

NSW Government response

Office of the NSW Chief Scientist and Engineer
independent review into the 2023 fish deaths in
the Darling-Baaka River at Menindee

November 2023

dpie.nsw.gov.au





Acknowledgement of Country

The Department of Planning and Environment acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

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NSW Government Response

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Introduction

The NSW Government welcomes the report of the Office of the NSW Chief Scientist and Engineer’s independent review into the 2023 fish deaths in the Darling-Baaka River at Menindee (the Review Report). We acknowledge the findings and accept the recommendations made by the Office of the NSW Chief Scientist and Engineer.

In summary, the NSW Government supports:

- strong and enforceable legislation to give effect to environmental protections and protect whole of catchment ecosystem health.
- integrated, open, whole of system approach to data collection, analysis and management.
- local, detailed and effective emergency management arrangements specifically for fish death events.
- strategic actions to reduce the risk of further mass fish deaths and restore the health of the broader river ecosystem.

In the past three years, fish death events in the Lower Darling-Baaka River and Menindee Lakes have meant the loss of tens of millions of fish. The Review Report found that hypoxia – a lack of dissolved oxygen – in the water, a large number of fish requiring oxygen and fish barriers restricting the ability of fish to move from low quality water to high quality water, were the most likely immediate causes of this most recent event. However, the fish deaths are just one indication of the long-term decline in river health.

Hypoxic conditions occur when there is low or depleted oxygen in the water body. Such conditions can be caused by a range of circumstances and lead to a decrease in the oxygen available to fish and other aquatic organisms, resulting in fish deaths due to hypoxia.

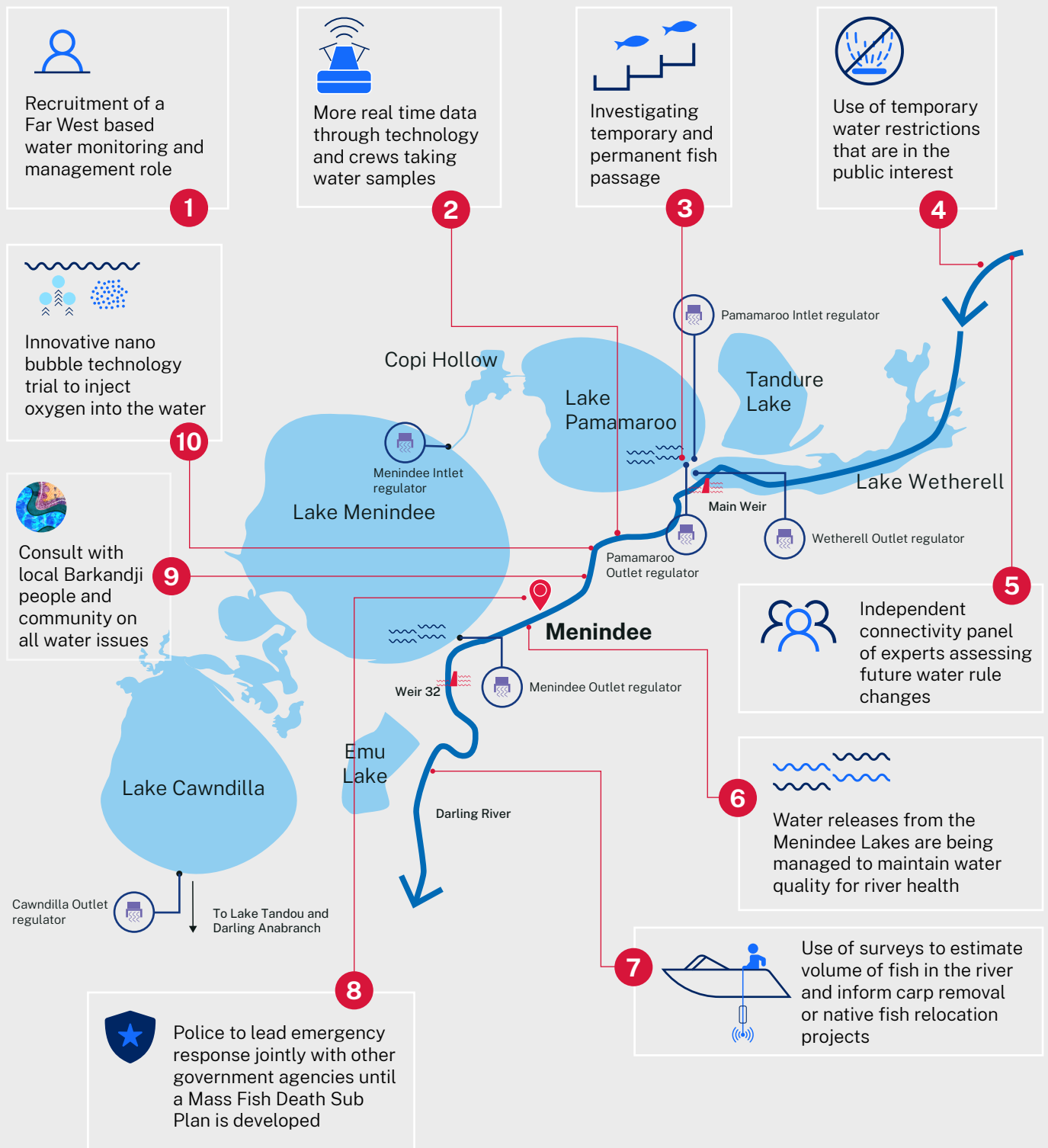
Other factors that contribute to conditions driving mass fish deaths include changes to the flow regime due to storages, dams and weirs, competing invasive species and the impacts from agriculture, land use change and loss of vegetation. Increasingly, climate change will continue to increase the risk of mass fish death events, with increased frequency of extreme droughts and flooding impacting ecosystems.

These challenges require all avenues to be explored to put NSW in a stronger position to improve the health of the river and its native fish. The Review Report provides direction for the NSW Government to make significant improvements to mitigate, better plan for and manage fish death events like earlier this year – and previous significant events. The NSW Government will address these challenges using a whole of government approach.

We have heard and we acknowledge that our engagement with the local Menindee community in the past has not been up to the standard rightly expected by the community. We want to do better and the NSW Government is committed to improving our engagement and consultation with the community.

What we are delivering in the next 12 months

Figure 1 – Summary of actions over the next 12 months



This document is an interim response to update the community on actions that the NSW Government has underway or has planned to commence by summer 2023-24.

As immediate actions to reduce the risk of more mass fish deaths, the NSW Government:

1 **Employ staff based in Far West NSW:** has been holding regular listening and update sessions with the Menindee and Lower Darling-Baaka community. We have heard that staff based in the local community will help improve communication with government. We have advertised for the role of Senior Water Implementation Officer, based in Far West NSW, to better connect with the community on water quality and water management issues and incorporate local knowledge.

2 **Better data to inform decisions over summer:** has already installed a telemetered buoy to provide real time data on water quality and guide decisions. Another two buoys will be installed this year. Government agencies are also deploying a monitoring crew twice a week to undertake on-ground sampling of the water. The WaterInsights Portal¹ is progressively making all routinely collected open-source data publicly available in near-real time to the public in one location. This includes data for dissolved oxygen levels and water temperature to allow agencies to better forecast and respond to deteriorating water quality conditions.

3 **Fish passage:** has secured a commitment from the Australian Government of \$2.3 million to support NSW progressing planning for permanent fish passage solutions at Menindee Lakes and the Lower Darling-Baaka River. Permanent fish passage solutions can take years to implement. In the short term, we are investigating the feasibility of temporary fish passage solutions and are seeking community views on temporary fish passage options. We will also remove the remainder of Old Town Weir from the weir pool in winter 2024, subject to environmental conditions at that time, to help improve flows in the Lower Darling-Baaka River.

4 **Embargoes:** will implement temporary water restrictions under section 324 of the *Water Management Act 2000* to restrict low priority licences as drier conditions escalate, when it is in the public interest. We will proactively communicate when these restrictions will be put in place to allow businesses and the community to plan and respond to the restrictions. We will remove reliance on embargoes once enduring changes are made to water sharing plans to better protect downstream flows in response to Recommendation 1 of the Review Report.

5 **Rule changes:** has set up an Independent Connectivity Expert Panel to provide recommendations on changes needed to NSW water sharing plans to improve downstream outcomes². Water sharing changes resulting from this work will be consulted on in 2024 with the necessary amendments to water sharing plans made by 30 June 2025. Other rule changes will also be investigated as part of the current review of the *Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2016*.

¹ <https://www.watensw.com.au/water-services/water-data/water-insights>

² The Connectivity Expert Panel's terms of reference is available at: <https://water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies/final/western-regional-water-strategy/connectivity-expert-panel>

6

Water releases: has been actively managing and modifying releases from Lake Pamamaroo to maintain water quality in the Menindee town weir pool and reduce the risk of more mass fish deaths. The Menindee/Lower Darling Water Quality Working Group³ (Working Group) continues to monitor water quality including dissolved oxygen levels and temperature in the Menindee Lakes system. As conditions dry, adaptive decisions will be made on when to reduce water releases and conserve the remaining water for drought security. We will continue monitoring conditions and provide the community with early communications on any decisions to release or hold back water, as well as implement drought preparedness activities as needed.

7

Fish surveys: has undertaken preliminary surveys to estimate the volume (biomass or equivalent metric) of fish in the Menindee town weir pool. The results of these surveys and existing knowledge of the habitat and fish community will inform actions such as removing carp and relocating native fish. We will explore opportunities to remove or relocate fish in partnership with local businesses, community groups and River Rangers.

8

Emergency response: will develop protocols and interim responses for when an emergency will be triggered if water quality drops over summer. Ahead of a Mass Fish Death Sub-Plan being prepared, the NSW Environment Protection Authority (EPA), will develop an interim response plan by the end of 2023. Unless otherwise specified by the Sub-Plan, the NSW Police Force will lead the emergency response for any mass fish death events over summer as the Emergency Operations Control (EOCON) in accordance with emergency management arrangements.

9

Aboriginal engagement: will work with the Barkandji people to understand the community's cultural water objectives, explore options for water access and ownership and establish monitoring mechanisms. As a first step, the Water Group of the Department of Planning and Environment (DPE Water) is working with Aboriginal people and community groups to develop six pilot cultural watering plans. The results of these cultural watering plans will inform a broader program across NSW.

10

Increasing oxygen in the water: will trial innovative nanobubble technology in the Menindee town weir pool to help inject oxygen into the water.



³ The Menindee Lower Darling Water Quality Working Group was previously known as the Hypoxic Blackwater Working Group, has changed its name to better reflect its role and geographic focus.

The NSW Government will provide and publish a comprehensive response and implementation plan which addresses each of the detailed recommendations in the Review Report in the first half of 2024. The NSW Government is looking at each of the detailed recommendations in the Review Report closely. There are many actions for the mid and long term that require further, careful consideration and sustained effort and resourcing alongside further community consultation and involvement.

The Review Report is already informing work currently underway and tasks we have planned for the immediate and longer-term. Where we can do things better, we will do better. Where additional resources and funding are needed, we will look at how we can make this happen, leveraging off the strong working relationships we have across NSW government agencies and with partner agencies we have outside of the NSW Government.

The NSW Government is already exploring as an action in the NSW Water Strategy⁴ how to better coordinate water quality management and monitoring currently done by multiple government agencies. The NSW Government is preparing a roadmap for governance arrangements for water quality management and monitoring. This work explores and considers options to address gaps, remove duplication or uncertainty and improve water quality governance arrangements.

The NSW Government is also looking at our regulatory frameworks and governance arrangements to see how we can provide better catchment scale and ecosystem outcomes. The scale and nature of this task requires time, resources and strong partnerships with our scientific, cultural and local communities to get it right.

The EPA is also conducting an independent investigation into the causes of the mass fish death event to determine whether regulatory action is warranted. This investigation is ongoing, and NSW Government agencies will continue to cooperate with the EPA as it uses its investigative powers under the Protection of the *Environment Operations Act 1997* to obtain information and/or records, conduct interviews and collect samples. Results from this investigation will help inform actions to be undertaken in response to the Review Report.

Finally, the NSW Government submits that the management of the Menindee Lakes more broadly needs to change. Changes to the operating arrangements at the Menindee Lakes requires agreement from all Murray-Darling Basin governments. NSW is working with other Basin jurisdictions to explore improvements to the operation of the Menindee Lakes, noting that the operational rules are established by the Murray-Darling Basin Agreement so are not controlled by NSW until the Menindee Lakes drop to 480 GL.

Conditions continue to deteriorate

As conditions dry over summer and with the El Niño weather pattern, there is a strong likelihood of more mass fish deaths. Under worst case scenarios, without significant inflows, the Menindee Lakes could be at 480 GL stored volume by March 2024, with 12 months of water remaining for critical needs by April 2024.

Even with implementing the immediate actions recommended by the Review Report and applying temporary water restrictions, the Menindee Lakes will not refill without significant rain and such rain events are less likely in an El Niño year. The higher temperatures in spring and summer and limited water throughout NSW Murray-Darling Basin valleys over the coming summer is likely to reduce water quality and potentially result in more fish deaths.

Water quality in Lake Wetherell is already deteriorating which means the habitat available to fish with good quality water will rapidly diminish. The next mass fish death event may be inevitable and could be larger than the March 2023 event.

The NSW Government continues to consider scenarios to either save the remaining water in Menindee Lakes for critical drought needs, or to continue releasing it to support river health, water quality and native fish. Noting this forecast, we are taking immediate action to intervene and to minimise the risk and extent of future mass fish deaths in the timeframes we have, but unfortunately, the risk cannot be reduced to zero.

4 https://water.dpie.nsw.gov.au/_data/assets/pdf_file/0007/409957/nsw-water-strategy.pdf

Engaging with the community

The NSW Government will continue to listen to community and take on board local knowledge and observations. We are committed to improving our consultation with the community on water and environmental management issues including the implementation of actions arising from the Review Report. We will explore options for direct involvement of community members in collection of data and observations, as well as management. The NSW Government acknowledges that we need to do better and engage better with the community.

Throughout the March 2023 event, the NSW Government engaged with the local community through face-to-face meetings, monthly web updates and frequent operational updates. We will continue to be transparent and coordinated in communications and management during future events and will work closely with local communities including councils, Aboriginal organisations, health agencies, utilities, scientific and environmental groups. This will be a journey of continuous improvement.

On the recommendations of the community and the Review Report the NSW Government has recently advertised for the role of Senior Water Implementation Officer, to help government better connect with the community around Menindee and the Lower Darling-Baaka on water quality and water management issues and incorporate local knowledge.

A specific message to the Menindee and Barkandji communities

The Menindee mass fish death events have been upsetting for the local community and everyone living and working near the river. We have been listening and we will continue to listen to your local perspectives and observations but we know we can do better. We will continue to work in partnership with you on recovery, prevention and improved water management and our place based local officer that we are recruiting will help strengthen connections with agencies responsible for water management.

We specifically acknowledge the impact the event had on the Barkandji people given their deep connection to the rivers and country, and the importance of the Darling-Baaka including totemic species affected by the mass fish death events. As the March 2023 event unfolded, DPE Water met with First Nations communities and gave a presentation to the Barkandji Native Title Board on hypoxic blackwater, fish deaths and the incident response.

The NSW Government recognises the importance of First Nations perspectives in the management of water in NSW and through our NSW Water Strategy we are seeking to secure a future where water for First Nations and Aboriginal people is embedded within our water planning and management framework regime delivering cultural, spiritual, social, environmental and economic benefit to communities. We are committed to continuous engagement and involvement with the Barkandji community while implementing mitigation actions in the short and long term, and to creating lasting relationships with First Nations communities.

Responsible agency

DPE Water were tasked with preparing the NSW Government response to the Review Report and will be responsible for coordinating and reporting on implementation of the NSW Government response. DPE Water have been given this task because the majority of the Review Report's findings and recommendations relate to DPE Water's functions in government.

Many of the Review Report's recommendations require other agencies (both within and outside of the NSW Government) to supply expert staff and funding and to lead or support delivery of actions. DPE Water is collaborating with these agencies to enable knowledge, expertise, learnings and insights to be shared and to inform a holistic and strategic response to this event and inform future planning and management action. DPE Water will continue to engage with the Office of the NSW Chief Scientist and Engineer to make sure the recommendations of the Review Report can be implemented as intended.

Reporting and next steps

The NSW Government is committed to transparent and regular reporting on how we are tracking with implementation of actions committed to in response to the Review Report.

This response details the NSW Government's immediate progress on recommendations that must be actioned first. A full response to the Review Report and implementation plan for all recommendations will be published in the first half of 2024.

Once the NSW Government's full response has been published, DPE Water will collate updates from across government agencies and publish quarterly updates on its website until the response measures for each recommendation are complete.

Progress on immediate actions



Recommendation 1: Regulatory environmental protections must be enforced

The regulatory framework must be upgraded to include legally enforceable obligations and powers to give effect to environmental protections and whole of catchment ecosystem health, as expressed in the objects of water, environmental and biodiversity legislation.

Improving the NSW framework

The NSW Government supports a strong and enforceable regulatory framework to give effect to environmental protections and protect whole of catchment ecosystem health.

DPE Water will seek independent advice on how existing legislation can be implemented in a way that delivers better on-ground outcomes and the roles, responsibilities and resourcing needed to deliver these improvements. The independent advice will include looking at how water legislation can work more effectively with land-use, pollution control and environmental legislation to achieve positive overall outcomes for the river and its catchment. This advice will inform the water quality roadmap and the full response to the Review Report in 2024.

We have already taken action to improve the NSW water sharing plan framework by appointing an Independent Connectivity Expert Panel (Panel) to provide advice on rules needed in water sharing plans to restrict upstream water take under supplementary water licences, floodplain harvesting licences and Barwon-Darling licences to enhance downstream outcomes. The Panel comprises Ms Amy Dula (Chair), Professor Fran Sheldon, Dr Phil Townsend, Professor Phil Duncan, Dr Mark Southwell and Mr Cameron Smith.

In response to the Review Report's recommendations, the Panel's terms of reference will be expanded to examine the adequacy of rules in relevant unregulated northern Basin water sharing plans in contributing to hydrological connectivity with the Lower Darling-Baaka River and southern Basin. This action will address **Recommendation 1.1 in the Review Report**.

An updated terms of reference for the Panel will be published on DPE Water's website.⁵

⁵ <https://water.dpie.nsw.gov.au/plans-and-programs/regional-water-strategies/final/western-regional-water-strategy/connectivity-expert-panel>

The expanded scope of the work will mean the Panel's draft report will be released by early 2024, following which there will be a short round of public consultation. The findings of the Panel will be included in a final report expected to be released in 2024 and will be used by the NSW Government to inform amendments to water sharing plans for the NSW northern Basin catchments. Changes to water sharing plans will aim to improve outcomes through the system including in the Lower Darling-Baaka River. Any proposed changes to the plans will undergo public consultation in 2024, with the necessary changes to be made by mid-2025. **This action seeks to address Recommendation 1.2 in the Review Report.**

The *Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2016* is due for review by the Natural Resources Commission (NRC) in the first half of 2024 ahead of its expiry in July 2026. The Minister for Water has requested that the NRC prioritise this review by bringing it forward to 2023 and for the NRC to focus on its adequacy to meet environmental and water quality objectives. **This action will address recommendation 1.3 in the Review Report.**

The *Water Sharing Plan for the Lower Murray-Darling Unregulated River Water Source 2011* is due to be replaced by July 2024 and there is also an opportunity for improvements to this plan as part of its replacement process.

NSW Government agencies, including DPE Water, the EPA, DPI Fisheries, DPE Environment and Heritage Group (DPE EHG) and WaterNSW will continue to work collaboratively to implement water and environmental reform activities across NSW to protect and enhance connectivity and ecological outcomes across waterways, including for native fish. These lead agencies for the environmental, biodiversity and fisheries frameworks may also propose changes to improve and better integrate these frameworks in due course.

Improving operating arrangements of the Menindee Lakes

The Menindee Lakes storage system consists of four main lakes: Wetherell, Pamamaroo, Menindee, and Cawndilla. The Menindee Lakes are a critical ecological system for native fish breeding and bird life and also hold important cultural values and significance for Aboriginal people. The Menindee Lakes are the only large public water storage in the Western region with the infrastructure owned and operated by the NSW Government.

Water in the Menindee Lakes can be shared to meet Murray River demands when the volume rises above 640 GL, and until it drops below 480 GL in accordance with the Murray-Darling Basin Agreement. Under the Murray-Darling Basin Agreement, the Murray-Darling Basin Authority (MDBA) may direct water to be released from the Menindee Lakes to meet downstream demand when their volume rises above 640 GL, and until they drop below 480 GL.

The recent mass fish death event has highlighted the need to recommence discussions between the NSW Government, the MDBA and other Basin governments around how the Menindee Lakes could be better managed to mitigate water quality and mass fish deaths including extending provisions currently only available when the combined Lakes are below 480 GL and to develop triggers and clearer rules on when to deliver water from the upper lakes to the Menindee town weir pool.

NSW has found operation of the Menindee Lakes challenging due to the recent and likely upcoming conditions. NSW is working closely with the MDBA and leading the consideration of these issues through interjurisdictional forums including the Environmental Watering Committee, River Murray Operators Committee and Basin Officials Committee, under the Murray-Darling Basin Ministerial Council.

An initial focus for NSW is on ensuring that 195 GL of active storage remains in the upper lakes when Menindee returns to NSW control. Longer term issues that NSW will seek to have considered include reviewing the triggers for additional dilution flows, using the Great Darling Anabranch for environmental water delivery, determining how environmental and social outcomes are considered (as opposed to current focus on water efficiency) and consideration of the impacts of climate change. These discussions are complex and ongoing and any agreement to review the operation of the Menindee Lakes will take some time and operational changes will not be complete before this summer.

An update on how discussions with Basin governments are progressing will be provided when the NSW Government releases its full response to the Review Report.

A key consideration for governments in reviewing the operating arrangements of the Menindee Lakes will be any resulting impacts on state shares. Relevant changes to the Murray-Darling Basin Agreement must be by consensus between NSW, Victoria, South Australia and the Australian Government.

NSW has sought agreement from other Basin States to change the management of Menindee Lakes by recognising releases of operational water down the Great Darling Anabranch. This has the potential to save water in lakes Wetherell and Pamamaroo and provide for a higher drought reserve.

While changes to the Murray-Darling Basin Agreement are yet to be formally considered, a trial will be undertaken when the MDBA next calls on water to release water down the Anabranch. The trial is expected to begin in late 2023 after unregulated conditions in the Murray River cease.

In the short term, water quality triggers to guide when a change in releases from the top Lakes is required to minimise the risk of mass fish deaths in the Menindee town weir pool are being developed to guide the operation of the Menindee Lakes over summer.

These steps, including the Anabranch release trial, water quality triggers and exploring improvements to the operations of the Menindee Lakes, provide the pathway for addressing Recommendations 1.4, 1.5 and 1.6 of the Review Report.

DPE Water will also review the Murray and Lower Darling Water Quality Management Plan and mitigation strategies for managing low dissolved oxygen to reflect water quality issues and mass fish deaths observed in 2018-19 and 2022-23. WaterNSW will continue to build on the work already delivered under the Fish at Risk Tool⁶ risk assessment project, which links water quality and river flow data with fish health to improve our predictive capability around mass fish deaths. **These actions will address recommendation 1.7 of the Review Report.**



6 Further information can be found in this paper: <https://www.publish.csiro.au/mf/pdf/MF20360>

Recommendation 2: Better decisions require better data

An integrated, open, whole-of-system approach to data collection, analysis and management needs to be established. This is essential to enable timely and transparent decision making and build trust in the community.

The NSW Government is committed to transparent, trusted and accessible water data throughout NSW. We know that accurate, timely and accessible data is critical for effective decision-making and to build and maintain community trust.

The NSW Government already has several initiatives underway to improve data collection, analysis and management as described below. We will consider the Office of the NSW Chief Scientist and Engineer's principles as we continue to explore further improvements in this area and funding arrangements to support their implementation. A more detailed response on how an integrated, open, whole-of-system approach to data collection, analysis and publication will be provided in the full response in the first half of 2024.

The NSW Government is preparing a water quality roadmap of roles and responsibilities for water quality management and monitoring and will explore and consider options to address gaps, remove duplication or uncertainty and improve water quality governance arrangements. **As part of finalising the roadmap, options to address the issues raised in Recommendation 2.1 of the Review Report will be further explored.**

Installation of dissolved oxygen sensors in high-risk areas

The monitoring of dissolved oxygen is generally the key parameter to indicate if water quality conditions are likely to cause mass fish deaths. Dissolved oxygen levels (in association with flow, algal concentration, water temperature and prevailing weather conditions) can be used to identify high risk areas for closer monitoring.

NSW currently has a dissolved oxygen network comprising continuous dissolved oxygen sensors at 34 sites in the Murray, Murrumbidgee, Lachlan and Barwon-Darling / Baaka River valleys. The purpose of this network is to act as an early warning system on poor water quality conditions. The network also allows monitoring of dissolved oxygen during a critical water quality event to effectively assess the ecological benefits of managed flows, flow rules and intervention measures.

At each site, sensors are installed at a gauging station with cables down into the river. The sensors are usually located at a depth as low as possible to ensure data is obtained even at the lowest flows. Dissolved oxygen sensors use a light source and detect changes in the luminescence, as it is affected by the presence of oxygen. By measuring the luminescence, the amount of dissolved oxygen in water can be determined.

From the existing network, we have a well-developed understanding of the impact of low flows into stratification (layers of water with different levels of dissolved oxygen), which is a significant cause of hypoxic conditions. However, the NSW Government recognises that this network will benefit from further improvement.

More real-time (telemetered), depth integrated probes are required in the Menindee town weir pool to help inform real-time decision making (e.g. whether to change water delivery strategies such as flow rates and from which lake these flows are sourced). Installing these is a high priority and is currently being progressed. One additional multi-depth integrated water quality monitoring buoy has already been installed. It has telemetry, data logging and live stream data capability.

The installation of sensors at multiple depths for profile monitoring is proposed for Lake Wetherell, Menindee town, Menindee railway bridge and Pooncarie. The upgrade of two existing fixed-depth sensor sites to multi-depth sensors in the Darling-Baaka River at Menindee is also being investigated. Multiple depth sensors give more information about how dissolved oxygen may change at different depths in the water column and whether stratification is occurring. Multi-depth sensors also

allow us to identify if oxygen is mixed through the whole water column and the possible benefits of intervention measures. The decision to install multi depth sensors at these sites is due to the highest risk of mass fish death and the deeper pools in the area.

The NSW Government is installing 40 additional high priority monitoring sites across the Basin. Due to extensive recent flooding in the Murray that damaged the gauging station network, the installations were postponed in 2022. It is intended to complete installation of 20 sites that are less flood affected in 2023-24 and the remaining 20 sites in 2024-25.

As part of this, two sensors have been installed at Weir 32 and Menindee town, and three temporary sensors have been installed at Menindee pump station, downstream of Menindee main weir and at Nelia Gaari in the upper reaches of Lake Wetherell.

Figure 2 is a map of the existing and proposed dissolved oxygen sensor monitoring across NSW. **Figure 3** is a map of the proposed dissolved oxygen sensor sites in the Darling-Baaka River near Menindee. **Progress to address Recommendation 2.2 of the Review Report is underway, and once all of the new sensors are installed, this action will be complete.**

Figure 2—existing and proposed dissolved oxygen monitoring sites across NSW

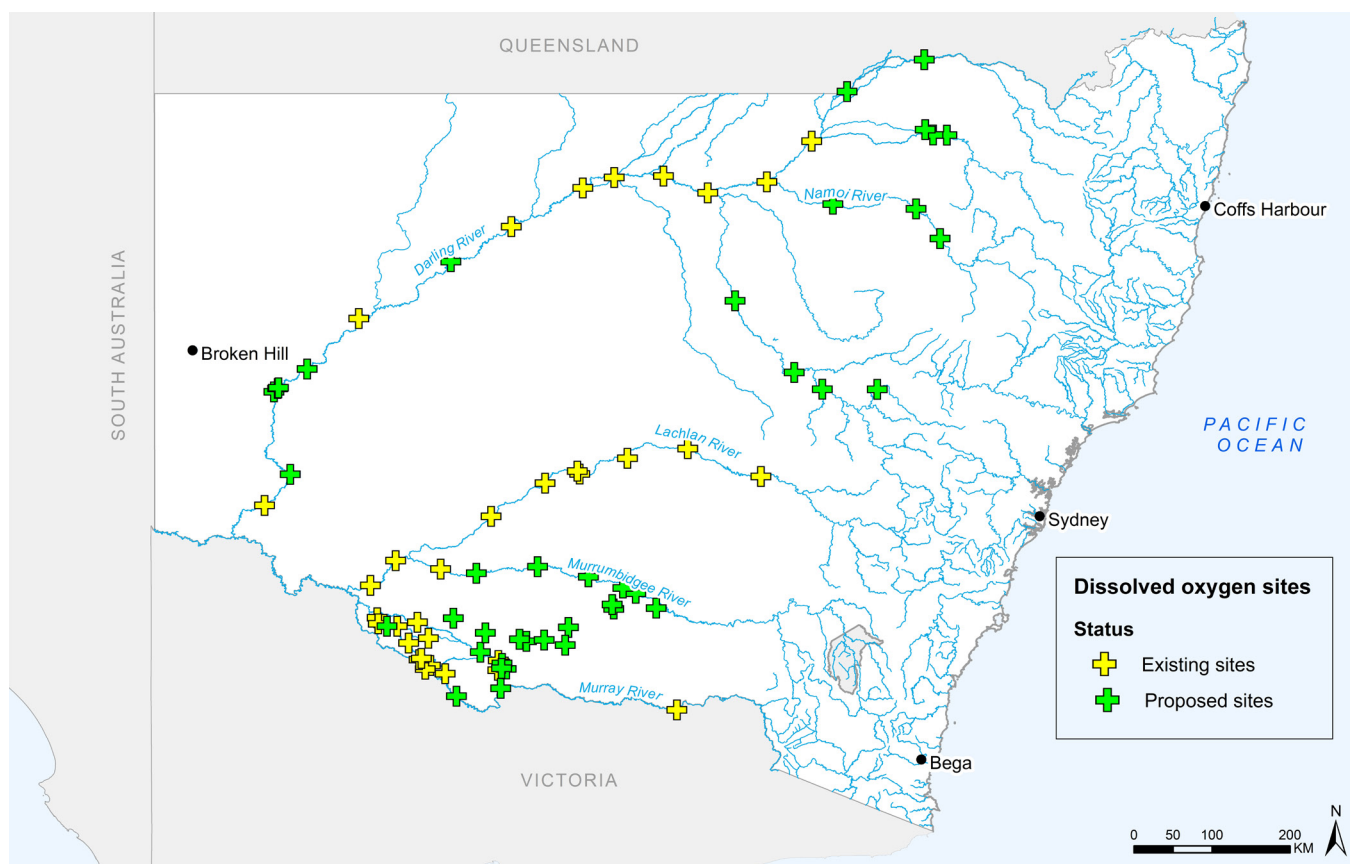


Figure 3—proposed dissolved oxygen monitoring sites in the Darling-Baaka River near Menindee



Once the new sensors have been installed at these highest priority sites, additional sites will be considered in the context of investment in new mitigation solutions, such as fish passage infrastructure.

An additional \$5 million monitoring program is being delivered by the EPA focussing on the recovery and environmental health in the Darling-Baaka following the floods and fish deaths (Recovery Program).

The Recovery Program includes a western science-based water quality monitoring River Health Project (led by DPE EHG) and a locally led Aboriginal cultural mapping program. The integration of Aboriginal cultural knowledge in the evidence base is an important principle under Recommendation 2.

Other water quality, fish and environmental monitoring programs

A number of other initiatives are underway that are intended to improve our water quality, fish and environmental monitoring and will contribute to an improved data approach as set out in Recommendation 2. These include:

1 Better understanding the flows needed to avoid stratification

DPE Water is leading the *Barwon Darling-Baaka stratification: minimising persistent thermal stratification and algal blooms in weir pools* project, in collaboration with the University of Technology, Sydney⁷. The project is taking and reviewing water quality samples at major weirs on the Barwon Darling-Baaka River, from Collarenebri to Pooncarie (downstream of Menindee Lakes) until March 2025. The project aim is to determine what flow rates are needed at different weirs, to avoid stratification and algal blooms, and to maintain connectivity and refugia. By recording this data and linking it to changes in stream flow, we can understand the flows required to minimise and break up thermal stratification and reduce harmful algal blooms, ultimately to help prevent fish death events in the future. This project will help support an improved water data regime with increased early warning capability to model, predict and make earlier interventions, which responds to elements of Recommendations 1 and 2.



2 Monitoring fish communities

DPI Fisheries currently undertake fish community monitoring through several projects including the Lower Darling-Baaka Recovery Reach (Recovery Reach) project⁸, funded by the MDBA since 2019, Basin Plan Environmental Outcomes Monitoring (BPEOM) – Fish project⁹ funded by the Australian Government since 2014 as part of Basin Plan Implementation activities, and the Murray-Darling Basin Fish Survey (MDBFS), funded by the MDBA since 2014. These projects aim to assess changes in the species and abundance of native fish in regions, over time in response to environmental conditions. While these existing programs contribute significantly to the longer-term assessment of native fish conditions, there are substantial gaps in finer spatial coverage that persist over longer temporal scales.

The NSW Government will also consider known gaps and the potential for expanded and longer-term fish community monitoring in our response to the medium and longer-term aspects of Recommendation 4.

3 Water quality sampling

Since March 2023, the EPA, DPE EHG and WaterNSW have been conducting water quality monitoring to assist with early identification of changes in water quality that would require preventative action. There are monitoring crews on the ground each week monitoring dissolved oxygen to inform decision making.

In addition, DPE EHG are sampling water at a monthly minimum to check for pesticides, excess nitrogen and phosphorus, ammonia, metals, algae and algal toxins. Test results are published on the EPA's website.¹⁰ Where samples return levels harmful to fish, DPE Water and the Working Group are notified to inform operational decisions and responses.

7 https://water.dpie.nsw.gov.au/_data/assets/pdf_file/0003/575283/ecosystem-processes-annual-report.pdf

8 https://www.dpi.nsw.gov.au/_data/assets/pdf_file/0005/1483592/Lower-Darling-Baaka-Recovery-Reach-Fish-Community-Monitoring-report-August-2023.pdf

9 <https://www.dpi.nsw.gov.au/fishing/fisheries-research/freshwater-ecosystems/ecology-and-environment/bpeom>

10 <https://www.epa.nsw.gov.au/working-together/community-engagement/updates-on-issues/menindee-fish-kill>

Improving the water data framework, transparency and access

The Review Report provided recommendations on a blueprint for long-term improvements to data access and transparency. Our aspiration is that in the future, any person will be able to access information on the quality of the water in their local area through any connected device. Over the long-term we want to have sophisticated models which can predict when and where major fish deaths and water quality incidents may occur before they do. The technology is available to progress these aspirations – satellite technology, artificial intelligence and machine learning provide the basis for predictive tools. The NSW Government will report on a pathway for progressing this aspiration as part of the full response in 2024.

In the immediate term, there are useful tools that will help us predict and make better decisions based on better data.

WaterNSW has developed the Fish at Risk Tool¹¹, which is a spatial tool to indicate the likelihood of a poor water quality event due to combination of flow, water quality and forecast meteorological changes, which may assist with predicting mass fish death events. The tool works similarly to the fire danger rating system by communicating the water quality risk and risk to fish health based on water quality data including data from the dissolved oxygen sensor network. The tool currently covers the Murray and Darling-Baaka rivers and is intended to be expanded to other major rivers in the Murray-Darling system.

NSW has been providing increased public access to water and environmental data, information products and data models, through the Sharing and Enabling Environmental Data (SEED) portal, WaterNSW's WaterInsights Portal and implementing DPE Water's open data framework and open data and information guidelines.

The WaterInsights Portal¹² is progressively making all routinely collected open-source data publicly available in near real-time. This includes data for dissolved oxygen levels and water temperature to allow agencies to better forecast and respond to deteriorating water quality conditions. We are also improving IT data systems by making upgrades through the Water Added Value Environment (WAVE) program.



¹¹ Further information can be found in this paper: <https://www.publish.csiro.au/mf/pdf/MF20360>

¹² <https://waterinsights.waternsw.com.au/>

Recommendation 3: Effective emergency management

A local, detailed and effective emergency management framework is required. The current system is dysfunctional and not well understood at the local level.

Not every mass fish death event should or will trigger an emergency response. However, there are instances where an emergency response may be appropriate, such as the scale of the March 2023 fish death event. Triggering an emergency response enables decisive action to be taken and provides additional resource availability to the 'combat agency' (lead). In accordance with the State Emergency Management Plan, any emergency is to be managed at the lowest level possible.

The NSW Government is acting immediately on key parts of Recommendation 3, as outlined below. There are a number of specific sub-recommendations that the NSW Government will respond to in the full response in 2024.

Emergency management planning

A challenge identified by community, agencies and the Review Report was that responsibilities for water quality and mass fish deaths are dispersed across multiple agencies and under multiple pieces of legislation with no clear lead for responding to emergencies. A whole of government response to the March 2023 event included increasing the number of meetings of the Working Group, which includes NSW Government and Australian Government water agencies. During this time, the Working Group met at least fortnightly and at times held multiple meetings per week when critical conditions for ecological health were evident and management action was

required. The Working Group continued to monitor dissolved oxygen levels at several sites and worked with environmental water holders and operators to make water releases to improve water quality and provide refuge for fish where possible.

The Working Group has continued to meet weekly and will continue to play a critical role to reduce the risk of, and respond to, water quality impacts and mass fish deaths. The Working Group is developing water quality triggers and clarified rules on when to start increased releases from Lake Pamamaroo to minimise risk of persistent stratification. These water quality trigger values are proposed to be one factor informing whether and when an emergency response should be activated. These trigger values will be ready for the 2023-24 summer.

In response to the recommendations in the Review Report, the NSW Government is developing a NSW Mass Fish Death Sub-Plan (the Sub-Plan) to the State Emergency Management Plan (EMPLAN). The Sub-Plan will articulate clear roles and responsibilities specifically for mass fish death and water quality events, under the *State Emergency and Rescue Management Act 1989* (SERM Act).

The EPA hosts the Environmental Services Functional Area (ENVSFA) under the SERM Act and has a key role in responding to emergencies or leading activities where the environment is at risk or impacted. This applies to all land, inland waters and air within or traversing NSW.

The development of an interim response plan will be led by the EPA, in consultation with relevant agencies and the community, and will focus on clarifying the roles and responsibilities to respond to an emergency incident once it has occurred. This interim plan will be developed by the end of 2023. The EPA will work closely with the Regional Emergency Management Committee (REMC), the Central Darling Local Emergency Management Committee (LEMC) and relevant NSW Government agencies to develop the plan.

These actions will contribute to addressing Recommendations 3.1 and 3.2.

There is still a high risk of mass fish deaths over the coming summer. While the Sub-Plan is being developed, if there is another mass fish death event above agency agreed thresholds, the NSW Police Force will coordinate the response with relevant agencies providing knowledge, expertise and support.¹³

A review to ensure the membership of the LEMC is appropriate will be undertaken, which will address Recommendation 3.3.

A resource review will be completed as part of the preparation of the Sub-Plan and its Menindee specific annexure. The 2019-20 Native Fish Drought Response was developed to address the emerging risk to native fish communities from drought and record low river flows. It established an initial preparedness and response framework including procurement and tender processes that identified a preferred supplier list for a range of response activities including aeration, clean up and rescue/relocation. Some of this information was used during the March 2023 response and is intended to form the baseline for the resource review.

This action will address the focus of Recommendation 3.5.

During development of the Sub-Plan, consideration will be given to whether there is also a need to develop a more holistic complementary Native Fish Extreme Event Response, which would direct responses on mass fish death events that are below the scale of an emergency. Such a program could provide a coordinated program for relatively small-moderate native fish emergency response activities across NSW, focussing on priority reaches, species, key fish habitat and working with communities including Aboriginal communities. The NSW Government is working to identify funding that could support such a program.

Emergency management training

The NSW Government recognises the increasing importance of emergency management training, for all agencies, not just for agencies traditionally involved in emergency operations. Several training courses are being organised by the NSW Police for the Far West to be held in December 2023 (Evacuation management), February and March 2024 (Introduction to Emergency Management and Emergency Operations Centre Concepts). All relevant NSW Government agencies in the Menindee region are being invited and are encouraged to attend.

Existing online training (administered by the Premier's Department) is also available for agency staff to access via www.emtraining.nsw.gov.au.

These actions deliver toward Recommendation 3.4.

¹³ Emergency Operations Controller (NSW Police Force) is responsible for coordinating an emergency response in accordance with the SERM Act and EMPLAN in the absence of a relevant sub plan.

Recommendation 4: Interventions to mitigate against future mass fish deaths

The NSW Government recognises the need to work quickly, particularly on immediate actions to manage water quality especially to maintain dissolved oxygen in the Menindee town weir pool.

Most actions identified as ‘immediate’ focus on mitigating risks once they emerge, rather than addressing underlying causes and providing longer term solutions. Critically we are also working to scope permanent options and secure funding to construct permanent fish passage solutions at Menindee and the Lower Darling-Baaka River. Delivering permanent fish passages at the Menindee Lakes will deliver longer-term solutions for improved movement and connectivity for fish between the Northern and Southern Murray-Darling Basin, reduce a key threatening process and assist the recovery of listed threatened fish species such as the Silver Perch and Murray Cod.

The following are all actions that NSW Government has identified as priorities and will deliver key parts of Recommendation 4.

Immediate measures to maintain dissolved oxygen in the Menindee weir pool

The following actions are being or have already been implemented as a priority to maintain dissolved oxygen in the Menindee town weir pool:

1 Modifying releases of water

The Working Group has already implemented modified environmental and other water releases to maximise water quality in the Menindee weir pool. Working Group discussions and community input have resulted in better management of water quality and flow delivery in the Lower Darling-Baaka River, with recent modified release patterns being implemented by WaterNSW based on requests from the Working Group.

2 Fish biomass¹⁴ estimates

Preliminary surveys of fish have been undertaken to estimate the number, location and abundance (or equivalent metric) of fish in the Menindee town weir pool to support an adaptive management approach to intervention measures. The unknown quantity of

¹⁴ The combined weight of organisms in a certain area or volume. In this case the total weight of all fish in an area of water.

fish in the Menindee town weir pool was a significant data gap in the March 2023 mass fish death event. A better understanding of biomass in the Menindee town weir pool will ensure we act where it will be most effective and cost-efficient.

Large numbers of fish will continue to increase oxygen demand. Estimates of fish biomass, existing data and our understanding of the fish community will inform fish removal and relocation activities, and temporary fish passage and oxygenation measures. The preliminary biomass estimates will be completed before summer 2023-24.

3 Removing Carp and relocating native fish in partnership with community

The fish biomass surveys will inform NSW Government decisions on whether fish removal or relocation would be effective actions to take. We may look to remove Carp and relocate native fish to help reduce oxygen demand in the Menindee town weir pool and reduce fish biomass where the fish survey shows us this will be feasible and would provide a benefit to the current water quality situation. The NSW Government will look at opportunities to partner with local businesses, community groups and River Rangers where practical and safe. If determined to be needed, a removal and relocation program will be progressed by summer 2023-24 for implementation as needed, and include relevant training, equipment and permit processes.

In April 2023 DPI Fisheries ran a trial for five days where commercial fishers removed 121,350 Carp from the river. This equated to 11.4 tonnes of fish. Importantly, we will apply the lessons learned from the April 2023 Carp removal trial in the Menindee town weir pool to guide future fish removal activities as needed.

4 Oxygenation trials

The NSW Government will take proactive and early intervention to mitigate likely stratification and hypoxic conditions. We will run a trial of nanobubble oxygenation technology in the Menindee town pool weir in late 2023 or early 2024. Results from the trial will inform future emergency aeration actions. The broader use of oxygenation and aeration technology will be informed by forecast and actual flows and observed water quality data – we will act sooner if the data indicates we need to.

In 2019-20, the Native Fish Drought Response conducted an extensive desktop review and tested a range of oxygenation technologies across inland NSW. Venturi pumps and nanobubble technology emerged as promising options from the study for replenishing oxygen levels without causing harm to fish. Nanobubble technology has been used successfully in Western Australia to improve oxygen levels in water and reduce the risk of fish deaths.

The Independent Assessment of the 2018-19 Fish Deaths in the Lower Darling report¹⁵ found that oxygenation is a short-term emergency measure that may not prevent additional fish death events if adverse conditions persist or re-occur.

Short-term technical fish passage solutions

The NSW Government is undertaking a feasibility study for a trial of temporary fishway technologies. The NSW Government will be holding on country inspections and meetings to help scope out a temporary fishway with a trap and transport option in November 2023. Experts have been engaged and representatives from local peak body Aboriginal groups have been invited to attend these inspections and meetings.

Temporary fishway options require on-ground scoping and an assessment of cultural considerations as well as related technical feasibility, procurement processes and permit assessment before any temporary fishway option can be installed.

Importantly, our understanding of the fish community and estimates of fish biomass will inform the costs, effort, timeframes and effectiveness of temporary fish passage options, and any related relocation efforts. The cultural, recreational and ecological implications of any relocations will also be required. Onsite inspections are scheduled to take place with experts from mid-November 2023 to inform future action.

The Working Group continues to monitor water quality at the Menindee Lakes. DPI Fisheries worked with WaterNSW to temporarily close the fishway at Weir 32 in response to conditions in the Menindee town weir pool to reduce further concentration of fish into the impacted zone, during the March 2023 event. A similar approach will be considered in future in response to deteriorating conditions.

¹⁵ <https://www.mdba.gov.au/sites/default/files/publications/final-report-independent-panel-fish-deaths-lower-darling.pdf>

Work by DPI Fisheries to replace the existing fishway at Burtundy Weir on the Lower Darling-Baaka River (via the Australian Government funded Lower Darling Fish Passage Program) is progressing well. This project will replace the current fishway with a contemporary vertical slot fishway that will significantly improve fish passage at the site over a wider range of flows. Construction is expected to commence in 2024.

The two other fishways in the Lower Darling-Baaka River below Menindee, at Pooncarie Weir and Weir 32, present technical issues which could be partially and temporarily addressed via simple modification works. These can be progressed over the next 12 months, with more enduring solutions to be investigated.

Permanent fish passage solution at Menindee Lakes and Lower Darling-Baaka River

The NSW Government is focussing efforts and resourcing on the investigation, design, business case and ultimate construction of a permanent fish passage solution at Menindee Lakes.

The NSW Fish Passage Strategy is a 20-year plan to proactively restore unimpeded fish passage at more than 135 high priority barriers across NSW. Fish passage at the Menindee Lakes is the highest priority under the Strategy.

The Australian Government is providing \$2.3 million for NSW to progress the planning and business cases needed to remediate fish barriers in the Menindee region including Weir 32, Pooncarie Weir, Lake Pamamaroo and Lake Wetherell. This work will be progressed as an immediate standalone priority to guide future implementation and investment in a permanent fish passage solution for the Lower-Darling Baaka and the Menindee Lakes.



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