance flows returning from the Barmah-Millewa Forest are not protected. The 2021 operating rules state that this water upon '*leaving the forest and returning to the upper River Murray, is not protected as it passes downstream and can be used by NSW and Victoria according to the [Murray-Darling Basin Agreement].*'[263]

Changing the Plan to protect the return flows of Barmah-Millewa Allowance would align with the Plan's environmental objectives and Clause 58(3) of the Plan that states that if the needs of the Barmah-Millewa Forest have been met the allowance can be used for other environmental purposes.[264] However, progressing this protection requires changes to the Murray-Darling Basin Agreement, O&O document, NSW and Victorian operating rules and the Plan.

Affording protection would also only be materially beneficial with increased use of the Allowance. As noted in **Section 8.2**, several factors have limited its use and need be addressed to warrant protection of return flows. Social and economic impacts associated with protection of these return flows would also need to be considered.

Recommendation R27 – Priority 1

To ensure that the needs of the environment, specifically the Barmah-Millewa Forest, are prioritised, the Water Group should:

a) develop a transparent procedure for borrowing and payback of the Barmah-Millewa EWA that prioritises the needs of the environment consistent with the Act and reference this in the replacement Plan

b) include a provision requiring for the NSW Environmental Water Manager be consulted on borrowing against the Barmah-Millewa EWA and concurrence from the Minister for the Environment for the borrowing of this water for regulated river (general security) access licences

c) to support R27(b), develop a decision tree in consultation with BCS for using the allowance for other environmental purposes when it is not needed for watering the Barmah-Millewa Forest to improve the use and effectiveness of the allowance

d) assess the feasibility of protecting Barmah-Millewa EWA return flows in consultation with the Basin Officials Committee and Victoria to improve the environmental benefits the allowance can provide

e) in consultation with BCS, review why the Barmah-Millewa Overdraw provisions have not been used during the term of the current Plan and revise them in the replacement Plan so that they are fit for purpose.

263 Section 11.3 of the *NSW and Victorian Operating Rules for the Barmah-Millewa Forest Environmental Water Allocation 2021*.
264 Clause 58(3) of the Plan.

8.3 Environmental provisions do not recognise Ramsar requirements

The NSW Central Murray Forests, which include Millewa, Werai and Koondrook-Perricoota forests, is listed on the Ramsar Convention of Wetlands of International Importance. This Ramsar site comprises around 38,000 hectares of the Millewa Forest Group (NSW),[265] Koondrook-Pericoota Forest Group[266] and Werai Forest Group.[267] Some of these forests are also included as The Living Murray Icon Sites. However, the Plan does not specifically recognise their importance or how it contributes towards maintaining their ecological character, which is a requirement of the listing under the Ramsar Convention.

The Commission recognises that the Millewa Forest has a dedicated environmental water allowance (the Barmah-Millewa Allowance, see **Section 8.2**), but the Plan does not explicitly state that this provision can contribute towards maintaining the ecological character of the Central Murray Forests Ramsar site.[268]

Plan objectives and performance indicators also do not recognise the Ramsar site. Given the lack of reference of the ecological character and wetlands watering targets, a recent policy analysis ranked the Plan as low in terms of its contribution towards maintaining the Ramsar site's ecological character.[269]

The replacement Plan should recognise the international importance of the Central Murray Forests and, in the Plan strategies, specify the Plan provisions that can assist in maintaining ecological character. Contributing towards these international obligations should be prioritised before any borrowing from the allowance account can occur.

Recommendation R30 – Priority 3

To ensure that the Plan aligns with commitments under the Ramsar Convention of Wetlands of International Importance, the Water Group should ensure that the replacement Plan includes:

a) objectives that list the internationally significant NSW Central Murray Forests

b) strategies that contribute towards maintaining the ecological character of the Ramsar site

c) specific provisions that provide for the required protection of the Ramsar site.

265 At the time of Ramsar listing the Millewa Forest Group included Millewa State Forest, Gulpa Island State Forest, Moira State Forest and Tuppal State Forest.

266 At the time of Ramsar listing the Koondrook State Forest, Perricoota State Forest and Campbells Island State Forest.

267 At the time of Ramsar listing the Werai Forest Group included Werai State Forest and Barratta Creek State Forest.

268 Harrington, B. and Hale, J., (2011) *Ecological Character Description for the NSW Central Murray Forests Ramsar site*, report to the Department of Sustainability, Environment, Water, Population and Communities.

269 Kirsch, E, Collier, MJ and Pittock, J (2021) *Lacking character? A policy analysis of environmental watering of Ramsar wetlands in the Murray-Darling Basin, Australia.' Marine and Freshwater Research*

8.4 Plan rules for managing water quality should be strengthened

The Plan is not explicit about provisions for managing water quality to support its water quality objectives. It is the responsibility of all water users to contribute to strategies to ameliorate water quality issues given river regulation is a causal factor and the impacts of water quality events can be far reaching.

When the original water sharing plan was developed the Murray Lower Darling Community Reference Committee (the Committee) intended for the Murray Additional Allowance (which reflects a high security contribution to environmental outcomes in the River Murray) to contribute towards instream environmental benefits and mitigation of blue green algae in the Mildura, Wentworth and Euston weir pools. The Committee estimated an average contribution of 8 GL per year.[270]

The Plan requires the NSW Environmental Water Manager '*to manage the Murray Additional Allowance for any purpose consistent with the environmental objectives in clause 8 of this Plan*'.[271] BCS advised that the Murray Additional Allowance is largely used for environmental water deliveries to wetlands and is not considered sufficient for managing water quality.

The Plan requires that an amount equal to 0.03 ML per unit share of all regulated river (high security) access licences in the Murray Water Source (excluding special purpose licences) is credited to the Murray Additional Allowance when the AWD reaches 0.97 ML per unit share.[272] This is equivalent to 5,691 ML based on current shares of 189,704 units across 845 regulated river (high security) access licences.[273]

The NSW Environmental Water Manager is responsible for managing the allowance, including making orders for its release consistent with the Plan's environmental objectives. It is typically included in orders early in the season given the Murray Additional Allowance is the first of the Plan's EWAs to be withdrawn in the event of dam spills.[274] During the Plan period, the Murray Additional Allowance has contributed around 5.7 GL in most years,[275] including watering events that have provided connectivity and associated environmental benefits.

The NSW Murray and Lower Darling Water Quality Management Plan does not list the Murray Additional Allowance as a mechanism to manage the risk of harmful algal blooms.[276] However, it lists the allowance as a mechanism to manage other water quality issues such as blackwater events and elevated turbidity. There is a lack of evidence of the allowance being ordered for managing water quality and algal events but the Plan currently provides the flexibility to use the allowance where it is needed.

Monitoring water quality in the River Murray is the responsibility of WaterNSW and the MDBA and is a requirement of the Murray-Darling Basin Agreement.[277] An interjurisdictional monitoring program led by the MDBA includes 28 sites across NSW, Victoria and South Australia. There are also other WaterNSW monitoring sites along the river. The MDBA-led

270 Murray Lower Darling Community Reference Committee (2003) *Guide to the draft water sharing plan for the NSW Murray-Lower Darling Regulated River Water Source, Appendix 1*, unpublished.
271 Clause 61(3) of the Plan
272 Clause 61(1) of the Plan.
273 Based on data from the *NSW Water Register* for the 2023/24 water year.
274 Clause 62 of the Plan.
275 Based on data from general purpose water accounts.
276 DPE (2020) *Water Quality Management Plan for the NSW Murray and Lower Darling water resource plan area SW8*
277 An interjurisdictional Water Quality Advisory Panel provides governance and expert advice regarding the MDBA's role in managing the water quality of the River Murray, its tributaries and storages.

program has been operating since 1978 and includes water quality parameters and algal monitoring.

Trend analysis of algal data (MDBA dataset) by La Trobe University indicates that cyanobacteria abundance (cells per millilitre) and biomass (cubic millimetres per litre) have increased since 1978 at all sites in the River Murray.[278] Several sites recorded the greatest increase in cell counts between 2010 and 2022, including Euston Weir,[279] which is one of the sites that the Murray Additional Allowance was intended to target for mitigating blue green algae.

Despite this evidence, the risk outcomes for recreational water quality from harmful algal blooms in the NSW Murray and Lower Darling Water Quality Management Plan rated Murray River at Euston low for harmful algal blooms.[280] This may be due to different monitoring site locations and timeframes for NSW and MDBA monitoring data. Nonetheless, the trend analysis does imply a higher algal risk at Euston.

In the replacement Plan, the Water Group and BCS should work together to clarify the role and purpose of the Murray Additional Allowance and the objectives it contributes towards. Agencies should also determine what provisions are needed to mitigate significant water quality issues and algal events (where these can be influenced by flow), including consideration of whether the allowance can be used or combined with other water deliveries to manage water quality and algal events.

For example, there may be opportunities for the Barmah-Millewa Allowance (where it is not borrowed or needed for sites in the Millewa Forest) to be combined with the Murray Additional Allowance to manage water quality and mitigate algal blooms.

Recommendation R28 – Priority 2

The Water Group should work with BCS to determine what rules are needed to meet the Plan's water quality objectives. The Water Quality Management Plan that the Plan refers to should also be updated to clarify the provisions that help manage water quality and algal events.

8.5 Delivery advice and protection for River Murray Increased Flows lack clarity

River Murray Increased Flows is environmental water made available through water recovered as part of the Water for Rivers (Snowy Joint Government Enterprise) Program. The purpose of River Murray Increased Flows is to improve the health of the River Murray system, including The Living Murray program icon sites. Under the Snowy Water Inquiry Outcomes Implementation Deed, up to 70 GL is credited each year for River Murray Increased Flows.[281] These arrangements predate the Plan and Basin Plan, with management

278 Holland, A, Gionfriddo, C, McPhan, L, Lewis, S, Shackleton, M and Silvester, E (2023) *Synthesis of Blue Green Algae (Cyanobacteria) bloom knowledge and analysis of recent trends in the Murray Darling Basin*

279 *Ibid*., p. 42.

280 DPE (2020) *Water Quality Management Plan for the NSW Murray and Lower Darling water resource plan area SW8*, p. 52.

281 Up to 70 GL of water is made available for River Murray Increased Flows based on water savings achieved through the Water for Rivers program. Under Clause 16.1 of the Snowy Water Inquiry Outcomes Implementation Deed, the NSW Government is to apportion water recovered under the program between Snowy River Increased Flows and River Muray Increased Flows on a 2:1 basis. Once River Muray Increased Flows annual allocation reaches 70 GL, all water is allocated to Snowy River Increased Flows.

of River Murray Increased Flows based on a set of temporary rules that sat outside the Plan in the 2013 Strategy for River Murray Increased Flow Rules.[282]

In 2022, provisions relating to the crediting, debiting, carryover and delivery of River Murray Increased Flows were added to the Plan.[283] This was an important step in formalising accounting arrangements (including a new planned environmental water account)[284] and the rules that apply to River Murray Increased Flows, including the requirement for the river operator to make River Murray Increased Flows releases '*in accordance with orders made by the NSW Environmental Water Manager*'.[285] Previously, Snowy Hydro had discretion over releases of River Murray Increased Flows and environmental water managers had limited opportunity to maximise the environmental benefits that could be realised from these flows.[286] Changes were made to the Snowy Hydro Licence in 2011 to allow NSW and Victorian environmental water managers to direct releases of River Murray Increased Flows, but this had not been carried across to the Plan.

Given the River Muray Increased Flow provisions are a relatively new addition to the Plan and no River Murray Increased Flow releases were made in 2022-23,[287] the Commission did not assess the Plan's new provisions in detail. However, the Commission acknowledges that River Murray Increased Flow releases were part of several environmental watering events that occurred during the term of the Plan and have contributed towards environmental outcomes in the Plan area. For example, they were part of the 2016 -17 and 2021-22 multi-site watering events listed in **Table 3** that provided a range of environmental benefits. The Commission also notes that requirements for annual reporting on environmental outcomes of River Murray Increased Flows sit outside of the Plan in the Murray-Darling Basin Agreement.[288]

Two key areas that the Plan does not specify, which should be clarified in the replacement Plan include:

- The role of the Southern Connected Basin Environmental Watering Committee when calling on River Murray Increased Flows. Other regulated river plans specify where the NSW Environmental Water Manager is to consult and consider advice from environmental water advisory groups before calling on planned environmental water. Similar provisions should be incorporated for the Southern Connected Basin Environmental Watering Committee to strengthen governance arrangements around the use of environmental water.
- The extent of protection afforded to River Murray Increased Flows. The Plan does not specify that River Murray Increased Flows deliveries are not to be used for meeting water orders of consumptive users. The replacement Plan should clearly specify how these flows are protected.

The Plan also allows for the Minister to consider creating a new licensed entitlement for River Murray Increased Flows water in lieu of the planned environmental water provisions

282 Basin Officials Committee (2013) *2013 Strategy for the River Murray Increased Flow Rules*, Item 10.2 – Attachment A.
283 Clause 63 of the Plan was included in Plan amendments in December 2022.
284 The 2013 Strategy for River Murray Increased Flow Rules required that River Murray Increased Flows be held in State accounts.
285 Clause 63(5) of the Plan.
286 MDBA (2023) *Proposed NSW Murray and Lower Darling Surface Water Resource Plan (SW8): Planned environmental water: Assessment of no net reduction (s10.28) in the level of protection*
287 General purpose water accounts indicate that now River Murray Increased Flows were made from Hume Dam during the 2022-23 water year.
288 Schedule F, Clause 20(5) of the Murray-Darling Basin Agreement requires the MDBA to report to the states annually on the environmental outcomes of the River Murray Increased Flows in that water year considering the objectives for the River Murray Increased Flows determined by the Ministerial Council.

at a future date. The Commission does not see a material benefit in converting the River Murray Increased Flows to licenced environmental water and recognises that converting to a licence could increase delivery costs for this water.

Recommendation R29 – Priority 2

To improve clarity regarding the calling on and protection afforded to River Murray Increased Flows, the Water Group should include the following in the replacement Plan:

a) a requirement for the NSW Environmental Water Manager to consult and seek advice from the Southern Connected Basin Environmental Watering Committee when calling on River Murray Increased Flows

b) a clause outlining that River Murray Increased Flows are not to be used for meeting water orders of consumptive users.

8.6 Environmental outcomes can be maximised with changes to PPMs

PPMs are designed to improve the efficiency and outcomes of HEW deliveries by enabling piggybacking of these releases with other dam releases and tributary inflows and providing for return flows (environmental water reuse). These measures seek to '*minimise the volume of water recovered [for the environment] by allowing for more efficient and effective use of HEW to maximise environmental outcomes under the Basin Plan, without impacting on the reliability of other water users*'.[289]

Provisions for enabling PPMs were introduced to the Plan as part of a 2022 amendment order.[290] These provisions allow for piggybacking and reuse of HEW and River Murray Increased Flows.

PPM actions in the Murray Valley appear to have taken place prior to the Plan amendments commencing, with two PPM actions occurring in the 2019-20 water year, including in the Edward–Wakool and a multi-site delivery from Hume Dam to the Murray Mouth, which included Millewa Forest. Both PPM events were reported to have achieved their intended environmental outcomes.[291]

While PPMs have provided several benefits in the Murray, there are limitations that need to be resolved regarding their scope and application. Some of these issues require policy and procedural changes, rather than changes to the Plan (see **Section 8.2.2** regarding lack of protection of returns flows of the Barmah-Millewa Allowance).

The Commission's review of the *Water Sharing Plan for the Murrumbidgee Regulated River Water Source 2016* recommended that PPMs could also be applied to planned environmental water (not just HEW, as is current policy), particularly discretionary environmental water. This could increase the environmental benefits associated with planned environmental water. A similar case could be argued for the Barmah-Millewa

289 Department of Industry (2019) *Prerequisite policy measures: procedures manual for the Murrumbidgee Regulated River*

290 *Water Sharing Plan for the NSW Murray and Lower Darling Regulated Rivers Water Source Amendment Order 2022*; Clause 71 of the Plan gives effect to PPMs and refers to the DPIE (2019) *Procedures Manual for the NSW Murray & Lower Darling Regulated Rivers,* while Clauses 46(4) and 46(5) set out accounting arrangements, and Clause 88 provides for amendment of debiting and operating rules.

291 *Appendix C: DPIE-EES Annual Environmental Watering Statement* in DPIE (2021) *NSW Prerequisite Policy Measures Annual Evaluation and Review: 2019-2020 water year*

Allowance. i.e. protecting Barmah-Millewa Allowance water once it returns to the River Murray. However, this would require changes to Section 11.3 of the *NSW and Victorian Operating Rules for the Barmah-Millewa Forest Environmental Water Allocation 2021* and the Murray-Darling Basin Agreement, which allows for the use of this water by NSW and Victoria.

Given the need for broader policy change to give effect to provisions that provide for protection of return flows of Barmah-Millewa Allowance, it would be appropriate to include an amendment provision in the replacement Plan foreshadowing future protection of these return flows.

Optimising the effectiveness of environmental water deliveries through PPMs will be further realised with relaxation of constraints and the management of overbank flows for environmental purposes (**Chapter 11**).

9 Restoring Aboriginal water rights, values and uses

> '*… the 24 years of management under the Water Management Act 2000 has seen the erosion of, reduced opportunity and absence of Aboriginal water rights. There is a particular absence for economic opportunities through cultural trade and practice with no measurable gains or limited benefits … Amendments to water sharing plans have been without culturally appropriate involvement of Aboriginal people or their defined aspirations and values considered … There is a need for equitable reform to address historical reviews, limitations, restrictions and issues. The Minister must rewrite the plans to address issues and reinstate Aboriginal peoples water rights (in Closing the Gap) and recognise connection with land, water and culture.*' – Professor Bradley Moggridge, Kamilaroi water scientist[292]

The Darling-Baaka and the Lower Murray regulated and unregulated systems have been and continue to be important to Aboriginal people. Aboriginal people who depend on the systems for cultural, social and economic reasons perspective have long emphasised their importance of these systems — not only due to their cultural responsibility to care for Country but also because of the reciprocal relationship of being cared for by the rivers:

> '*We'll lose a lot of our cultural heritage and our cultural practices without the river and lakes. We need the water out in the system.*'[293]

This arguably is a view shared by many Aboriginal people across the Plan areas, and other plan areas across NSW, that describe similar cultural, social and economic connection to water and waterways.

While the Plan areas can be described as essentially two regulated systems (the Murray and the Lower Darling-Baaka), Aboriginal peoples' descriptions of Country are not divided by regulated and unregulated boundaries or plan areas but share a sense of connectivity and landscape scales. This is conveyed by Aboriginal elder and traditional owner William 'Badger' Bates' description of the Baaka:

> '*[The Baaka] begins near Brewarrina in northern NSW. Including its tributary catchments, it extends nearly 1500 km with a catchment area that exceeds 600,000 km^2. The area around Baaka is flat and wide, and the river is famed for its steep banks and slow-moving waters that travel deep into the arid heart of NSW, receiving its flows from the vast and sprawling floodplains of its six main tributary catchments.*'[294]

The Murray River shares a similar sense of scale and connectivity and has significant cultural value to the many Aboriginal groups that have and will continue to care for Country well before and long after colonisation. The importance of the Murray system to Aboriginal peoples was captured in the 2007 Echuca Declaration, where communities recognised and reaffirmed their sovereign rights to water, and where each of the Indigenous nations '*obtain and maintain their spiritual and cultural identity, life and livelihood from their lands and waters*'.[295]

Part 2 of the Plan provides a vision statement that establishes the intent that the Plan will provide for '*the spiritual, social, customary and economic benefits of surface water to*

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292 Pers comms. Professor Bradley Moggridge (Kamilaroi water scientist), 14 August 2024.
293 Quote from Aunty Barbara Quayle in submission: Nature Conservation Council, received 22 February 2024.
294 Bates, W.B. *et al*. (2023) 'A tale of two rivers – Baaka and Martuwarra, Australia: Shared voices and art towards water justice', *The Anthropocene Review*, 11(1).
295 MLDRIN (2009) *The Echuca Declaration*

Aboriginal communities'.[296] Supporting the vision statement and with reference to Aboriginal culture there are two types of objectives; one broad, as well as a set of more targeted objectives. The broad objective is to '*maintain, and where possible improve, the spiritual, social, customary and economic values and uses of water by Aboriginal people*'.[297] The Plan notes that the broad objective describes a long-term outcome that will '*not be directly measured but evaluated by considering the cumulative achievement of the associated targeted objectives*'.[298]

The Plan's targeted objectives, which are intended to be measured, are:

- to provide access to water in the exercise of native title rights
- to provide access to water for Aboriginal cultural use, including fishing
- to protect and, where possible improve, identified surface water-dependent culturally significant areas, including important riparian vegetation communities
- to contribute to the maintenance of water quality within target ranges to ensure suitability of water for Aboriginal cultural uses.[299]

The Plan nominates several strategies to achieve the Aboriginal cultural objectives, including providing access to water for native title rights and Aboriginal cultural use, and reserving shares of water to mitigate alterations to natural flow regimes and maintain connectivity. It also provides a set of performance indicators used to measure strategy success.[300]

The Commission assessed the available evidence against the targeted objectives and associated strategies to understand progress towards the Plan's broader objectives and vision. This chapter provides a summary of the key challenges identified in the Commission's analysis and raised by stakeholders, including that:

- there have been limited benefits for Aboriginal communities from the Plan, despite being a stated objective (**Section 9.1**)
- no water has been made available to exercise rights under native title of the Barkandji Traditional Owners (**Section 9.2**)
- uptake of Aboriginal access licences is limited (**Section 9.3**)
- provisions for Aboriginal cultural use do not explicitly support economic outcomes (**Section 9.4**)
- changes to flow regimes and connectivity have impacted cultural values (**Section 9.5**).

Where appropriate, the Commission makes recommendations to address the points above to improve the Aboriginal cultural outcomes of the Plan.

296 Part 2 Clause 7c of the Plan.
297 Clause 10 of the Plan.
298 Part 2: Notes (2) of the Plan.
299 Clause 10 of the Plan.
300 Clause 10 of the Plan.

9.1 The Plan has not resulted in benefit for Aboriginal communities

Currently there is no clear method for measuring and reporting on performance indicators and understanding the effect or impacts Plan strategies have in achieving Aboriginal cultural benefits. The Plan relies on measuring 'one or more'[301] performance indicators to represent the total outcome of Aboriginal objectives, where a complete understanding would be reporting all strategies and their respective outcomes to present a holistic overview and baseline.

Stakeholders have stated that without clear benchmarks or performance indicators for key outcomes, people are struggling to understand where the Plan is looking to achieve positive outcomes or benefit. This in turn makes it hard to gather information to evaluate the Plan's performance and inform any improvements.[302] Added with the complexity of plan rules, stakeholders are unable to physically see the outcome of strategies and the benefit they are looking to deliver.

Without an appropriate methodology to monitor and measure improvement, it is not possible to report that Aboriginal cultural values have been maintained or improved through the implementation of this plan (including previous iterations). However, the Commission considers it unlikely that the Plan is delivering meaningful benefit to Aboriginal communities, particularly given that key strategies such as the allocation of water for native title (see **Section 9.2**) and Specific Purpose Access Licences - Aboriginal commercial, community development and Aboriginal cultural (see **Section 9.3**) have not been implemented.

Indeed, there is increasing evidence that strategies are likely having adverse impacts to Aboriginal cultural values and uses, including fishing. This includes through:

- increases in the magnitude and frequency of fish kills (see **Chapter 7**)
- a decline in water quality (see **Chapter 7**), with increased pesticide residues
- a lack of connectivity and river maintenance
- vegetation impacts including access to riparian zones and medicinal flora.

These impacts demonstrate an issue of transparency and ineffectiveness by the Plan to:

- consider the objects[303] of the Act to take all reasonable steps to recognise and foster the benefits to Aboriginal people (spiritual, social, customary and economic use) of land and water
- consider the water management principles of the Act[304] to protect features of Aboriginal significance and to deliver the watering requirements associated with the Aboriginal values and uses.

Stakeholder feedback indicates there is scepticism regarding the genuineness of the Plan's actions to contribute to outcomes for Aboriginal communities. Some stakeholders consider that, while the Plan adopts a vision to provide water for the specific benefit of Aboriginal communities, it appears tokenistic in its delivery and may be the cause of additional issues, stating:

301 Clause 10(5) of the Plan.
302 Interview: Social stakeholders group interview, 9 August 2024.
303 Clause 3(c)(iv) of the Act.
304 Clause 5(2)(e) of the Act.

> '*It would seem that the current plan, as it progresses from vision to rules, constraints and at later ignores the needs of local indigenous communities. Such inclusion of Indigenous values is tokenistic. For Australian Indigenous peoples, the nurture of water landscapes holds significant meaning and purpose. Limited access to water and its associated impacts on cultural practice have created a history of socio-economic disadvantage.*'[305]

DCCEEW is developing strategies that aim to improve processes where Aboriginal communities can inform Plan development, align their aspirations for water and its use, and address obstacles to achieving improved outcomes from water access and use. These initiatives include a pilot for cultural watering plans (improving access to water, sharing knowledge and promoting awareness[306]), engagement strategies in the form of regional Aboriginal water committees (improving Aboriginal participation in water planning, program development and informing policy[307]) and the ongoing development of the Aboriginal Water Strategy.

While these initiatives appear as steps in the right direction to improve outcomes and benefits for Aboriginal people, the Commission notes critical views held by Murray Lower Darling Rivers Indigenous Nations (MLDRIN) regarding the actions of the Water Group in frequently deferring to '*... future activities and commitments ...*'. MLDRIN members are of the view '*... that NSW has a poor track record of delivering on past commitments ...*', and further expressed a lack of confidence that such future strategies would result in outcomes having regard for their views and interests.[308]

The Commission also notes that improvements in Plan outcomes have been a matter of concern raised in the Commission's previous reviews[309] and have yet to report improved outcomes over the past 24 years since inception of the Act.

Recommendation R32 – Priority 2

To improve accountability against cultural objectives, the Water Group should ensure the Plan's objectives, corresponding provisions and performance indicators are co-designed with Aboriginal stakeholders, reflect Priority 2 of the *NSW Water Strategy* and continue to align with the Act.

9.2 No water has been made available to exercise native title rights

The Plan area includes lands recognised under native title of the Barkandji Traditional Owners. As with most systems where Aboriginal groups and traditional owners have an ancient and deep cultural connection to water, equity in water sharing – including water rights legally recognised through native title – has long been a challenge for the Barkandji people:

> '*The Barkandji, along with other native title holders including the Ngiyampaa, Ngemba and Murrawarri Peoples, continue to suffer from a situation where ... existing [non-Indigenous] water users hold the power to continue to enjoy and benefit from access to*

305 Submission: National Parks Association of NSW, received 25 February 2024.
306 DCCEEW (2024) *Cultural Watering Plans*
307 DCCEEW (2024) *Regional Aboriginal Water Committees*
308 MLDRIN (2023) *MLDRIN's Assessment of the 2023 version of the proposed NSW Murray and Lower Darling Surface Water Water Resource Plan*
309 Natural Resources Commission (2024) *Completed Reviews*

> *highly valuable water resources, while power and agency for Aboriginal peoples to do similarly remains obstructed*'.[310]

The Plan includes a requirement to provide water to exercise native title rights where a determination or ILUA is made.[311] The Plan also includes a relevant objective, strategy and performance indicator to monitor the extent to which native title requirements have been met and a provision to support amendments where native title rights may change under the *Native Title Act 1993*.[312]

There is currently no water for the exercising of native title rights and none has been provided over the duration of the Plan.[313] The Barkandji determination contains different access rules for water, including but not limited to rights to fish/fishing, rights to access water for Aboriginal cultural purposes and 'other interests'.[314] While non-exclusive[315] areas require water to be granted for 'insubstantial' water uses,[316] requirements for water use in exclusive areas – where water could be used for any purpose without a licence or work approval – are yet to be fully understood:

> '*The provision of native title water rights and cultural flows is long overdue. It is essential that action be accelerated to address these issues, including provisions for improved water sharing arrangements and more effective engagement.*'[317]

A growing number of submissions received by the Commission argue for a stronger understanding of the water requirements for native title and cultural uses, with one submission stating that, while the provisions exist to support these types of water use, '*it is an indictment on the process to date that the provision of water has still not been achieved for First Nations access … It is critical that impediments to meeting these provisions are understood*'.[318]

Measuring the effectiveness of the provision for native title is a challenge when the current provision of water for the exercise of native title rights within the Plan sits at zero, with no clear methodology for any future native title water and outcomes.

As per the Commission's previous recommendations,[319] the Water Group should proactively consider and work more closely with Aboriginal communities (including the Barkandji native title holders) to better align (and amend where required) Plan provisions with native title determinations, ILUAs or other land and water agreements wherever possible to ensure access to water for native title rights.

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310 Hartwig, LD, Jackson SE and Osborne, N (2018) 'Recognition of Barkandji Water Rights in Australian Settler-Colonial Water Regimes', *Resources*, 7(1).
311 Clause 11(2) of the Plan.
312 Clause 85(5) of the Plan.
313 Clause 19 of the Plan.
314 Barkandji Traditional Owners #8 v Attorney-General of New South Wales [2015] FCA 604; Barkandji Traditional Owners #8 (Part B) v Attorney-General of New South Wales [2017] FCA 971.
315 Non-exclusive native title rights may include the right to access, hunt and camp on traditional Country, but not the right to control access to, and use of, an area. In some cases, native title rights may include possession of an area to the exclusion of all others (see: Australian Institute of Aboriginal and Torres Strait Islander Studies (n.d.) *Native title, rights and interests*
316 Barkandji Traditional Owners #8 (Part B) v Attorney-General of New South Wales [2017] FCA 971 Definitions paragraph 13.
317 Submission: Lifeblood Alliance, received 22 February 2024.
318 Submission: Inland Rivers Network, received 20 February 2024.
319 Natural Resources Commission (2024) *Completed Reviews*

Recommendation R31 – Priority 1

The Water Group should work the Barkandji native title holders (and any future native title or ILUA holders) to determine water requirements for the practice of native title rights in the Plan area.

9.3 Uptake of Aboriginal access licences is limited

Part 7 of the Plan provides for Aboriginal people to access water associated with Aboriginal cultural values and uses through the application and granting of a subcategory of Specific Purpose Access Licence (high security) called 'Aboriginal Cultural'.[320]

There is no evidence of an 'Aboriginal Cultural' licence being granted during the last Plan period.[321] The Water Access Licence Register shows zero active Specific Purpose Access Licences for 'Aboriginal Commercial', 'Aboriginal Community Development' or 'Aboriginal Cultural' in the NSW Murray and Lower Darling Regulated Water Sources.[322] This compares to more than 900 high security licences for other subcategories issued in the Murray and Lower Darling Regulated systems.[323]

With no Specific Purpose Access Licences issued for economic purposes, community development or Aboriginal cultural uses, it is difficult to suggest that Aboriginal water licencing provisions have been successful in or contributed to the targeted objective to provide for the use of water by Aboriginal people, or the overall objective to maintain or improve the spiritual, social, customary and economic values and uses of water by Aboriginal people.[324]

The Commission's recent review of the *Water Sharing Plan for the Murrumbidgee Regulated River Water Source 2016*[325] highlighted water access issues experienced by Aboriginal peoples, including:

- improving the uptake and outcomes on Specific Purpose Access Licence provisions
- transparency and consultation issues around plan amendments
- improving native title allocations.

The Murrumbidgee review also highlighted the Riverina Local Land Services' 'Developing Aboriginal Cultural Water Use Opportunities in the Murrumbidgee Valley' project, which aims to improve uptake and increase water access and use for Aboriginal people in the Murrumbidgee Plan area.

Information from DCCEEW regarding Specific Purpose Access Licences states that '*at the end of 2022, uptake of this licence was very low, with only 7 licences ever issued, and 2 remaining in place*'.[326] Findings of the above Riverina Local Land Services project may have relevance across all surface water regulated and unregulated plans in improving uptake and should be considered in the replacement Plan.

320 Part 7 Clause 42(3) of the Plan.
321 Clause 22(1a) of the Plan.
322 WaterNSW (2024) *NSW Water Register*
323 *Ibid.*
324 Clause 11(5) of the Plan.
325 Natural Resources Commission (2024) *Review of the Water Sharing Plan for the Murrumbidgee Regulated River Water Source* (unpublished)
326 DCCEEW (2023) *Cultural Watering Plans*

The Commission also notes DCCEEW's work to establish a framework to pilot Aboriginal cultural watering plans and encourages efforts to continue to refine and increase the availability and reach of this program.[327]

Recommendation R33 – Priority 2

To improve Aboriginal access licence uptake and use, the Water Group should work with the Aboriginal peoples of the Plan area to better understand their water needs and ensure alignment of licence types, use and conditions are reflecting these needs.

This recommendation aligns with a submission from the CEWH, which highlights the importance of '*consultation with First Nations, improvements to the [water sharing plan] to enable First Nations organisations and communities to access and manage water, including through Aboriginal cultural access licences.*'[328]

9.4 Provisions for Aboriginal cultural use do not explicitly support economic benefits

No data are available to support any improvement of outcomes by Aboriginal communities regarding economic benefit resulting from the management of the Plan and implementation of its strategies. There is limited evidence to suggest any explicit initiatives are currently proposed, planned or underway that deliver economic benefit.

Specific Purpose Access Licences, including a regulated river (high security) 'Aboriginal Cultural' are restricted in their ability to deliver economic benefit. Currently, the onus is on the Minister to determine if the proposed use is suitable and of sufficient volumes for its proposed purpose. Applications must fit within the approved explicit purposes of the licence, which currently do not include any explicit economic uses. Further, the available volumes are capped at 10 ML per application per year, which potentially restricts the sustainable use of small volumes for economic purposes.[329]

There is a long history of 'trade' and sharing of resources as a cultural practice that saw Aboriginal people grow resources on their Country and often venture outside of their own Country for trade and ceremony.[330] However, trade is not recognised in the purpose for which a Specific Purpose Access Licence may be granted. A review of the Plan needs to better balance economic opportunity with that of a cultural purpose:

> '*Maintaining spiritual and cultural relationships with land, water and Country are intertwined for Aboriginal peoples. The right to economically develop natural resources, consistent with cultural obligations, is also of significant importance.*'[331]

The economic benefits of water access and use by Aboriginal people will continue to be limited in the absence of any clear and purposeful strategy to include economic benefit in the prescribed uses of an 'Aboriginal cultural' Specific Purpose Access Licence. The Commission notes DCCEEW's development of the draft Aboriginal Water Strategy and

327 DCCEEW (2023) *Cultural Watering Plans*
328 Submission: CEWH, received 28 February 2024.
329 Clause 47(2) of the Plan.
330 Robert S. Fuller, Michelle Trudgett, Ray P. Norris, Michael G. Anderson (2014) *Star Maps and Travelling to Ceremonies -- the Euahlayi People and Their Use of the Night Sky*
331 Submission: NSW Aboriginal Land Council, received 3 May 2022.

Action Plan, which are currently being consulted on with NSW Aboriginal communities and others and could be used to inform Plan strategies around economic benefits.[332]

Recommendation R34 – Priority 2

To support improved economic outcomes from the Plan, the Water Group should work with Aboriginal communities to:

a) better understand cultural obligations and amend the purposes for which Aboriginal access licences may be granted by recognising traditional trade practice, such as sale, exchange, gifting, and bartering of goods made from water provided under all categories of Aboriginal access licences

b) explore further opportunities to enact all three sub-categories of Aboriginal access licence to support the Plan's Aboriginal cultural objectives.

9.5 Changes to flow regimes and connectivity have impacted cultural values

The Plan has two strategies to provide for shares of water to be reserved for the environment to:

- partially mitigate alterations to natural flow regimes in water sources[333]
- maintain longitudinal and lateral connectivity within and between water sources.[334]

There is no clear measurement or share of 'cultural' water that can be clearly attributed to these provisions or connectivity or water quality targets, and recent issues including reduced water quality and fish deaths suggest that compliance with these Plan provisions may be an issue (see **Chapter 7** for additional connectivity and water quality related issues impacting Aboriginal cultural values).

An insight into the impacts of these issues in the Baaka to the Barkandji people is described by Barkandji elder and traditional owner, William 'Badger' Bates:

> '*When the European settlers arrived, they wanted to have it all, but Barkandji still survived on the river, and because of the river. Barkandji never left their Country, they are still there, and they love their Country, and it loves them back. But Baaka, and the Barkandji way of life with it, is disappearing because of upstream water extractions. Barkandji see that their river has been unusually dry over the past 20 years. This has resulted in stagnant pools with little life that has led to the death of catfish first, silver perch and then mussels, while the river snail disappeared years ago. Barkandji are also witnessing the decline or the disappearance of birds, water spiders, river boat men, water rats and water lizards, while river plants and floodplain plants are dying*'.[335]

The strategy of reserving a share of water to support the environmental water rules of the Plan[336] and '*partially mitigate alterations to natural flow regimes and to maintain longitudinal and lateral connectivity within and between water sources*', has been in effect throughout some of the largest fish kills in recent times, both for the Plan area and across NSW. The

332 DCCEEW (2024) *Aboriginal Water Strategy and Action Plan*
333 Clause 10(3)(c) of the Plan.
334 Plan Clause 10(3)(d) of the Plan.
335 Bates, WB *et al*. (2023) 'A tale of two rivers – Baaka and Martuwarra, Australia: Shared voices and art towards water justice', *The Anthropocene Review*, 11(1).
336 See Part 10 Division 1 and Division 2 of the Plan.

Office of the NSW Chief Scientist & Engineer's recent review into the 2023 mass fish deaths in the Darling-Baaka at Menindee highlighted the extensive negative impacts of fish kills to Aboriginal access and use of water, including significant signs of degradation of food sources, cultural and totemic connection, as well as impacts to caring for Country obligations and overall community wellbeing.[337]

Further findings of the Chief Scientist's review point to changes to flow regimes adding to degradation in river ecosystems and failure in policy implementation as significant contributing factors to the decline in water quality and overall river health.[338] This appears to be in contrast with the intended positive outcome of the strategy in reserving water for the purpose of partially mitigating changes to natural flow regimes. The effectiveness and measurability of this strategy are also difficult to assess when the share of water reserved is unknown with no method of measurement.

Submissions to this review are also critical of the poor performance and outcomes of this strategy, including reserving a share component to support connectivity:

> '*IRN considers that the WSP has overwhelmingly failed to contribute to positive cultural outcomes. First Nations communities have been severely impacted by loss of river health, loss of the cultural values associated with a healthy river system populated by abundant native fish food sources and fresh water quality. The lack of access to any licenced water for cultural benefit is a key failing of the WSP.*'[339]

> '*The outcry from indigenous people about the fish kills in terms of impact on their own spiritual connection to country was heartbreaking and needs to be addressed in any review of the plan.*'[340]

There are similar issues shared by the strategy to reserve water for connectivity, which is crucial within and between water sources to help improve river health, as highlighted by Murray Irrigation Limited:

> '*If improvements in the health of the Lower Darling River are a priority, the Upper Darling above Menindee should continue to be a key focus of attention.*'[341]

For Barkandji elder Uncle William 'Badger' Bates, the relationship between systems and a landscape scale view of management is just as significant where the '*Baaka is in the Murray-Darling Basin (MDB) and connects the northern and southern parts of this large and complex river basin. It is reliant for its flows mainly on the Barwon River (Barre Warre Yulluk) and its tributaries, some of which originate in the state of Queensland, located north of NSW*'.[342]

337 Office of the NSW Chief Scientist & Engineer (2023) *Independent review into the 2023 fish deaths in the Darling-Baaka River at Menindee*
338 *Ibid*.
339 Submission: Inland Rivers Network, received 20 February 2024.
340 Submission: National Parks Association of NSW, received 25 February 2024.
341 Submission: Murray Irrigation Limited, received 23 February 2024.
342 Bates, WB *et al*. (2023) 'A tale of two rivers – Baaka and Martuwarra, Australia: Shared voices and art towards water justice', *The Anthropocene Review*, 11(1).

Recommendation R35 – Priority 3

To support the Plan objective to maintain connectivity for cultural outcomes and review of Plan rules by Aboriginal water users, the Water Group should:

a) include provisions specifying volumes that are being reserved, how they are being managed and their level of effectiveness in providing connectivity

b) in the replacement Plan, establish Aboriginal cultural performance indicators and improve measurability of Aboriginal cultural outcomes for connectivity.

10 Securing town water supply to meet future needs

Town water supply, provided under water access licences issued across the Plan, is essential for local populations. The Plan provides for 42,613 ML per year for local water utilities,[343] accounting for 2 percent of total Plan entitlement.

The majority of the region's towns access the Murray regulated river to meet town water needs (42,191 ML per year).[344] There are 17 local water utility licences (including the licence for Broken Hill established in 2019) and two high security licences for Murray Irrigation Limited[345] to supply town water to local communities in Finley, Berrigan, Wakool and Bunaloo. Greater Hume Council advised they have accessed town water from Albury City Council for the Villages Water Supply Scheme since the early 1980s supplying the villages of Jindera, Brocklesby, Burrumbuttock, Gerogery, Gerogery West, and connected rural areas.[346]

The Plan allows for 422 ML per year from the Lower Darling Water Source[347] for town water for Pooncarie – managed by Wentworth Council – and the Menindee township – managed by Essential Water. Communities in the Lower Darling-Baaka have access to surface water from the regulated Darling and Murray Rivers and use groundwater when needed.

While the needs of towns accessing water from the Murray Regulated Water Source were likely to have been met over the life of the Plan (see **Section 10.1**), this was not always the case for towns accessing water from the Lower Darling Regulated Water Source.

Broken Hill was at risk of running out of water during the most recent drought. The construction of the Wentworth to Broken Hill pipeline in 2019 to deliver town water from the Murray Regulated Water Source has increased town water security for Broken Hill and is likely to continue to provide positive social outcomes for the Plan area.

The Lower Darling Regulated Water Source also experienced a range of water quality issues that impacted on town water supply over the Plan life. Maintaining secure access to quality town water is essential to underpin community needs, socioeconomic prosperity and amenity in remote towns like Menindee, Pooncarie and Broken Hill.

The review identified areas for improvement for the Plan to ensure future risks are managed, including:

- risks to water quality, impacting town water supply and amenity values in the Lower Regulated Darling Water Source (**Section 10.2**)
- potential growth in town water needs as a result of projected population growth in the Murray Regulated Water Source (**Section 10.3**).

343 See Clause 21 of the Plan.
344 See Clause 21 of the Plan.
345 Note: Irrigation corporations cannot hold a local water utility licence, the two high security licences are held by Murray Irrigation Limited.
346 Interview: Greater Hume Council, 4 July 2024.
347 See Clause 21 of the Plan.

10.1 Town water needs were mostly met during the Plan period

When the Plan commenced, there were estimated to be 42,613 ML per year share components for town water (2 percent of total share),[348] from both the Murray regulated and Lower Darling regulated water sources. WaterNSW data indicate total share components available in 2023/24 was 45,808 ML, including the Broken Hill pipeline share of 8, 694 ML per year from the Murray Regulated Water Source (see **Table 4**).

Table 4: Plan Total Share Component (entitlement) in 2023/24[349]

Licence category	Number of water access licences	Total share component available (ML)
Murray Regulated Water Source		
Local Water Utility	16	33,497
Local Water Utility (domestic and commercial) – Broken Hill *	1	8,694
Regulated River (High Security) [Town Water Supply]	2	3,195
Lower Darling Regulated water source		
Local Water Utility	2	422
Total	**21**	**45,808**

*Note total share component for Broken Hill was established in 2019.

10.1.1 Murray Regulated Water Source

Over the life of the Plan, the use of total share components in the Murray Regulated Water Source ranged from 47 to 91 percent per year.[350] The total share component for the high security (town water) licences held by Murray Irrigation Limited to supply Berrigan, Finley, Wakool and Bunaloo was used consistently over the Plan period.[351] This provides some indication that town water needs were likely to have been adequate on the Murray Regulated Water Source over the life of the Plan, and Murray Irrigation Limited confirmed that its town water share was adequate over the life of the Plan.

Greater Hume Council advised that, while town water needs sourced from the Murray Regulated Water Source for the villages of Jindera, Brocklesby, Burrumbuttock, Gerogery, Gerogery West, and connected rural areas were met over the life of the Plan, town water security is a major concern under future climate change and population projections and associated water use (see **Section 10.3**).[352]

In 2019, the NSW Government established the Broken Hill pipeline to source water from the Murray Regulated Water Source to deliver water to Broken Hill to improve town water security.[353] The pipeline is owned and operated by WaterNSW. As part of this, an 8,694 ML per year for local water utility licence from the Murray River Regulated Water Source was

348 See Clause 21 of the Plan.
349 WaterNSW (n.d.) *NSW Water Register*, accessed 11 April 2024.
350 *Ibid.*
351 *Ibid.*
352 Interview: Greater Hume Council, 4 July 2024.
353 Essential Water (2018) *Drought Management Plan for the water supply business in the Broken Hill Region*

created and managed by Essential Water (a subsidiary of Essential Energy).[354] Essential Water advised that Broken Hill would likely have run out of town water supply during the Plan period without the construction of the pipeline:

> '*The Plan has significantly improved town water security in the Plan area because the pipeline has made Broken Hill's town water supply very secure. If the pipeline had not been built, we probably would have had to evacuate Broken Hill during the last drought because there would not have been sufficient bores. Having the new entitlement in the Murray has significantly improved social outcomes for Broken Hill.*'[355]

Improving the security of town water supply to Broken Hill has contributed positively to the achievement of the Plan's social objectives.

The Commission did not receive submissions from Albury City, Berrigan, Edward River, Federation or Murray River Councils, who also access town water from the Murray Regulated Water Source. Representatives were also unavailable to be interviewed for this review. The Commission encourages the Water Group to continue its engagement with these local water utilities to determine if future town water needs can be met and review local water utility entitlements to ensure that town water is adequately provided for, going forward.

10.1.2 Lower Darling Regulated Water Source

In the Lower Darling Regulated Water Source, Menindee and Pooncarie's use of total local water utility share component over the life of the Plan ranged from 33 to 67 percent per year.[356] Essential Water advised that Menindee's share of town water entitlement is likely adequate and population growth is not expected.[357] During the 2019 drought, Menindee experienced problems accessing town water due to connectivity issues experienced on the Lower Darling River.[358] Essential Water raised that, if Menindee were to experience similar access issues in the future, there is scope to provide town water from the Broken Hill pipeline supply:

> '*If we run out of water in the Darling, our Plan B is to supply Menindee via the Broken Hill pipeline. We are not sure if we are allowed to do that given the licence conditions, but we are confident that this would be amended if there was an emergency situation. This is only a temporary option and not sustainable for extended periods. We also have the option of a bore at Menindee.*'[359]

If the Plan allows for town water to be accessed from the Broken Hill pipeline to support security of town water for the Menindee township it would need to be considered within sustainable limits of the Plan's LTAAEL. Maintaining security of town water in Menindee is also important for local amenity and supporting the town's tourism industry, which contribute to the Plan's social and economic outcomes.

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354 WaterNSW (n.d.) *NSW Water Register*, accessed 11 April 2024. Essential Water manages four local water utility licences to provide town water to approximately 18,498 customers in Broken Hill, Silverton, Menindee and Sunset Strip. These licences span the Lower Darling Regulated River Water Source, the NSW Murray Regulated River Water Source, the Western Murray Porous Rock Groundwater Source and the Lower Murray-Darling Unregulated Water Source (Essential Water (2018) *Drought Management Plan for the water supply business in the Broken Hill Region*).

355 Interview: Essential Water, 30 April 2024.

356 WaterNSW (n.d.) *NSW Water Register*, accessed 11 April 2024.

357 Interview: Essential Water, 30 April 2024.

358 *Ibid.*

359 *Ibid.*

Wentworth Council advised over the last 10 years, Pooncarie township's total local water utility share was 190 ML per year but in most instances, actual take under the local water utility share was far below the share component and ranged between 60 and 70 ML per year, meaning the local water utility was yet to be fully utilised.[360]

10.2 Water quality issues may impact Lower Darling town water and amenity

Maintaining water quality for town water supply, basic rights, stock and domestic and surface water dependent cultural, heritage and recreational uses is a key objective of the Plan.[361] Stakeholder feedback indicates that water quality issues have been experienced over the life of the Plan in the Lower Darling Water Source.

The social impacts of low or cease to flow events on the Lower Darling-Baaka and recent fish kills were felt strongly by communities. Stakeholders highlighted the detrimental social impacts from cease to flow events on the Menindee Lakes during the 2019 drought, which have significant social, recreational and amenity value for Lower Darling-Baaka communities:

> '*IRN considers that the [water sharing plan] has failed to contribute to social outcomes because the failure to deliver sufficient and timely water flow has resulted in poor water quality not being adequately addressed. Communities in the Lower Darling have suffered increasing health threats and loss of population, loss of recreation opportunities and loss of sense of place and well-being due to poor water management and planning decisions.*'[362]

Pooncarie is a small remote community north of Wentworth, supplied by the Lower Darling Regulated Water Source. It has had ongoing issues with water quality. Wentworth Council advised that it had to cart water in for Pooncarie 2019 as the Lower Darling-Baaka ran dry and the remaining water was not fit for human consumption, significantly impacting on social outcomes:[363]

> '*We had a disastrous time at Pooncarie when the river ran dry. A population of 50 to 60 people experienced a huge decline in social wellbeing. We had to cart water costing around $150,000 as water quality in remaining pools declined. It wasn't safe to use for anything. It had a huge impact on people's welfare. Water quality and water availability were big issues.*'[364]

Pooncarie also experienced blue green algae events over the life of the Plan, which triggered regular amber and red alerts for the Pooncarie township.[365] Bores were established in Pooncarie in 2018 and have been accessed in summer periods when blue green algae events occurred. The impacts of these events have reduced the water quality for both drinking water and domestic and stock watering. While there is a treatment process for algal events, the Lower Darling-Baaka can experience extended periods on red alert, which result in increased risks to town water quality.

360 Interview: Wentworth Council, 17 May 2024.
361 See Clause 11(c) of the Plan.
362 Submission: Inland Rivers Network, received 20 February 2024.
363 Interview: Wentworth Shire Council, 7 May 2024.
364 Interview: Wentworth Shire Council 26 July 2021.
365 Wentworth Shire Council (2024) *Community Notice Water quality and blue green algae – drinking water is safe*

Poor water quality in the Lower Darling-Baaka also has the potential to impact tourism, which provides important economic and amenity value for the small remote town:

> '*Thirty caravans is around 60 people, which is a substantial portion of population that is adding an important scale to economic outcomes for the town's pubs and shops, which can then support the rest of the town. If you have a crook river then there are no tourists.*' [366]

Risks to water quality from low and cease to flow events have increased in the last two decades, with the longest cease to flow period on record experienced during the Plan period. Water quality issues will continue to remain a challenge in the future, warranting changes to plan provisions as outlined in **Chapter 7**.

Wentworth Council also advised that, during the 2022/23 floods, the Mildura Weir had to be removed and before it was reinstalled, sediment removal and dredging was required. This made accessing town water for Gol Gol and Buronga difficult.[367]

Essential Water advised that water quality for town water in Menindee was largely adequate over the life of the Plan and connectivity for town water has been adequate, except for the 2018/19 drought.[368] The Menindee treatment plant has supported water quality improvements:

> '*We have a new Tier 5 Treatment plant at Menindee so there are no water quality issues. Water quality, even during the recent fish kills, has not been an issue to supply potable town water to Menindee.*'[369]

Maintaining adequate flows to meet safe drinking water quality standards is an important consideration for the Plan remake. Pooncarie and Menindee are remote townships and are more likely to be subject to social disadvantages and vulnerabilities. Access to safe drinking water supports amenity, recreation and tourism for these small remote communities. As part of the Plan remake, the Water Group should consult with these communities to consider how Plan provisions can adequately provide for safe drinking water in the future.

Recommendation R36 b) – Priority 2

To ensure town water supply needs are provided for, the Water Group should:

For the Lower Darling Regulated Water Source:

b) consult local water utility managers for the Pooncarie and Menindee townships to consider how Plan provisions can provide adequate flows to maintain water quality for towns consistent with relevant standards.

366 Interview: Wentworth Shire Council, 7 May 2024.
367 *Ibid.*
368 Interview: Essential Water, 30 April 2024.
369 *Ibid.*

10.3 Population growth and climate change may risk town water needs in Murray Regulated Water Source

Population growth in the Murray Regulated Water Source may place pressure on town water needs in the term of the replacement Plan. The strongest predicted population growth from 2021 to 2041 in local government areas that rely on regulated surface water are:[370]

- Albury City Shire – an annual per centage growth of 1.6 percent (overall change of 21,170 people)
- Greater Hume Council – an annual per centage growth of 1.1 percent (overall change of 2,576 people)
- Murray River Council – average annual per centage growth of 1.1 percent (overall change of 3,030 people).

Greater Hume Council advised that, while town water needs for villages accessing the Murray Regulated Water Source were met over the life of the Plan, it expects to see significant population growth in the next 50 years. Water security under climate change and future drought scenarios is also a significant concern.[371] The Commission notes that Greater Hume Council can access water via Albury City Council's supply network. As Albury is located just downstream of Hume Dam, Greater Hume Council's concern about water security may relate to the insufficient local water utility provided to cater for a growing population. If the water supply infrastructure between Albury and Greater Hume Council area is insufficient, this would require broader consideration of adequate water supply infrastructure and would be outside the scope of this Plan.

The Commission considered analysis undertaken for the draft *NSW Murray Regional Water Strategy*, including modelling of town water supply shortfall risks for some of these communities, including Albury. This assessment considered historic and future climate scenarios. This analysis suggests that there is an increased likelihood under a future drier climate that some communities relying on the Regulated Murray Water Source may not be able to meet their unrestricted daily demand for consecutive days within current licenced entitlements. The Water Group should continue its engagement with these local water utilities to determine if future town water needs can be met and review local water utility entitlements to ensure that town water is adequately provided for going forward.

Wentworth Council advised that town water needs for Gol Gol and Buronga supplied by the Murray Regulated Water Source may be inadequate given the rate of population growth projected over the term of the next Plan:

> '*Based on forecasted growth at Gol Gol and Buronga, the population is to double between now and 2050. We are expecting to run out of water share entitlement (2,838 ML per year) in about 5 years' time. Currently, use peaks at 2,100 ML, and demand is forecast to start hitting the maximum entitlement volume around the year 2030. Long term between 2030 and 2050, Wentworth Shire Council will need up to an extra 1,000 ML per year to meet increased demand.*'[372]

The *Wentworth Community 2017-2027 Community Strategic Plan* highlights growth is a result of proximity to Mildura, which is a major Victorian town:

370 NSW Government (2024) *NSW Projections Explorer*
371 Interview: Greater Hume Council, 4 July 2024.
372 Interview: Wentworth Shire Council, 7 May 2024.

> '*The Buronga – Gol Gol community is located at the central southern end of the Shire on the banks of the Murray River. The George Chaffey Bridge is the major river crossing that links the Wentworth Shire with Mildura, one of Victoria's major regional destinations. This community is considered to be the growth area of the Wentworth Shire, with new subdivisions set to provide approximately 500 new large residential housing allotments.*'[373]

Alongside system augmentation in the Plan replacement process, the Water Group should determine if the share components for local utility access licences need to be adjusted to meet future town water demand because of population growth. Any adjustments would need to be considered in maintaining a sustainable LTAAEL for the Plan area and related LTAAEL compliance.

The Commission recognises that given highly variable climate conditions, local water utilities across the Plan area have invested in infrastructure and water entitlements to continue to secure town water over the life of the Plan. Modelling undertaken for the Murray and Western regional water strategies suggests the risk of surface water supply shortfalls for towns along the Murray and Darling rivers may also need to be considered under a changing climate (see **Chapter 4**).

In addition to reviewing the appropriateness of current local water utility entitlements, the Commission also suggests reviewing the current trade provisions related to local water utilities to ensure that they are adequate and meet the priorities of the Act, while also providing flexibility to local water utilities to use trade to meet their town water needs. The Commission notes that the Plan's trade provisions are linked to the Murray-Darling Basin Agreement, and as such reviewing or amending trade rules may require consultation with other Basin states.

Recommendation R36 a) – Priority 2

To ensure town water supply needs are provided for, the Water Group should:

For the Murray Regulated Water Source:

a) ensure share components for local utility access licences reflect projected population growth in Wentworth Council, Greater Hume Council and Albury City Council and sustainable limits are adjusted accordingly if required alongside other strategies to augment supply.

373 Wentworth Shire Council (2017) *2017-2027 Community Strategic Plan*

11 Reducing the impact of flow constraints on environmental outcomes

A flow constraint is any physical or operational barrier limiting the flow of managed water in river systems.[374] Constraints refer to maximum limits for managed flows including for managed environmental water along specific river reaches that are caused by:

- operational limitations, including requirements to protect infrastructure and private property from inundation by managed flows and maximise reliability of supply for consumptive use
- physical limitations, such as impacts to physical structures, including low-lying bridges and roads (channel capacities), or the rate that water can be released from a storage (release capacities)
- legal liabilities associated with releasing higher environmental flows.

Constraints restrict the maximum flow rate the river operator can release for managed or regulated flows under normal conditions. This operational practice protects landholders from inundation arising from small overbank flows under normal operations. Constraining managed flows leads to fewer low-level inundation events and reduces social and economic impacts associated with these events (**Section 11.3**). It is important to note that constraints do not impact flows occurring associated with unregulated flows or natural flows associated with flooding or uncontrolled flow events.

However, in some cases, the operation of constraints to restrict managed flows means that river operators are unable to release water in a manner that allows for the connection of rivers with their dependent ecosystems, thereby limiting environmental outcomes that can be achieved in the Plan area. Consequently, HEW cannot be used to generate the overbank flow events required to maintain the health of the river, wetland and floodplain environments.[375]

As a result, most overbank ecosystems only receive inundation during uncontrolled or unregulated flow events, when flows are beyond river regulation capacities. Works and measures programs can provide controlled overbank watering over limited areas. Over time, overbank environments have been inundated less frequently leading to overall ecosystem decline (**Section 11.2**).[376]

The Basin Plan required a strategy to relax constraints to allow higher managed flows to improve environmental outcomes.[377] The MBDA's *Constraints Management Strategy* identified measures to '*allow environmental water to be used to maximum effect and to maximise the benefits of … held environmental water*'.[378] As part of commitments under the Basin Plan, the NSW Government has developed the Reconnecting River Country Program to assess options for relaxing constraints and, subject to funding, proposes to relax constraints to enable higher environmental flows and address adverse social and economic impacts, particularly to riparian landholders (**Section 11.5**).

374 DPE-Water (2023) *Reconnecting River Country Program: Flow options*
375 MDBA (2013) *Constraints Management Strategy 2013 to 2024*
376 DPE-Water (2023) *Reconnecting River Country Program: Flow options*
377 Section 7.08 of the Basin Plan.
378 MDBA (2013) *Constraints Management Strategy 2013 to 2024*

11.1 Constraints are listed in a Plan note, which is not enforceable

Constraints are outlined as '*operating channel capacities*' in Clause 67(1) of the Plan. This clause requires WaterNSW to determine and specify the operating channel capacities throughout the water source, in accordance with procedures established by the Minister, after considering the following:

- the inundation of private land or interference with access
- the effects of inundation on the floodplain and associated wetlands
- the transmission losses expected to occur
- the capacities of structures in the water supply system.

A note within this clause identifies the operational constraints determined at the commencement of the Plan, as follows:

- Hume Dam and Lake Mulwala, 25,000 ML per day
- Tocumwal Choke, 10,600 ML per day
- Barmah Choke, 8,500 ML per day
- Edward River / Kolety offtake, 1,600 ML per day
- Gulpa Creek, 350 ML per day
- Pooncarie, 20,000 ML per day.

The identified constraints do not form a binding part of the Plan as they are identified as a Plan note rather than as a Plan provision.[379] In addition, the Commission understands that no procedures have been established by the Minister to specify these constraints. Maximum operational flow rates have been revised to respond to changes in river hydrology or other factors.[380] For example, the Basin Officials Committee agreed to a lower temporary operational limit downstream of Yarrawonga of 15,000 ML per day (which can be increased to 18,000 ML per day under certain conditions).[381]

However, given the significance of any tightening of constraints to achieving Plan outcomes, these revisions should be required to be included in the Plan. Plan remakes should include the flow rates or flow level and stream gauges for constraint levels as Plan provisions. The Plan should require that any adjustment of these flow rates is applicable only after their incorporation as an amendment to the Plan.

In addition, WaterNSW's WaterInsights[382] portal does not currently list constraints as occurs in other plan areas. The portal should be updated to reflect the operational limits.

379 Clause 5(6) of the Plan states: '*notes in the text of this Plan do not form part of this Plan*'.
380 For example, in instances where river channel capacity changes due to siltation, or additional third-party risks arise due to increased development on low-lying riparian lands.
381 DPI-Water (2016) *Yarrawonga to Wakool Junction Reach Constraints Measure, Concept Proposal Business Case*, p. 4.
382 WaterNSW (n.d.) *WaterInsights portal*

11.2 Relaxing constraints can provide significant environmental benefits

The natural flow regime of the Murray and Lower Darling-Baaka have been significantly changed by river regulation and consumptive water use, leading to fewer overbank flows connecting wetlands and floodplain environments.[383] Under current rules, most of these areas have not received environmental watering frequently enough to maintain ecological condition,[384] leading to ecosystem degradation and direct negative impacts on native flora and fauna.[385]

As lateral connectivity between rivers and wetlands decreases, so too does the ability of aquatic species to move between them, limiting the availability of food and nutrients for animals and vegetation. The risk of hypoxic events also increases when water eventually reaches floodplains, due to the infrequent flushing of organic matter.[386]

Relaxing constraints can provide significant environmental benefits. Riverine environments can be inundated with the timing, frequency, extent and duration of higher flows they depend on for ecosystem viability and health. The targeted delivery of environmental water can improve lateral connectivity over a range of lower lying environmental sites, reconnecting the lower reaches of the wetlands, floodplains, creeks and billabongs that provide important habitat for local wildlife.

In the Plan area, higher flows are particularly important for reconnecting wetlands and forests, including for the Ramsar listed Barmah–Millewa Forest, Gunbower–Koondrook–Perricoota Forest and Werai Forest. Hydrological modelling of potential outcomes shows that by relaxing constraints, water for the environment could reach 2.5 times more floodplain habitat area compared to current conditions, improving the health of river red gum forest and woodland and increasing the abundance of native fish and waterbirds.[387] Relaxed constraints provide healthier river and wetland habitats for native vegetation, fish and other fauna.[388]

River operators benefit from increased operational flexibility under a relaxed constraint scenario. The river operator can vary the release of environmental flows, including by providing larger volumes over a shorter duration. These variable releases can improve environmental outcomes by reducing the impacts of riverbank notching and erosion associated with prolonged periods of constant water levels.[389] Greater operational flexibility can also result in more effective and efficient use of environmental water allowing river operators to:

- reconnect rivers with their dependent ecosystems in low-level floodplain and wetlands
- reinstate more natural flow patterns, and, at times, varying flow rates to a greater extent, interspacing consistent releases that lead to riverbank notching and erosion

383 DPE-Water (2023) *Murray Environmental Benefits and Risks Analysis Synthesis Report*
384 *Ibid.*; Productivity Commission (2023) *Murray–Darling Basin Plan: Implementation review 2023*
385 DPE-Water (2023) *Murray Environmental Benefits and Risks Analysis Synthesis Report*
386 Productivity Commission (2023) *Murray–Darling Basin Plan: Implementation review 2023*
387 DPE-Water (2023) *Murray Environmental Benefits and Risks Analysis Synthesis Report*
388 DPE-Water (2023) *Reconnecting River Country Program: Flow options*; see DPE-Water (2023) *Murray Environmental Benefits and Risks Analysis Synthesis Report* for an evaluation of environmental benefits to fish, vegetation, waterbirds, ecosystem production and water quality.
389 Lauchlan Arrowsmith, CS, Vietz, G, Wakelin-King, G, Grove, J, Rutherfurd, I, Cheetham, M, Martin, J, Gower, TG, Al Baky, A, Woods, K and Lam, D (2022) *Geomorphic Assessment for the NSW Reconnecting River Country Program in the Murray and Murrumbidgee Rivers*, report prepared for Water Infrastructure NSW.

- trigger breeding and movement of native fish, waterbirds and other water-dependent animals
- release and transfer carbon and nutrients underpinning the aquatic food web
- enhance native fish populations and support healthy river and wetland ecosystems
- improve the health of forests, woodlands and shrublands along river corridors and on low-lying floodplains
- allow the existing environmental water portfolio to be managed more efficiently and effectively for greater environmental benefit.[390]

11.3 Relaxing constraints can significantly impact social and economic outcomes

River regulation (including dam construction) and operational management has led to fewer low-level overbank flows, to the benefit of some riverine landholders who experienced social and economic impacts associated with low-level inundation.

Relaxing constraints for environmental flows will result in periodic low-level inundation of public and private land,[391] which can impact property, business operations and landholder livelihoods. Low-level inundation can impact social and economic outcomes for riverine landholders, businesses and communities through:

- temporarily impeded access
- loss and damages to agricultural operations (crops, improved pastures, horticulture) from inundation, as well as an increase in grazing pressure from native animals seeking refuge from inundated public reserves over extended periods
- costs, damages and losses to farm infrastructure (tanks, troughs, pumps, fences)
- farm management costs related to relocating stock and pumps, distribution of debris across paddocks, weed control, animal health, clean up and farm planning
- costs and damage to public infrastructure including roads, tracks, culverts, bridges, levees and landscaping
- costs and damage to residential properties, and specialist activities including turf farms and quarries.[392]

The scale of potential impacts will depend on the frequency, duration and timing of the low-level overbank flows, as well as the flow rate targeted for relaxed constraints.

The Commission acknowledges that the Reconnecting River Country Program is working on improving and verifying the number and extent of landholders affected by inundation based on revised model simulations. However, the Water Group advised that the revised information is not finalised or published. The Commission has used public information from the MDBA (dated 2015) and the NSW Proposed Business Case (dated 2016), which may not reflect revised estimates.

390 DPE-Water (2023) *Reconnecting River Country Program: Flow options*; Productivity Commission (2023) *Murray–Darling Basin Plan: Implementation review 2023*
391 DPE-Water (2023) *Reconnecting River Country Program: Flow options*
392 DPI-Water (2016) *Yarrawonga to Wakool Junction Reach Constraints Measure, Concept Proposal Business Case*; MDBA (2016) *Hume to Yarrawonga Constraints Measure, Business Case*

In 2016, it was estimated that between Hume and Yarrawonga, 1,117 hectares of private agricultural land across 207 riparian landholders in NSW and Victoria could be affected by the maximum flow rate of 40,000 ML per day.[393] In addition, between Yarrawonga and Wakool it was estimated that 1,513 properties would be affected by a 50,000 ML per day flow rate, which is 5,000 ML per day above the maximum flow rate under consideration.[394]

The Commission notes that the NSW Government seeks to address adverse social and economic impacts associated with constraints relaxation through proposed program measures (formerly known as the impact management toolbox) (**Section 11.5**).

11.4 Relaxing constraints can also have social and economic benefits

Relaxing constraints can also benefit social, economic and cultural (see **Chapter 9**) outcomes, including through improved environmental condition. Social and cultural outcomes may benefit from improvements in amenity, fish populations for recreational fishing, increased flows to water-dependent culturally significant areas, and reductions in hypoxic events. Cultural outcomes may benefit from improved environmental conditions benefiting community outcomes including connection to Country.

Economic benefits can also be gained by relaxing constraints, including reduced economic impacts related to reduced hypoxic events, increased operational variability, and improvements in soil quality[395] and moisture that enhance agricultural productivity. Enhanced environmental outcomes may also benefit wider economic outcomes through increased regional tourism. Reinstating some of the low-level inundation that occurred prior to river regulation will also benefit economic outcomes for landholders who depend on that inundation for pastures and river redgum forestry.

In addition, complementary programs to implement constraints relaxation measures may provide significant regional investment to:

- upgrade roads, bridges and infrastructure to improve access and keep access routes open
- improve flood mitigation infrastructure
- provide financial support to temporarily or permanently relocate assets during higher flow events
- improve high flow river forecasting and warning systems.

This investment will also reduce social and economic impacts associated with existing uncontrolled low-level flooding events. In addition, these measures can improve community safety and resilience to natural flood events up to the constraint relaxed flow rates, which are expected to increase under climate change (**Chapter 4**).

Finally, as the program to relax constraints was notified as a ‘supply measure’ under the sustainable diversion limit adjustment mechanism, these measures help reduce the volume of environmental water recovery under the Basin Plan, maintaining larger volumes of water in the consumptive pool for economic purposes.

393 MDBA (2016) *Hume to Yarrawonga Constraints Measure, Business Case*, p. 7.
394 DPI-Water (2016) *Yarrawonga to Wakool Junction Reach Constraints Measure, Concept Proposal Business Case*, p. 60.
395 Soil quality can be improved through increased cycling of carbon and nutrients between rivers and floodplains.

11.5 Potential social and economic impacts must be addressed

The NSW Government has developed the Reconnecting River Country Program to address potential impacts of relaxing constraints on landholders within flow corridors.[396] This program seeks to engage potentially impacted parties to determine a range of responses that address possible impacts.

A key program requirement is establishing enduring agreements on title representing environmental flow corridor easements. Flow corridors would provide river operators with the right to release water for environmental purposes up to the flow limit, within the flow corridor. Flow corridors would also provide landholders with certainty on the maximum flow extent (including buffers) to be expected from these water releases. The agreements will be negotiated through the proposed landholder negotiation scheme,[397] which will establish the process for negotiating compensation payments through transparent, fair, equitable and consistent negotiations with those landholders likely to be affected.[398]

At the time the Commission was finalising the Plan review, the NSW Government was undertaking consultation on the draft landholder negotiation scheme regulation and guidelines, which set out the approach for negotiating voluntary agreements with landholders affected by delivery of water for the environmental purposes at higher flow rates, or under different regimes, than current operating practice. Supplementing the landholder negotiation scheme are the proposed program measures,[399] which identify options available to mitigate potential impacts.[400]

11.6 Higher flow options increase environmental benefits and socioeconomic impacts

The Reconnecting River Country Program is investigating five relaxed constraint flow options in the Plan area (**Table 5**). The Commission notes that a preferred flow option has not yet been identified.[401] The options are specified as flow rates measured at Doctors Point and downstream of Yarrawonga Weir.

The flow rates for all options under consideration are lower than the Bureau of Meteorology's 'minor' flood level classification at these locations.[402] The highest flow rate is also lower than recommendations from previous analyses including the MDBA's constraints management strategy (50,000-65,000 ML per day at downstream of Yarrawonga).[403]

Option 5 provides the greatest improvement to environmental outcomes,[404] as larger managed inundation of riverine lands can occur. However, larger inundation can also lead

396 Productivity Commission (2023) *Murray–Darling Basin Plan: Implementation review 2023*; DPE-Water (n.d.) *Reconnecting River Country Program*
397 DPIE (2022) *Impact Management Toolbox summary*; NSW Government (2022) *Reconnecting River Country Program, Landholder Negotiation Framework- Discussion Paper*
398 DPE-Water (2023) *Reconnecting River Country Program: Communique from meeting #2 with private landholder reference groups*
399 DPE-Water (2023) *Reconnecting River Country Program: Mitigation measures*
400 DPE-Water (2023) *Reconnecting River Country Program: Communique from meeting #2 with private landholder reference groups*
401 DPE-Water (2024) *Flow options*
402 Doctors Point: Minor flood 44,000 ML per day; downstream Yarrawonga Weir: Minor flood 81,000 ML per day (see MDBA (2023) *Managing floods at Hume Dam* and DCCEEW (n.d.) *Murray River: Yarrawonga Weir to Wakool Junction*).
403 MDBA (2016) Hume to Yarrawonga Constraints Measure, Business Case; DPI-Water (2016) Yarrawonga to Wakool Junction Reach Constraints Measure, Concept Proposal Business Case
404 DPE-Water (2023) *Murray Environmental Benefits and Risks Analysis Synthesis Report*

to greater impacts to social and economic outcomes, which need to be addressed as part of the program measures.

The Commission notes that current NSW Government policy seeks to relax constraints only for the delivery of water for environmental purposes. The program does not increase operational limits related to releases of water for non-environmental purposes, including policy around trade, cultural water or operational management (i.e. flood management).

Table 5: Flow options being investigated in the Plan area[405]

Flow limit option	Hume to Yarrawonga (measured at Doctors Point gauge) L/d)	Yarrawonga to Wakool Junction (measured at downstream of Yarrawonga Weir)
Base Case	25,000 (current operational limit in Plan)	15,000 (current temporary operational limit)
Option 1	25,000	25,000 (current operational limit in Plan)
Option 2	30,000	30,000
Option 3	35,000	35,000
Option 4	40,000	40,000
Option 5	40,000	45,000
		50,000*

*The maximum buffer is not a target for water delivery or a preferred flow limit but is used for impact mitigation purposes.

11.7 Plan provisions should be amended if constraints are relaxed

The Commission has identified additional matters that require resolution if constraints are relaxed. While these matters are largely outside the scope of review under Section 43A of the Act, resolution of these matters likely requires amendments to Plan provisions to ensure the Plan materially contributes to achieving environmental outcomes.

If constraints are relaxed, two sets of constraint levels should be identified in the Plan to provide clarity to stakeholders on the flow rate limits that apply to general river operations and the higher flow rate limits that apply to water for the environment within relaxed constraint flow corridors.

If constraints are relaxed, the NSW Government will need to engage with landholders and river operators to resolve outstanding issues related to providing river operators with the legal authorising environment to release environmental flows along flow corridors up to the relaxed constraint flow rates. The Plan should reference, as Plan notes, any statutory provisions relied upon to provide transparency and clarity to landholders and the river operator river operator discretion to refuse orders of environmental flows for the purpose of achieving environmental outcomes within flow corridors.

405 DPE-Water (2023) *Murray Environmental Benefits and Risks Analysis Synthesis Report*; DPE-Water (2024) *Flow options*

Recommendation R37 – Priority 1

To improve environmental outcomes that can be achieved in the event of constraint relaxation, the Water Group should:

a) include provisions that identify the flow rates or flow levels related to normal operations and where environmental flows are being released within relaxed constraint flow corridors

b) ensure provisions promote the release of environmental flows and that the river operator cannot unreasonably refuse to deliver environmental flows up to the relaxed constraint flow levels.

12 Aligning channel capacity sharing with the Act

When total water orders and required deliveries (i.e., basic landholder rights, EWA and water orders) exceed channel operating constraints the river operator is unable to release enough water to meet all needs. During these times, the river operator must share channel capacity based on the Plan's priority of extraction provisions.[406] Under these provisions, basic landholder rights are provided the highest priority. At the commencement of the Plan, provisions for sharing capacity did not identify where EWA releases sit within the priorities. Amendments made in 2022 placed EWA water in the lowest priority category, to be shared with regulated river (general security) access licences.[407]

Providing the lowest priority for EWA releases potentially contradicts Section 5(3) of the Act, which prioritises water to protect the water source and its dependent ecosystems alongside basic landholder rights.

The 2022 amendments also removed the Plan clause for specifying limits on the volume or rate of extraction for access licences, also known as extraction components.[408] In other plan areas, individual daily extraction components have been specified in water access licences to fairly distribute limited water flows in a way that complies with a total daily extraction limit.[409] Irrigation infrastructure operators have also implemented a mechanism to share the available flow rate during a supply restriction by specifying delivery entitlements.[410] Extraction components and delivery entitlements are generally tradable within river sections. The Commission notes that introducing extraction components could provide an equitable and transparent mechanism for sharing limited river capacity.

The Commission is also aware of stakeholder concerns related to whether the treatment of environmental water complies with the Barmah Choke trade rule. The MDBA and the Water Group should seek to improve transparency on bulk transfer mechanisms and any implications on channel capacity sharing.

Recommendation R38 – Priority 3
To align with priorities under the Act, the Water Group should revise Clause 68 of the Plan to specify that planned environmental water (for example, EWA) holds channel capacity priority equivalent to basic landholder rights and above all other extractive users and ensure that held environmental water deliveries are treated equitably.

406 Clause 68 of the Plan.
407 Clause 68(1)(c) of the Plan.
408 Clause 37 from the Plan dated 29 July 2016.
409 DPIE (2021) *Individual Daily Extraction Components (IDECs): Daily extraction limits in the Barwon-Darling Unregulated Water*
410 For example, Murrumbidgee Irrigation (2018) *Delivery Entitlements- Frequently Asked Questions*

13 Compensation implications of recommendations

Under the Act, compensation may be payable by the NSW Government to access licence holders – only in some circumstances where water allocations under a water sharing plan are reduced. Section 43A(3A) of the Act requires the Commission to report whether changes proposed to the Plan are to restore water to the environment due to changes in inflows or improvements in scientific knowledge. Specifically, the Act states that:

> *'(3A) If a report of the Natural Resources Commission under subsection (3) recommends changes to a management plan that will result in a reduction of water allocations in relation to which compensation might be payable under section 87AA, the Commission is to state in the report whether the purpose of the proposed change is:*
>
> *(a) to restore water to the environment because of natural reductions in inflow to the relevant water source, including but not limited to changes resulting from climate change, drought or bushfires, or*
>
> *(b) to provide additional water to the environment because of more accurate scientific knowledge that demonstrates that the amount previously allocated to the environment is inadequate.'*

Many of the recommendations can be advanced without triggering compensation. For instance, the Commission notes that Section 87AA indicates that compensation is not payable due to a reduction in water allocation if *'the reduction in water allocations is for the purpose of restoring water to the environment because of natural reductions in inflow to the water source, including but not limited to changes resulting from climate change, drought or bushfires.'* The Commission has sought to identify where compensation may be payable under Section 87AA of the Act. These impacted recommendations are listed in **Table 6**.

Table 6: Recommendations that may trigger compensation

Recommendation		Cause of change
Ensuring sustainable extraction		
R6	The Minister should require the Water Group to develop and adopt a sustainable LTAAEL that: a) sets aside the water required to protect the water source and its dependent ecosystems b) enables the achievement of the Plan's environmental, social and cultural objectives c) establishes a limit framework that is responsive to the impacts of climate change d) is not reliant on the SDL to achieve the Plan's environmental outcomes.	Changes due to improved scientific knowledge and climate change
Strengthening environmental protections in the Lower Darling-Baaka		
R15	The Water Group should amend the Plan as a priority (before the Plan expires) to: a) incorporate updated minimum daily flows consistent with the Commission's advice, including provisions that allow the flexibility in	Changes due to improved scientific information and climate change

	their delivery based on water quality, water availability and ambient conditions b) delegate the responsibility for managing minimum daily flows to the Water Quality Working Group and clarify governance arrangements and membership c) establish an active storage trigger to enable the Minister for Water to have discretion over delivery of minimum daily flows during drought periods with concurrence from the Minister for the Environment.	
R16	To improve the effectiveness of the Lower Darling EWA, the Water Group should amend the Plan as a priority (before the Plan expires) to: a) sets aside the water required to protect the water source and its dependent ecosystems b) enables the achievement of the Plan's environmental, social and cultural objectives c) establishes a limit framework that is responsive to the impacts of climate change d) is not reliant on the SDL to achieve the Plan's environmental outcomes.	Changes due to improved scientific information and climate change
R18	The Water Group should seek Basin Officials Committee agreement on permanent arrangements to recredit all water for the environment originating from the northern Basin to formalise its protection in the southern Basin. These provisions should be incorporated into the replacement Plan and the Murray-Darling Basin Agreement.	Changes due to improved scientific information and climate change
R20 (a)	To support the effectiveness of Plan provisions for the Lower Darling-Baaka, the Water Group should: a) Work with the Basin Officials Committee to: i. reduce or remove lower priority demands from the upper lakes, including shared resource demands that exceed minimum daily releases, to reserve the upper lakes for high priority commitments ii. codify that the management of the shared resource continues to maximise stored volumes in the upper lakes and expand the use of surcharging the upper lakes when appropriate, in turn highlighting the need for investment in infrastructure upgrades iii. redefine the volume of a priority storage reserve in the upper lakes, based on a water balance approach, which provides a drought reserve for human and environmental needs over an appropriate planning horizon	Changes due to improved scientific information and climate change
R24	As part of Plan replacement, the Water Group should recognise the interrelationship between the	Changes due to improved scientific information and climate change

	Lower Darling Water Source and the Great Darling Anabranch and establish provisions for flows down the Anabranch to support the Plan's connectivity and environmental objectives and to ensure consistency with the *Darling Anabranch Management Plan*.	
R25	As part of Plan replacement, the Water Group should: a) incorporate replenishment flow provisions for Three Mile Creek (up to twice a year when water is available in Lake Wetherell, or a single delivery when Lake Wetherell falls below 75 percent capacity) b) develop and incorporate water quality triggers (based on existing water quality monitoring within Lake Wetherell) to inform delivery of flows down Three Mile Creek from Lake Wetherell c) consider an event-based monitoring program for flow events through Three Mile Creek d) engage with BCS, DPIRD Fisheries and CEWH regarding opportunities for delivery of water for the environment along Three Mile Creek, including its protection.	Changes due to improved scientific information and climate change

While there are also other recommendations that may affect water allocations, these changes are allowed through amendment provisions provided for in the Plan or in the Commission's view would not affect long-term allocation or are entirely due to changes in climate and therefore not subject to compensation. DCCEEW should seek its own legal advice on this matter.

In considering the requirements under Clause 87AA of the Act, the Commission has not made any determination in relation to entitlements to or the amount of compensation and does not provide legal advice in this report. DCCEEW should seek legal advice regarding any potential compensation implications of implementing the recommendations in this report.

Appendix 1 - Barmah-Millewa EWA

Water Year	Account carryover	Credits	Spill	Evaporation forfeit	Use	Account balance	Available for use	Borrow carryover	Borrow	Borrow repay	Borrow account
2004-05	175,000	50,000	0	0	0	225,000	0	175,000	50,000	0	225,000
2005-06	225,000	75,000	0	0	256,450	43,550	43,550	225,000	50,000	275,000	0
2006-07	43,550	47,500	0	0	0	91,050	0	0	91,050	0	91,050
2007-08	91,050	21,500	0	0	0	112,550	0	91,050	21,500	0	112,550
2008-09	112,550	17,500	0	0	0	130,050	0	112,550	17,500	0	130,050
2009-10	130,050	50,000	0	0	0	180,050	0	130,050	50,000	0	180,050
2010-11	180,050	50,000	0	720	134,500	94,830	94,830	180,050	48,500	228,550	0
2011-12	94,830	75,000	0	0	139,800	30,030	30,030	0	0	0	0
2012-13	30,030	75,000	2,440	850	0	101,740	101,740	0	0	0	0
2013-14	101,740	75,000	76,730	2,460	0	97,550	97,550	0	0	0	0
2014-15	97,550	75,000	0	2,420	0	170,130	170,130	0	0	0	0
2015-16	170,130	50,000	0	0	0	220,130	0	0	220,130	0	220,130
2016-17	220,130	75,000	94,510	3,370	84,030	113,220	113,220	220,130	25,590	245,720	0
2017-18	113,220	75,000	0	2,570	0	185,650	185,650	0	187,280	187,280	0
2018-19	185,650	75,000	0	0	0	260,650	0	0	260,650	0	260,650
2019-20	260,650	33,000	0	0	0	293,650	-2,440	260,650	35,440	0	296,090
2020-21	293,650	50,000	0	170	0	343,480	343,480	296,090	46,060	342,150	0
2021-22	343,480	75,000	168,980	3,770	47,890	197,840	197,840	0	350,000	350,000	0
2022-23	197,840	75,000	72,840	2,450	0	197,550	197,550	0	0	0	0

Source: DCCEEW (2024) *General Purpose Water Accounting Report NSW Murray Catchment 2022-23*, p.104.