



Murray Darling Basin: fish kills and current conditions

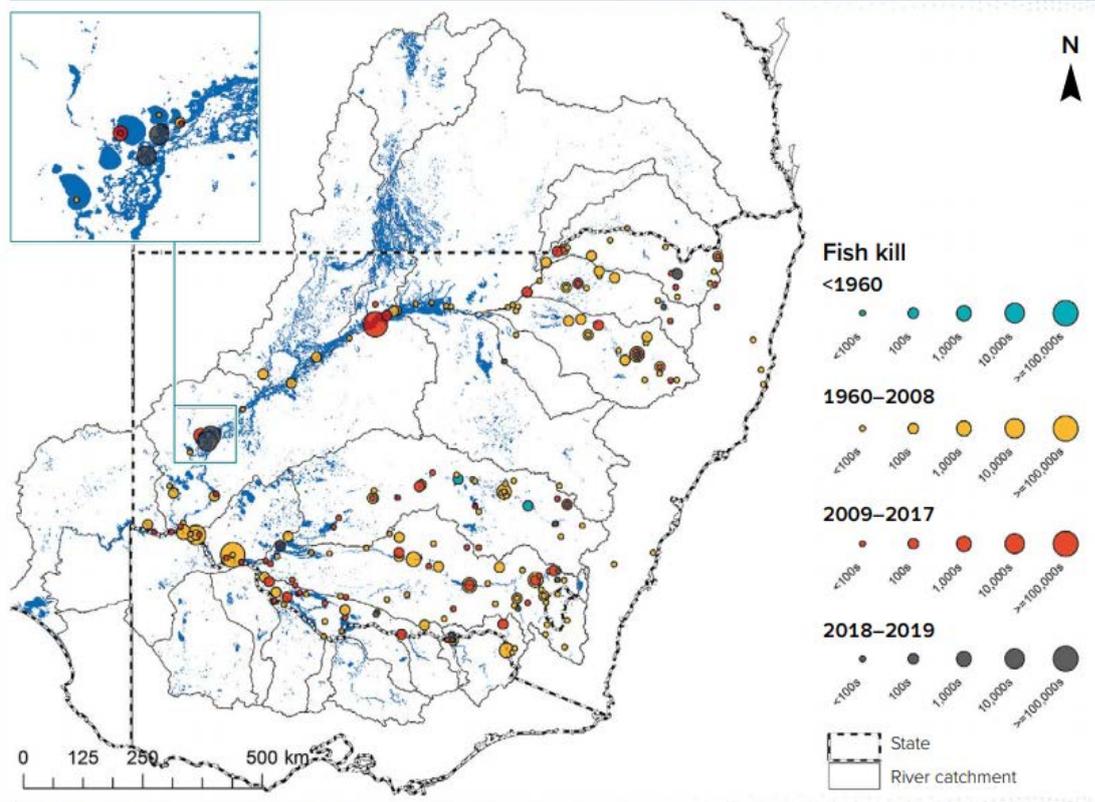
This Issues Backgrounder covers recent fish kills in the Murray Darling Basin (MDB). It focuses on the investigations into three large fish kills that occurred near Menindee on the Darling River over the 2018-19 summer. Of most significance for policy makers, the investigations broadly agreed on the three long-term causes of the fish kills: the current drought; and two human-induced causes which have exacerbated the effects of the drought – water management policies, and climate change. The paper also considers the impact of the fish kills on local and Indigenous communities, and provides an update on the current condition of the MDB.

- Fish kills in the Murray Darling Basin 1**
- The three large fish kills 2**
 - Findings: Immediate causes..... 5
 - Findings: Long-term causes 5
 - Key recommendations..... 9
 - Government response to the Vertessy Report..... 11
- Impact on communities 11**
- Current conditions in the Murray Darling Basin..... 13**

FISH KILLS IN THE MURRAY DARLING BASIN

According to the Australian Academy of Science, fish kills occur “reasonably frequently” in the Murray-Darling Basin (MDB) (Figure 1). The NSW Department of Primary Industries – Fisheries (DPI – Fisheries) database has records of over 1,600 fish kill events of all sizes since the 1980s. DPI – Fisheries also observes that a number of smaller events go unnoticed or unreported. Prior to the 2018-19 summer, the most recent large fish kill in the Lower Darling involved the death of tens of thousands of fish in June 2011.

Figure 1: Fish kills recorded in the NSW part of the Murray-Darling Basin



Fish kills recorded for the NSW part of the Murray-Darling Basin over time and in each river, from various causes, sorted by periods including before water resource development (1960), 1960–2008 (main period of water resource development) and 2009–2017 (water recovery period) (see Table 1 for details on large fish kills).

Source: Australian Academy of Science, [Investigation of the causes of mass fish kills in the Menindee Region NSW over the summer of 2018-2019](#), 18 February 2019, p 10

There have been [22 fish kills](#) of varying sizes between the first of three large fish kills in the Murray Darling Basin on 15 December 2018 and 24 April 2019 (Figure 2). The most recent took place near Bourke on the Darling River, with hundreds of Bony Bream affected.

THE THREE LARGE FISH KILLS

[Three large fish kills](#) occurred in the 2018-19 summer on the [same 45km stretch of the Darling River](#), between Menindee Main Weir and Weir 32, on [Barkandji land](#) in the Lower Darling (Figure 3). On 15 December 2018, the first fish kill event killed tens of thousands of fish. Hundreds of thousands of fish were killed in the events on 6 January 2019 and 28 January 2019. These fish kills were [unusual](#) in the combination of their severity, association with low flows, and their effect on Silver Perch, Golden Perch and large, old Murray Cod.

After the first two events, on 25 January the NSW Department of Primary Industries – Water (DPI – Water) released the [Fish death interim investigation report](#) and the Murray Darling Basin Authority (MDBA) released [Response to recent fish death events: Recommended action plan](#). On 18 February, the Australian Academy of Science (AAS) published a [report](#) commissioned by the federal opposition, in which they noted that their panel saw the possible beginnings of a fourth fish kill on 4 February 2019. The Commonwealth Government appointed its own [independent](#)

[panel](#) to investigate, which released an [interim report](#) on 20 February and a [final report](#) on 29 March 2019 (the Vertessy Report).

Figure 2: Recent fish kills in the Murray Darling Basin

Date	Location	Number of fish
15 Dec	Menindee, Darling River	Tens of thousands
24 Dec	Murrumbidgee River	<10
5 Jan	Macquarie River	Tens
6 Jan	Menindee, Darling River	Hundreds of thousands
9 Jan	Namoi River	Hundreds
9 Jan	Murrumbidgee River	<10
12 Jan	Macquarie River	Over 1,000
18 Jan	Macintyre River	Not recorded
20 Jan	Billabong Creek, Murray River	<50
21 Jan	Macintyre River	Thousands
22 Jan	Macintyre River	Not recorded
22 Jan	Namoi River	Hundreds
24 Jan	Namoi River	Hundreds
25 Jan	Thredbo River	Approximately 20
28 Jan	Menindee, Darling River	Hundreds of thousands
30 Jan	Macintyre River	Up to 100
30 Jan	Namoi River	Hundreds
31 Jan	Murrumbidgee River	Thousands
28 Feb	Coppabella Creek, Murray River	Hundreds
12 Mar	Dumaresq River	Hundreds
26 Mar	Walgett, Barwon River	Hundreds
24 Apr	Bourke, Darling River	Hundreds

* Fish kills in the Barwon-Darling River are in bold

[Actions](#) taken by government authorities in response to the kills included:

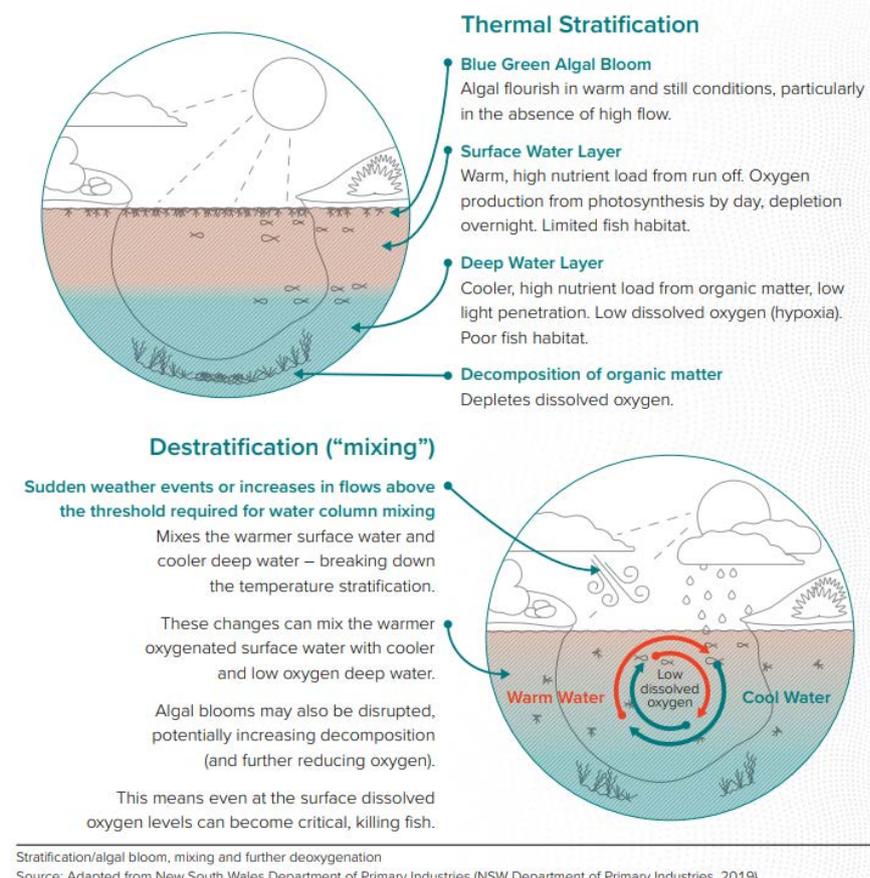
- Additional water quality monitoring;
- Trialling aerators and other technologies to improve water quality;
- Undertaking localised fish rescues and translocations to establish ‘insurance’ populations; and
- Undertaking a large clean-up effort to minimise rotting biomass that might give rise to further oxygen depletion in the weir pools.

In the week of 4-10 March 2019, there was [significant concern](#) that a [fourth large fish kill](#) may occur. While another large event did not happen, the Vertessy Report found that future events may be [expected](#) without significant flushing inflows.

FINDINGS: IMMEDIATE CAUSES

All four reports ([DPI – Water Report](#), [MDBA Report](#), [AAS Report](#), and [Vertessy Report](#) (both interim and final)) found that the immediate cause of the fish kills was stratification and then mixing of oxygen-depleted bottom water with oxygenated surface water (Figure 4). Low-flows and high temperatures caused the water layers to separate. Together with high nutrient inputs into the system, this stimulated blue-green algae growth (see the WaterNSW interactive [Algal alerts in NSW map](#)) before storm activity mixed the water layers.

Figure 4: Immediate causes of the fish kills (AAS Report)



Stratification/algal bloom, mixing and further deoxygenation

Source: Adapted from New South Wales Department of Primary Industries (NSW Department of Primary Industries, 2019).

Source: Australian Academy of Science, [Investigation of the causes of mass fish kills in the Menindee Region NSW over the summer of 2018-2019](#), 18 February 2019, p 8

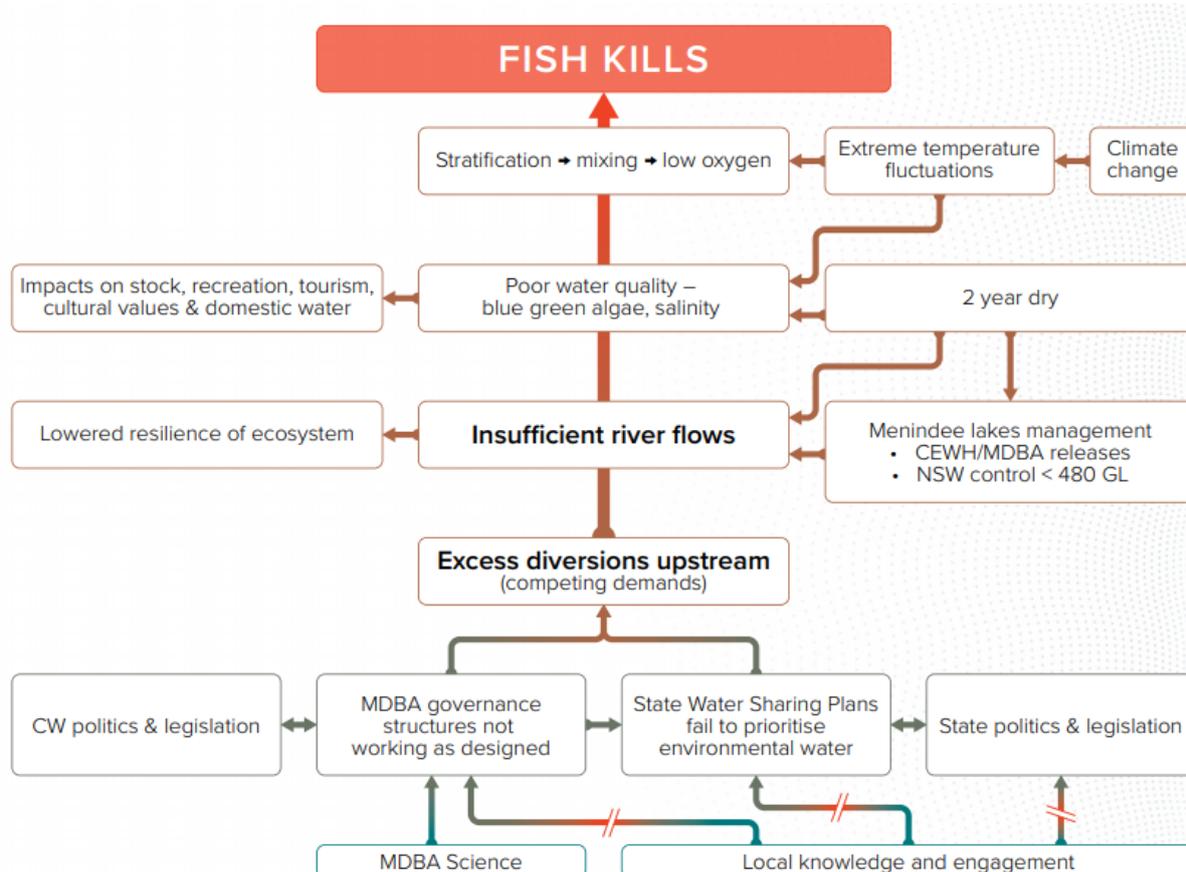
FINDINGS: LONG-TERM CAUSES

The [AAS](#) and [Vertessy](#) reports made broadly similar findings regarding the three long-term causes behind the poor water quality that resulted in such large fish kills:

- (1) Drought;
- (2) Water management policies; and
- (3) Climate change.

Arguably, the long-term causes are of most relevance for policy-makers when it comes to taking action to reduce the likelihood of future fish kills. Drought is a [natural cause](#) of fish kills. While severe, the current drought is not unprecedented when compared to the Millennium Drought (2000 to 2010). The impact of this drought has been exacerbated by the other two, human-induced causes. Climate change has amplified extreme temperature fluctuations (Figure 5), raised the annual mean temperature of the northern Basin by [about 1.5°C since 1910](#), and [reduced runoff generation](#) after rainfall. [Water management policies](#) have increased the number of “cease to flow” and “low flow” days, raising the risk of blue-green algae blooms occurring. Where the two investigations differed in their findings was in the emphasis they placed on certain factors over others (Figures 5 and 6). These differences reflect ongoing debates in the [broader context](#) of current [environmental](#), [social](#) and [governance](#) issues in the MDB.

Figure 5: Causes of the large fish kills (AAS Report)



Summary chain of causes leading to the fish kills. Red barriers refer to poor ratings for use of information.
 MDBA – Murray-Darling Basin Authority; CW – Commonwealth; CEWH – Commonwealth Environmental Water Holder.

Source: Australian Academy of Science, [Investigation of the causes of mass fish kills in the Menindee Region NSW over the summer of 2018-2019](#), 18 February 2019, p 1

The AAS Report placed greater emphasis on the governance and management of water in the Murray Darling Basin (page 2):

- **The root cause of the fish kills is that there is not enough water in the Darling system to avoid catastrophic decline of condition through dry periods.** This is despite a substantial body of scientific research that points to the need for appropriate flow regimes. Similarly, engagement with local residents, Indigenous and non-Indigenous, has been cursory at best, resulting in

insufficient use of their knowledge and engagement around how the system is best managed [emphasis in original]; and

- The panel strongly supports the objectives of the *Water Act 2007* and the framework of the Murray-Darling Basin Plan (2012), which were developed with bipartisan political support and intended to increase water for the environment. However, the findings summarized above and detailed in the following sections point to serious deficiencies in governance and management, which collectively have eroded the intent of the *Water Act 2007* and implementation of the Murray-Darling Basin Plan (2012) framework.

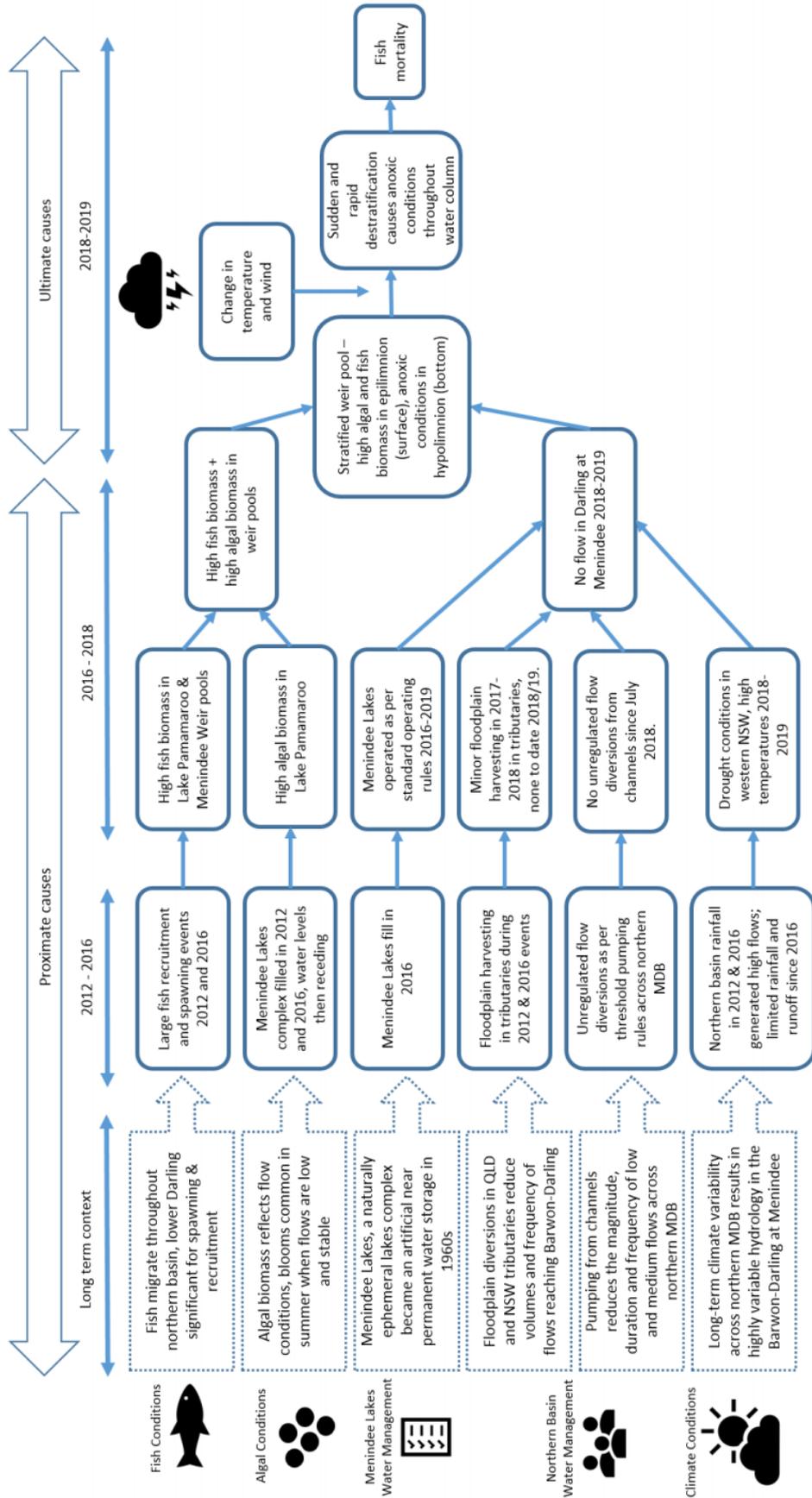
The Vertessy Report placed greater emphasis on the drought, and made more specific findings with regards to water diversions (pages 10 to 12):

- The fish death events in the lower Darling were preceded and affected by exceptional climatic conditions, unparalleled in the observed climate record;
- Modelled flow data up to 2009 indicate that pre-development inflow volumes into the Menindee Lakes are of the order of two to three times greater than those under current developed conditions. The effect of upstream development on lake inflows during 2017-18 could not be determined, owing to the unavailability of an updated pre-development model and insufficient metering of extractions; and
- In recent times, one of the main impacts on the frequency, magnitude and duration of low flows in the Barwon–Darling River, which have high ecological importance, is the change in the behaviour and use of A Class diversion licences. Relaxing constraints on water access and providing more flexible "carry-forward" arrangements under A Class licenses in the 2012 Barwon–Darling Water Sharing Plan has led to significant increases in the extraction of water during low flow periods.

The Vertessy Report also made several other key findings:

- Contrary to public perception, due to the unfavourable water availability outlook in the northern Basin during 2017-18, the MDBA operated Menindee Lakes relatively conservatively. The rates of MDBA releases of water from the lakes were more gradual than usual, and the pattern of release favoured maintaining storage in the upper lakes rather than the lower lakes;
- Combined community and government actions to respond to the fish death events successfully created refuge zones that protected remaining fish. Fish that were also rescued (Murray Cod, Silver Perch and Golden Perch) were translocated to create "insurance" populations, they have recovered quickly and are in good health;
- The prospect of more fish deaths exists due to low oxygen levels in the remaining weir pools. Without significant flushing inflows, further deaths of surviving fish may be expected in the future;
- The full extent of the fish deaths on fish populations and the broader ecology of the lower Darling River will not be known until the current adverse conditions have abated, fish are no longer stressed and targeted research investigations can commence; and
- Weir 32 and Menindee Main Weir are partial barriers to dispersal (despite the presence of fishways which largely pass fish upstream); therefore, as flows were reduced, fish became trapped within the reach. This confinement likely exacerbated the scale of the fish deaths.

Figure 6: Causes of the large fish kills (Vertessy Report)



Source: Vertessy R et al., *Final report of the Independent Assessment of the 2018-19 fish deaths in the lower Darling*, 29 March 2019, p 11

KEY RECOMMENDATIONS

Protection and restoration of native fish populations

All four reports ([DPI – Water Report](#), [MDBA Report](#), [AAS Report](#), and [Vertessy Report](#) (both interim and final)) recommended a series of emergency responses to the fish kills, including:

- Provision of localised fish refuges through short-term re-oxygenation of water using aerators;
- Establishment of “insurance populations” of native fish;
- Protection of fish populations in risk areas with available environmental water; and
- The protection of any “[first flush](#)” events from the Northern Basin which may occur in the near-term in order to improve water quality and replenish the Barwon-Darling River and Menindee Lakes.

The Vertessy Report evaluated the responses implemented prior to its publication and [found that](#):

- Community and government actions successfully created refuge zones that protected remaining fish; and
- Rescued fish that had been translocated to create “insurance” populations had have recovered quickly and were in good health.

On the need to ensure ongoing protection and restoration of native fish populations, the Vertessy Report recommended that:

- Governments should ensure that the [recently announced](#) Native Fish Management and Recovery Strategy is adequately resourced and involves authentic collaboration with scientists, academics, consultants, local communities and Indigenous stakeholders.

Policy recommendations

The AAS and Vertessy Reports both made a number of policy recommendations. These have been grouped below under four headings, with attention drawn to similarities and differences.

Monitoring¹

Both reports recommended:

- Increased use of ‘[real time](#)’ [water quality monitoring](#) to support early warning and forecasting; and
- Improved water accounting, including through monitoring of end-of-system tributary flows, continuous and real time monitoring of diversions, and audit and

¹ For the latest NSW assessment of river health across the MDB, see the [2018 NSW State of the Environment report](#)

ongoing monitoring of floodplain harvesting. On this point, the Vertessy Report recommended that Basin States should update their [Strategic Water Information Monitoring Plans](#) to reflect the enhanced hydrologic monitoring requirements associated with the Basin Plan and the recently agreed [Murray–Darling Basin Compliance Compact](#).

The AAS Report also recommended restoration of funding to the [Sustainable Rivers Audit](#) for monitoring of biota including priority species.

Research

Both reports recommended:

- Increased investment in research and development to fill high priority knowledge gaps such as around our understanding of riverine hydrology and ecology; and
- Improved understanding of the impacts of climate change.

The AAS Report also recommended research into the relationship between land management practices and the quantity and quality of water in the Darling River. The Vertessy Report called for development of a single hydrological model of the Basin to enable improved evaluation of discrete water management policies and actions.

Water management

Both reports recommended:

- Improved management of environmental water using mechanisms such as '[water shepherding](#)' – arrangements that allow for the protection of environmental water from downstream extraction;
- A review of the management and operation of the Menindee Lakes;
- Improved governance and transparency in water management.

Significant differences exist between the management options put forward by both reports. Key AAS Report recommendations included:

- Repeal of the [Northern Basin Amendment decision](#), which reduced the amount of water recovered for the environment from the Northern Basin by 70 GL, from 390 GL to 320 GL;
- Repeal of the [cap of 1,500 GL on water buybacks](#); and
- Reinstatement of the [1995 Murray-Darling Basin Cap on Surface Water Diversions](#) (the Cap), to be achieved through an inquiry to determine the levels of take of water at 1993/1994 (NSW, VIC, SA) and 1999/2000 (QLD) levels of water resource development from the river, floodplains and connected groundwater systems, affecting flows into the Darling River.

The Vertessy Report supported the Northern Basin Amendment decision. It also recommended publication of the NSW, Queensland and MDBA joint plans for the [toolkit measures](#) intended to complement and support the Basin Plan, with an

“aggressive timeline for delivery”. These measures were adopted at the same time as the Northern Basin Amendment.

Community engagement and support

Both reports stressed the importance of improved engagement with affected communities moving forward. They also recommended provision of ‘[structural adjustment](#)’ funding to affected communities – financial support to reconfigure farm businesses where water is recovered from them by government.

The AAS Report made additional recommendations on this subject:

- Initiation of a community planning process in the Lower Darling to restore river health and sustain local livelihoods; and
- Incorporation of the rights and interests of Indigenous communities (their values, uses and native title rights) into the Northern Basin [Water Resource Plans](#), which are currently under development.

GOVERNMENT RESPONSE TO THE VERTESSY REPORT

On 10 April 2019, the Commonwealth Government [announced](#) a suite of measures in response to the Vertessy Report, including:

- The Department of Agriculture and Water Resources will, in consultation with community and NSW Government, seek to secure A class licences to protect low flows in the Barwon Darling into the future as recommended by the report;
- The Federal Government will invest up to \$25 million into metering in the northern basin, in the form of a 25% subsidy for AS4747 compliant meters. This will be backdated 12 months and states will be asked to contribute;
- \$5 million for cameras to live-stream river flows to the internet to provide absolute transparency to the public ...;
- \$20 million to expand research on the Murray-Darling Basin for better water and environmental management and to address gaps in our knowledge ...;
- Allocation of additional water to Indigenous communities; and
- An additional \$5.24 million for the [Toorale Water Infrastructure Project](#) to better connect the Warrego and Darling Rivers.

IMPACT ON COMMUNITIES

The Vertessy Report authors met with representatives of the Barkandji people, local residents and landholders, as the [Terms of Reference](#) for their investigation required them to “assess information available and interviews with State and Federal agency staff and local residents including Aboriginal stakeholders”. They encountered (page 29):

... an engaged, well-informed, but distressed community. They were grieving about the absence of reliable access to clean water and what this means for their [business and the continued viability of their community](#). It was evident that they were fearful for their future. It was made clear to the panel that the health of the river has a major impact on the physical and mental health of the community and a noticeable bearing on crime.

Media coverage reported that communities did not feel that town water was good enough for consumption because of its [smell](#) and [discolouration](#), despite assurances from Essential Water and the Central Darling Shire Council that it still met [national and international standards](#). For hundreds of kilometres [downstream from Bourke](#), water cannot be withdrawn directly from the River for human consumption due to poor water quality.

Figure 7: Map of western NSW showing the Barkandji Traditional Owners native title claim area



Note: Thick brown line denotes boundary of the area claimed by the Barkandji People. The lower reaches of the Darling River were excluded from this claim but surrounding lands were included

Source: Hartwig LD, [Recognition of Barkandji Water Rights in Australian Settler-Colonial Water Regimes, Resources](#), 7(1), p 6 of 26

For the [Barkandji people](#), the river (the *Barka*) is “[central to their existence](#)”, providing them with food and medicine, as well as a physical connection to their history and culture. After an [18 year legal case](#), the Barkandji people had their native title rights recognised for 128,000 square kilometres of land in 2015 (Figure 7). The [native title rights](#) include the taking and use of water for domestic, social and cultural purposes. These water requirements have the same priority as stock and domestic rights under NSW law, and therefore are to be met prior to any other consumptive uses even in times of extreme drought. As of May 2019, native title rights are not recognised in any of the five Water Sharing Plans (WSPs)² that apply to water bodies partly or wholly

² [Water Sharing Plan for the Lower Murray-Darling Unregulated and Alluvial Water Sources 2011](#); [Water Sharing Plan for the NSW Murray Darling Fractured Rock Groundwater Sources 2011](#); [Water Sharing Plan for the NSW Murray Darling Porous Rock Groundwater Sources 2011](#); [Water Sharing Plan for the Barwon-Darling Unregulated and Alluvial Water Sources 2012](#); [Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2016](#). Note that, as of 26 June 2019,

within the land of the Barkandji People. According to the [Productivity Commission](#), the NSW Government indicated in 2017 that the native title rights had been recognised too late in the planning process for the [New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2016 WSP](#). The NSW Government intends to account for the native title rights when the WSP is updated as part of the [Water Resource Planning](#) process under the [Basin Plan](#).

It is [widely recognised](#) that the capacity of Indigenous Peoples to have a say in water management has been [limited to date](#). On 3 March 2019, the NSW Aboriginal Land Council (NSWALC) launched its [When The River Runs Dry](#) campaign with a [Day of Action](#). A NSWALC statement dated 4 March 2019 says of the campaign:

The New South Wales Aboriginal Land Council in partnership with our Local Aboriginal Land Councils at Bourke, Dareton, Dubbo, Menindee, Walgett and Wilcannia, took a lead in organising community gatherings in six townships along the Murray Darling and Barwon rivers because we listened to the cries for help from our members and residents and witnessed the hardship they are enduring first-hand.

...

The When The River [Runs] Dry day of action is just the start. Together we have planted the seed, prompted conversation and demonstrated how seriously these communities are taking this water crisis. Now it's up to government to play their part to bring about change through swift and effective solutions.

Communities across New South Wales are without water. This is a disgrace and is unacceptable. It's time for a Federal Royal Commission to provide answers. We need to put a stop to water trading and we need a state level inquiry. It's time the Aboriginal community were given a seat at the table when it comes to the management of the Murray Darling catchment. Our people managed these waterways for 60,000 years. Since then, the deterioration and destruction has been rapid.

A [Citizens' Inquiry into the Health of the Darling River and Menindee Lakes](#) was established by community leaders, environmental and human rights lawyers and First Nations Elders in January 2019. The Inquiry concluded a round of public hearings in March and will publish a report later this year.

CURRENT CONDITIONS IN THE MURRAY DARLING BASIN

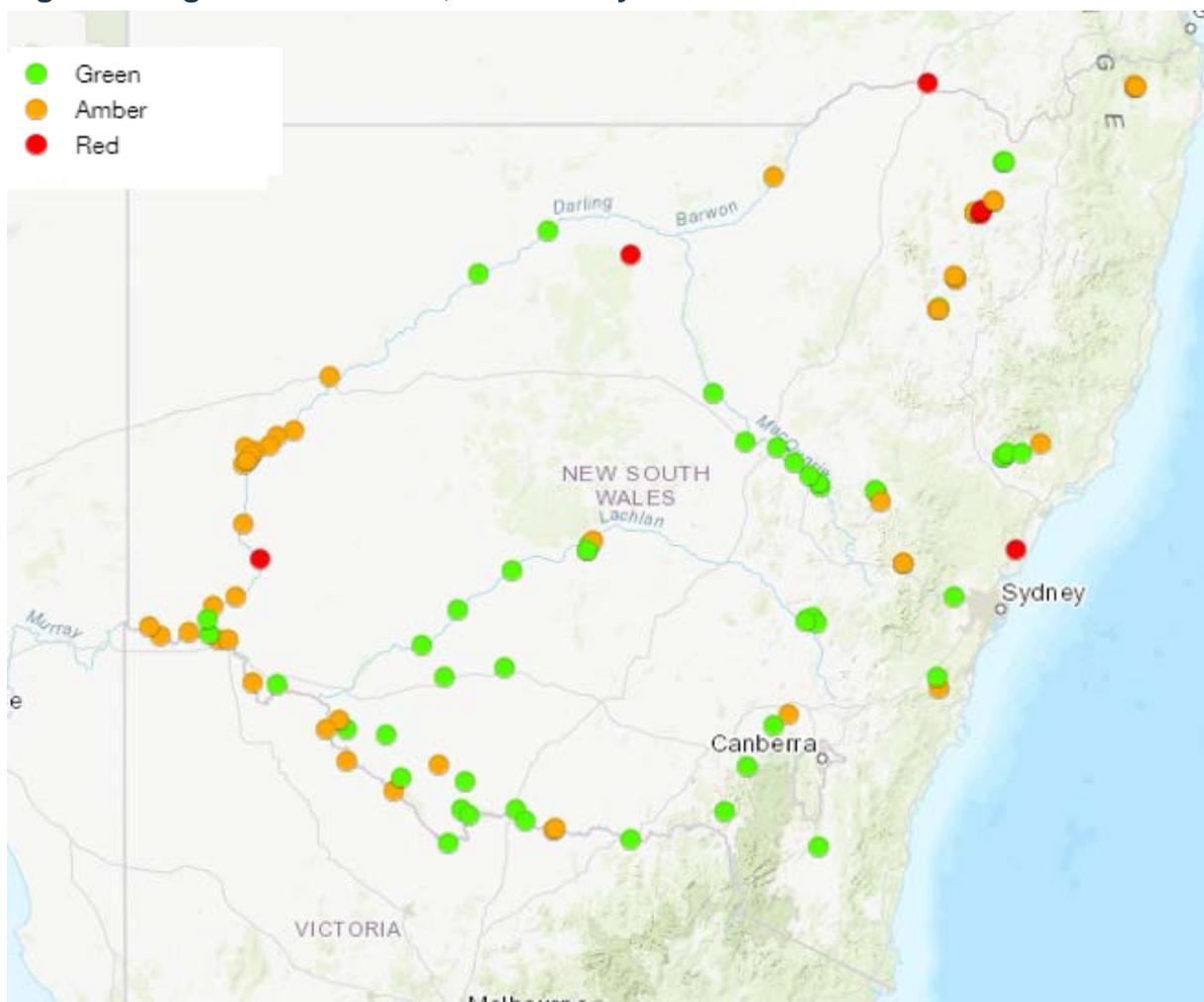
According to the [Bureau of Meteorology](#) (BOM), in the month of May 2019, rainfall was average across 58% of the Murray-Darling Basin. Some areas in the South experienced higher than average rainfall while areas in the North and West experienced lower than average rainfall. The mean rainfall was 6% lower than the long term mean for May (33mm compared to 35mm). Streamflow was below average for 57% of the Basin, average for 21%, and above average for 18%. Three sites on the Barwon, Darling and Namoi Rivers had the lowest streamflows for May since 1980. The Darling River at Menindee Upstream Weir 32 had a total flow of 0.09 GL and was "very much below average" compared to past years.

the NSW Natural Resources Commission was partway through a [review](#) of the [Water Sharing Plan for the Barwon-Darling Unregulated and Alluvial Water Sources 2012](#).

During May, the total accessible volume of water increased in four storage systems, decreased in six storage systems, and remained steady in eight storage systems. By the end of May, the total water stored in the Murray-Darling Basin was 27% of capacity, a decrease of 21% from the same time last year. Six of the 18 storage systems in the Basin were at 0-20% capacity: the Menindee Lakes system; and five in the Northern Basin. Note that this only refers to public water storages. Data collated in the AAS Report suggests that private storage capacity in the Northern Basin could be up to 3,309 GL.

[WaterNSW](#) monitors [blue-green algae](#) across the State. It issues alerts according to the amount of algae present in the water (Figure 8). Red alerts represent ‘bloom’ conditions, which are considered toxic to humans and animals. As of 1 July 2019, six red alerts were in place in the Murray Darling Basin, including one on the Darling River at Pooncarie. Amber alerts represent sites where blue-green algae may be multiplying in number. Water is considered unsuitable for potable purposes, may be unsuitable for stock but remains suitable for recreational use. Green alerts are issued where blue-green algae are present at low densities, possibly signalling the early stages of a bloom or the decline of a bloom. Water is considered suitable for all purposes.

Figure 8: Algal alerts in NSW, as of 1 July 2019



Source: WaterNSW, [Water quality: Algal alerts in NSW map](#), last updated between 7 May 2019 and 20 June 2019, [website – accessed 1 July 2019]

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For further information please contact the Research Service on 9230 2356

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