

The tale of Ross Billabong – Toorale National Park

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Key points

- Proposed restoration works at Ross Billabong are expected to significantly increase hydrological connectivity between the Darling-Baaka and Warrego Rivers, improving ecological function and water exchange.
- Ross Billabong supports diverse aquatic fauna, including important populations of waterbirds, frogs, turtles and native fish, and acts as a key refuge habitat during dry periods.
- Kurnu-Baakandji representatives expressed support for the proposed works and identified opportunities for cultural water management, cultural tourism, fishing and restoration of culturally significant plant species.

Abstract

This study assessed how restoration works at Ross Billabong, Toorale National Park, will alter hydrological connectivity with the Darling-Baaka and Warrego Rivers and the associated ecological and cultural outcomes. Proposed lowering of the eastern block banks is expected to substantially increase the frequency and duration of flow connections, improving water exchange, productivity, habitat diversity and fish movement, despite reducing overall storage capacity. Ross Billabong remains an important refuge for waterbirds, frogs, turtles and native fish, while also holding strong cultural significance for Kurnu-Baakandji people. Cultural aspirations include supporting cultural camps, tourism, fishing, environmental watering and restoration of culturally significant plant species.

Keywords

Baaka River, Darling-Baaka River, Barwon-Darling River, billabong, environmental values, cultural values, connectivity

Introduction

Ross Billabong sits within Toorale National Park near the confluence of the Warrego and Darling-Baaka Rivers in north-western NSW (Figure 1). The billabong is both an ecologically and culturally important feature of Toorale. Historically, the billabong received water from the Darling-Baaka River via a floodplain channel that connected to the river during large freshes. However, during the late nineteenth and twentieth centuries, the billabong was modified to support irrigated agricultural production. These modifications included damming and channeling to promote its connection with the Warrego River, the establishment of a training wall between the billabong, the Warrego River and the Darling-Baaka River, and water pumping from the Darling-Baaka. Toorale Station was acquired and included in the NSW conservation estate as a National Park in 2008. Since then, the pumps have been decommissioned, a dam has been removed, and the western end of the training wall has been breached to improve connectivity to the Darling-Baaka River and the Warrego River. Additional deconstruction of a section of the training wall to the east is being considered to further improve connectivity, with the specific design informed by both ecological and cultural considerations (Figure 2).

In 2019, Peebles Dam, located downstream of the confluence of the Warrego River and the channel to Ross Billabong (Figure 1), was removed as part of the Toorale Infrastructure project (NSW Government

2026). This dam previously backed water into Ross Billabong and therefore elevated ‘full’ storage capacity of the billabong. In 2024, a section of the training wall was removed (‘Western levee block bank’ in Figure 2) to allow water to flow to and from Ross Billabong along a natural flood channel. The height of the training wall was reduced from a 99 m AHD to 94 m AHD, consistent with the surrounding bed level. Additional breaches of the training wall at its eastern end (‘Eastern levee block banks’ in Figure 2) are proposed, reducing the current level from 97 m AHD to a sill level of 92 m AHD. Analysis of storage capacities for the current project considered change related to previous and proposed modifications to the training wall.

This study describes how works to improve connectivity between the billabong and the Darling–Baaka River have altered the billabong’s hydrology, and how these changes may deliver both environmental benefits and outcomes that support cultural aspirations for the billabong into the future.

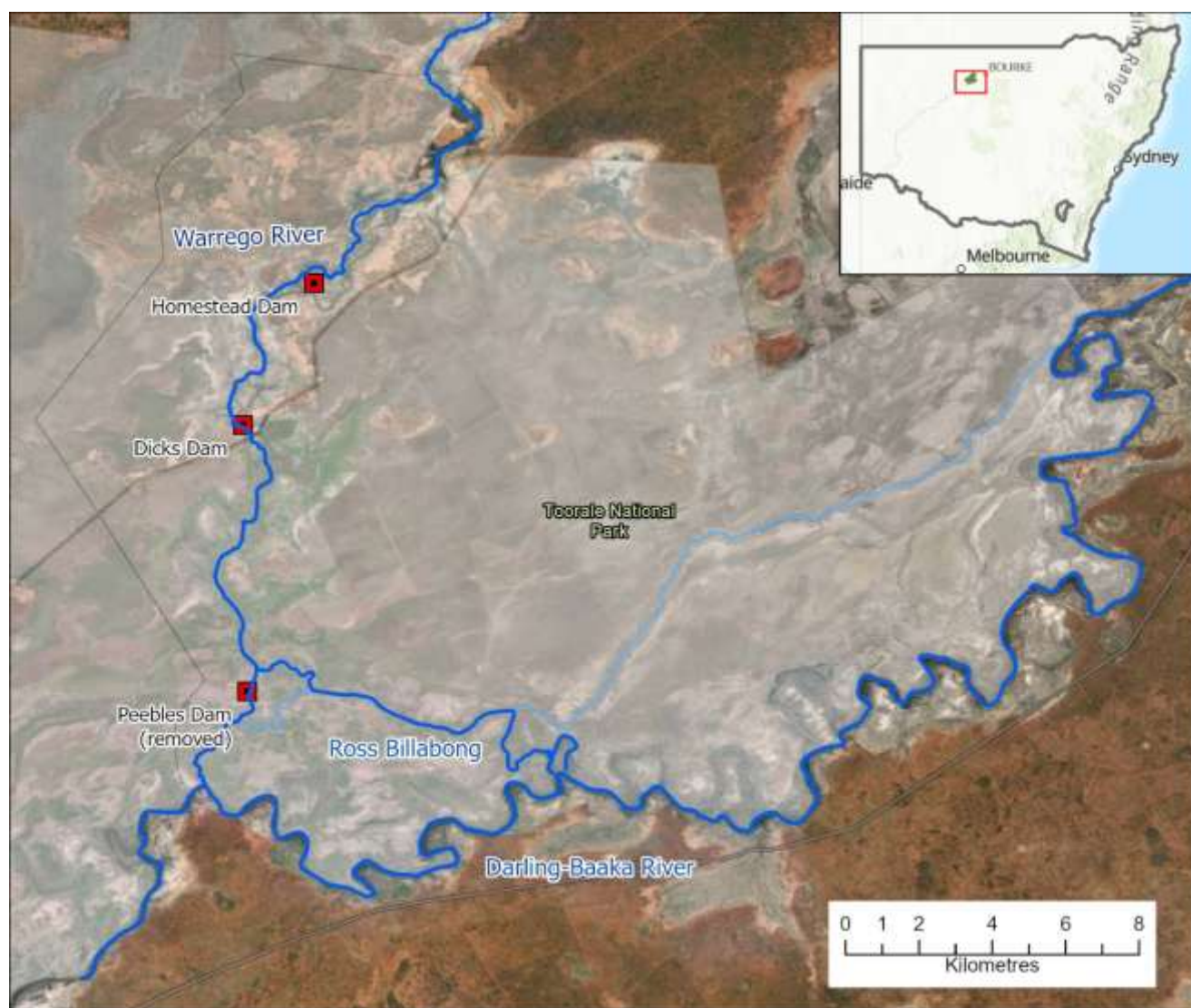


Figure 1 Location of Ross Billabong within Toorale National Park. Light blue lines represent flood channels



Figure 2 Location of previous and proposed works to improve the connectivity of Ross Billabong. Light blue lines represent flood channels

Methods

Storage capacity of Ross Billabong

To estimate the storage capacity of Ross Billabong under different management actions, available digital elevation models (2022 1 m DEM (NSW Government 2024)), Inundation extent mapping processed using the Modified Normalized Difference Water Index (MNDWI (Xu, 2006)) on Sentinel 2 satellite imagery, and field observations were analysed.

The analysis was carried out in three stages;

1. Estimate the approximate full surface area of the billabong using inundation extent mapping. A Sentinel 2 image from March 2022 was used. Based on the prevailing upstream Warrego River flows and our knowledge of system wetting, this image was used to represent the ‘full’ level of the billabong
2. Estimate channel depth and bank profile of the billabong using the DEM and field observations. This step was required as the LiDAR used to create the DEM was captured when there was water present in Ross Billabong obscuring the bank shape below the water level. Channel depth and bank profile below the water level was estimated through examination of field photographs of monitoring staff standing within Ross Billabong and comparing these to trees on the bank that could be observed in the aerial photography at the time the billabong was classed as full. Linking these multiple data sources permitted a 3D shape of the billabong surface to be created.

3. Estimate the volume of the billabong at various AHD heights relevant to management actions using the DEM. Volumes were calculated using the storage capacity function within the Spatial Analysis extension of ArcGISPro 3.4. The storage capacity function calculates the surface area and total volume of the underlying defined region at a series of elevation increments based on the channel depth and bank profiles.

Changes to the connectivity of Ross Billabong

Hydrological analysis was undertaken to compare the differences in connectivity between the Darling-Baaka River and Ross Billabong with and without the proposed works to reduce the eastern block bank being completed. This analysis was undertaken using the following steps:

- Calculate the water level (m AHD) at the Weir 19a gauge on the Darling-Baaka River which is upstream of the eastern block banks of Ross Billabong
- Determine when, and for how long, flows down the Darling-Baaka River would have exceeded the necessary height to overflow into Ross Billabong with and without the presence of the eastern block bank from 18 May 2002 to 3 September 2025 (with the current eastern block bank, a flow of 30,000 ML/d is required for water to spill into Ross Billabong through a flood channel which connects to the Darling River around the Darling River Campground (Black Rocks); with the eastern block bank reduced to 92 m AHD, a flow of 3,500-4,000 ML/d is required). These relationships were determined by comparing water level and discharge at the Weir 19a gauge, which is the first gauge upstream of the Ross Billabong inflow.

Environmental values of Ross Billabong and potential implications of changes to connectivity

A literature review of the Commonwealth Environmental Water Holders Long Term Intervention Monitoring (LTIM) and Flow-MER monitoring reports (Commonwealth of Australia 2019, 2023) was undertaken to ascertain the existing environmental values of Ross Billabong. These were then used to assess the likely environmental implications of changes to the connectivity of the billabong.

Cultural aspirations for Ross Billabong

Discussions with Kurnu-Baakandji Elders Uncle Badger Bates and Uncle Kevin Knight revealed some preliminary cultural aspirations for Ross Billabong (2rog Consulting 2025). It should be noted that Kurnu-Baakandji people of Toorale have gained funding to develop a Cultural Watering Plan over the next 2 years, including for Ross Billabong. These will further inform the future aspirations for Ross Billabong from a cultural perspective.

Findings

Storage capacity of Ross Billabong

Full inundation level of Ross Billabong was calculated at 93 m AHD. At this level, total capacity when inundated was calculated at 1,766 ML. Given the reduced western training wall has a sill height of 94 m AHD, this modification was found to have no impact on the 'full' storage capacity of the billabong post Peebles Dam removal. It will, however, increase connectivity and hydrological exchange between the billabong and the Darling-Baaka and Warrego Rivers during flooding. Removing the eastern block banks to a sill level of 92 m AHD, would likely reduce the 'full' storage capacity of Ross Billabong to 1,246 ML, a 30% reduction of full storage capacity.

Changes to the connectivity of Ross Billabong

Removing the eastern block banks would increase the connectivity experienced by Ross Billabong due to flows down the Darling-Baaka River (Figure 3, Table 1). A threefold increase in the number of connection events is estimated, along with a more than fourfold increase in the number of days the billabong would be connected. The connection frequency of the billabong would increase from an average of every 2.5 years under current conditions to more than once a year on average. The billabong is likely to have a shorter inundation duration compared with the higher storage capacity, but will fill more frequently (i.e., the period in between connection events would be reduced).

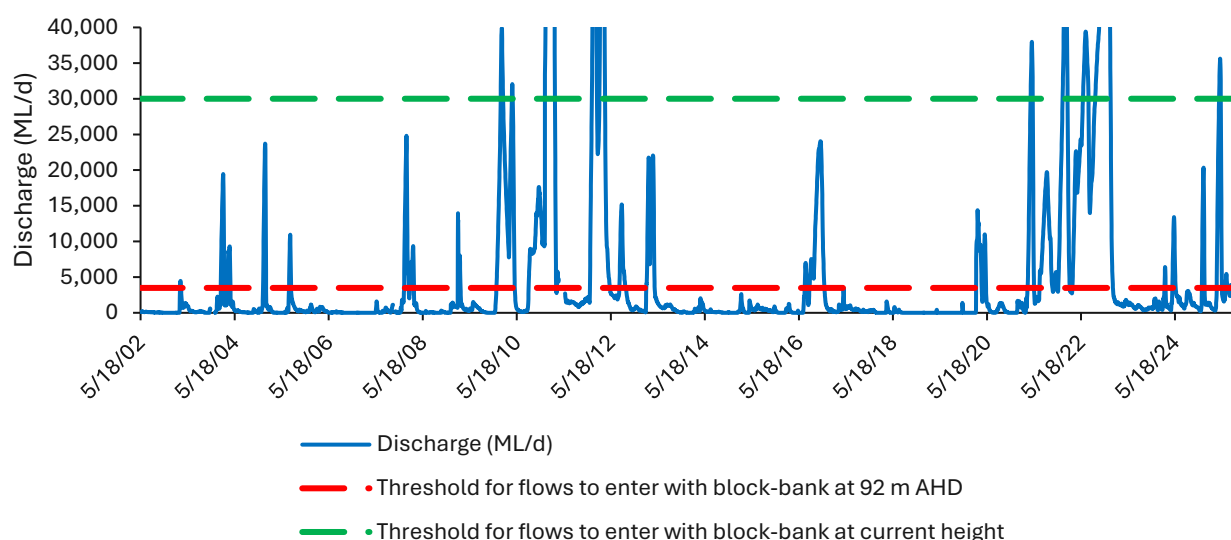


Figure 3 Discharge rate (ML/d) recorded at Weir 19a on the Darling-Baaka River upstream of the eastern block banks of Ross Billabong with associated fill levels for the billabong

Table 1 Comparative statistics relating to inflows from the Darling-Baaka River to Ross Billabong before and after the Proposed Works (18 May 2002 – 3 September 2025)

Comparison	Before Proposed Works	After Proposed Works
Number of times connected	10	31
Total days connected	407 days	1,715 days
Mean duration of individual events (i.e. flows of sufficient size to spill into Ross Billabong)	42.1 days	55.3 days
Median duration of individual events (i.e. flows of sufficient size to spill into Ross Billabong)	39.5 days	25.0 days
Maximum time connected (i.e. longest event recorded)	120 days	314 days
Maximum time disconnected (i.e. longest recorded period between flow events)	3,306 days	1,179 days
Frequency of connection (times connected / total years)	0.4	1.3

Environmental values of Ross Billabong and potential implications of changes to connectivity

Ross Billabong has consistently supported a diverse range of aquatic species as reported in the LTIM and Flow-MER1.0 projects (2014–2024), including significant populations of waterbirds, frogs, turtles and native fish (Commonwealth of Australia 20219, 2023). Notable waterbird species recorded include Australian pelican, plumed whistling-duck, little black cormorant and royal spoonbill, with evidence of breeding also observed. Frog species such as the barking marsh frog, salmon-striped frog and Peron’s tree frog were commonly recorded, along with Murray River turtles and broad-shelled turtles. Native fish species included spangled perch, golden perch and bony herring. As one of the larger and more permanent waterholes in the Lower Warrego River system, Ross Billabong provides important refuge habitat during dry periods. Research from 2022–2023 also found the billabong had the highest productivity and microbial diversity of monitored areas, likely due to the mixing of Darling-Baaka and Warrego River waters, creating more productive conditions than either river system alone (Commonwealth of Australia 2023).

Improved connectivity through the removal of the eastern block banks will allow the Lower Warrego River to have a more natural flooding regime. It will enable greater connectivity between Ross Billabong, the Warrego River and the Darling-Baaka River; in particular, more flow events in the Darling-Baaka River will pass through to the lower Warrego River. This increased connection will benefit aquatic fauna

by allowing for increased movement between the two systems. It will also expand the floodplain habitat available to aquatic species at lower flow levels and support more natural patterns of vegetation occurrence. Moreover, as observed in Commonwealth of Australia (2023), increasing connectivity and mixing between the waters of the Warrego and Darling-Baaka Rivers can boost productivity. Finally, water quality in Ross Billabong is also likely to improve through more regular flushing.

Several other recent improvements to the connectivity of Ross Billabong and the Warrego River have been undertaken. These include the removal of Peebles Dam on the Warrego River and the removal of a section of the block bank at the western end of Ross Billabong. Combined with the removal of the eastern block banks, these will benefit fish species by allowing juvenile individuals to move out of the Warrego River and into the larger and more permanent Darling-Baaka River, while also enabling adults to move more freely into the Warrego system. The Warrego system is thought to be an important contributor of golden perch recruits to the broader Murray-Darling Basin, so increasing connectivity and opportunities to migrate is expected to provide positive environmental benefits (Commonwealth of Australia, 2019).

Cultural aspirations for Ross Billabong

On 11 September 2025, Uncle Badger Bates and Uncle Kevin Knight met with Dr Mark Southwell to discuss cultural water planning for Toorale, including the Warrego River and Ross Billabong. Following discussion of the proposed works and hydrological changes, both representatives expressed support for the removal of the eastern block banks and the anticipated benefits for water quality, habitat condition and future cultural use of the area. The discussions also improved understanding of how Ross Billabong connects with the Warrego and Darling-Baaka Rivers and how these connections may support cultural activities into the future.

Key priorities identified during discussions included maintaining water levels in Homestead Dam and Ross Billabong to support cultural camps, fishing, yabbie collection, cultural tours and public access. Suggestions included using cultural water to top up Ross Billabong, promoting culturally significant plant species such as Penny Royal and Quandongs, improving access tracks and crossings, and potentially restoring accommodation near the billabong to support guided cultural tourism activities.

Conclusions

The proposed works to improve connectivity at Ross Billabong are expected to provide substantial ecological and cultural benefits by restoring more natural hydrological connections between the Warrego and Darling-Baaka Rivers. Reducing the eastern block banks will decrease the storage capacity but it will significantly increase the frequency and duration of connection events, improving water exchange, water quality, productivity and habitat availability for aquatic species. Increased connectivity is also expected to support fish movement and broader ecosystem function across the Lower Warrego and Darling-Baaka systems.

Ross Billabong remains an important refuge habitat supporting diverse waterbird, frog, turtle and native fish communities, while also holding strong cultural significance for Kurnu-Baakandji people. Discussions with Uncle Badger Bates and Uncle Kevin Knight identified future opportunities for cultural water management, cultural tourism, recreation and the promotion of culturally significant plant species. Continued collaboration through future Cultural Water Planning will help ensure that ecological restoration and cultural aspirations are jointly supported into the future.

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