

# Watering of wetlands on Indigenous Country in the Murray–Darling Basin, Australia

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## ABSTRACT

**Context.** Water managers in the Murray–Darling Basin increasingly recognise the cultural and environmental benefits generated by Indigenous co-management of environmental water. However, traditional knowledge and values are subsidiary to western technical and scientific perceptions when prioritising environmental water use. **Aims and methods.** We mapped the locations and volumes of Commonwealth Environmental Water Office environmental watering events onto the wetlands within the land area represented by different state-determined Indigenous organisations and discuss how this relates to the varied nature and extent of Indigenous engagement in environmental watering decisions. **Key results.** Between 2014–15 and 2018–19, one organisation had nearly 13% of the area of wetlands watered, but the average was less than 3%. In all, 18 of the 26 organisations received no environmental water. **Conclusions.** The distribution of environmental flows does not meet the cultural needs of Indigenous nations due to physical restrictions and policy limitations. Yet, there are clear environmental and cultural co-benefits where Indigenous peoples have developed partnerships with environmental water managers. Developing stronger partnerships and increasing Indigenous water entitlements from the current 0.17% of issued entitlements would maximise these benefits in catchments where environmental water is prioritised. **Implications.** The reviews of the *Water Act* and the Basin Plan scheduled for 2024–26 present opportunities to implement reforms.

**Keywords:** co-management, cultural flows, environmental water, Indigenous water ownership, Murray–Darling Basin, participatory resource management, water partnerships, water policy.

## Introduction

There are growing threats to water availability in the Murray–Darling Basin, Australia (hereafter ‘the Basin’), to sustain cultural and environmental values. These threats include over-extraction, policies and water-planning rules (Wheeler et al. 2020), as well as climate change (Cai and Cowan 2008; Whetton and Chiew 2021). The observed river flows at the South Australian border between 2012 and 2019 were 22% less than expected under the Murray–Darling Basin Plan (hereafter, the ‘Basin Plan’; Wentworth 2020). Average surface-water availability in 2008 was 23 417 GL year<sup>−1</sup>, with 11 327 GL year<sup>−1</sup> (48%) diverted for consumptive use (CSIRO 2008). The objective of the Basin Plan is to re-allocate water from irrigation to the environment, with 2107 GL year<sup>−1</sup> recovered by September 2021 (Murray–Darling Basin Authority 2021a). However, even under a moderate scenario of global warming, average surface-water availability by 2030 is projected to decline by nearly 2500 GL, and possibly as much as 7900 GL year<sup>−1</sup> (CSIRO 2008, p. 9), which is considerably more than has been re-allocated to the environment under the Basin Plan.

Wetlands occupy ~63 000 km<sup>2</sup> (6%) of the Basin and include extensive floodplain forests, terminal marshes, rivers, lakes and billabongs (Kingsford et al. 2004), including 16 Ramsar wetlands. As a signatory to the Ramsar Convention on Wetlands, the Australian government has committed to maintaining the ecological character and wise use of all wetlands (Pittock 2018). Other international agreements cover threatened

species and ecological communities, migratory birds and the conservation of representative areas of each ecosystem type. Despite the objective of the Basin Plan to protect and restore ‘water-dependent ecosystems’ and ensure their resilience to climate change and other threats (Commonwealth of Australia 2012, S5.03a), from 2014–15 to 2018–19, only 0.8% of the area of major wetlands received environmental water as flows (Chen *et al.* 2021). The magnitude and extent of environmental watering is limited to those rivers and wetlands to which it is physically possible to deliver flows, by the volume available each year and the requirement to avoid flooding of private property.

Water rights are central to self-determination and control of territory by Indigenous peoples (Robison *et al.* 2018; Hartwig *et al.* 2020). There are ~55 Traditional Owner groups in the Basin (Murray–Darling Basin Authority 2018), comprising 10.5% of the total population in the northern Basin and 3.4% in the south, and growing rapidly at a rate of ~3.8% year<sup>-1</sup> (Hartwig *et al.* 2021).

Water and land are sacred and central to Indigenous existence (Marshall 2017), being linked to identity, culture and spirituality through custodial responsibilities, territorial associations, kinship ties and ceremony (Bark *et al.* 2015; Moggridge *et al.* 2019). Indigenous people’s relationships with Country, that is, the cultural, spiritual and biogeophysical environment they inhabit, is intimate, and closely interconnected and suffused with meaning through oral traditions of stories, songs and knowledge that are linked to customary law regarding permissible uses of land, water and other resources and obligations to look after and nurture the land and its waters (Marshall 2017). Indigenous obligations for the protection of water help ensure healthy people and healthy water. In a contemporary context, the People on Country Project (Altman and Kerins 2012) and the Caring for Country movement are examples of how living on and caring for the land and its waters have improved Indigenous health, wellbeing, self-esteem and sense of identity (Burgess *et al.* 2009; Kingsley *et al.* 2013).

Prior to European settlement, wetlands and rivers provided Indigenous peoples with most of their material needs to support their cultural economies, including diverse and abundant sources of foods, medicines, fibre and weaving materials, including the following: waterfowl and their eggs; fishes, shellfish and reptiles; bulbs, corms, tubers and fruits; bark for dwellings, canoes, shields and coolamons; and timber for weapons, firewood and building materials (Zola and Gott 1992; Rose 1996; Clayton and Barlow 1997; Colloff 2014, pp. 19–27). Other water-dependent values include maintaining creation sites, sites recorded in creation stories, and culturally significant totemic species (Venn and Quiggin 2007; Moggridge *et al.* 2019). Many of the species that provide these values remain important for the wellbeing of Indigenous peoples of the Basin’s rivers: ‘First Nations value and use these species today, in the same way we have for thousands of years. Water in the rivers means

water for these species’ (NBAN, quoted in Department of Agriculture Water and the Environment 2020).

Indigenous peoples have been dispossessed of their traditional rights and access to water since colonisation. Water management since Federation is built on principles of property rights and entitlements and, more recently, neoliberal market economics (Hartwig *et al.* 2020). This legacy has prevented Indigenous people from acquiring water entitlements or participating in the water market (Marshall 2017). Indigenous nations have been excluded from decision-making on water allocations (Burchi 2012; Hartwig *et al.* 2020). The National Water Initiative established water licences as a property right, separated from the land (Council of Australian Governments 2004; Williams 2017). This transfer of rights has hindered Indigenous people’s ability to maintain their ownership of what little water they have (Marshall 2017).

Indigenous water holdings represent 0.22% of available water in the New South Wales Murray–Darling Basin and only 0.17% of permitted Basin-wide surface-water take (Hartwig *et al.* 2021). Water held by an Indigenous organisation is regarded as a financial asset and may be disposed of if that organisation becomes insolvent. Some 20% of Indigenous water holdings were lost in the New South Wales (NSW) Basin between 2009 and 2018 (Hartwig *et al.* 2020). In an attempt to address these issues, AU\$40 million for improved Indigenous water access was allocated by the Federal government in 2018. However, this has not been spent or accrued any interest at the time of preparing this paper. The funding was recently transferred from the Water Minister’s portfolio in the Department of Agriculture, Water and Environment to the Minister for Indigenous Australians, National Indigenous Australians Agency for allocation under the ‘Closing the Gap’ program (cf. below; Senate Rural and Regional Affairs and Transport Legislation Committee 2021, pp. 45–50).

Ensuring that environmental flows benefit Indigenous nations is yet to be realised under the Basin Plan. The Murray–Darling Basin Authority (MDBA) has acknowledged that a ‘clear and committed pathway for First Nations social and economic outcomes’ is necessary (Murray–Darling Basin Authority 2020a, p. 125). In 2018, a Direction from the Australian Government Minister of Agriculture and Water Resources required that the MDBA considers Indigenous values and uses and involves Indigenous people in environmental water planning, consistent with the *Water Act* (Commonwealth of Australia 2012, S175; Murray–Darling Basin Authority 2020b, p. 3). In 2020–21, Indigenous environmental watering objectives were officially represented at a basin scale by the Commonwealth for the first time (Department of Agriculture Water and the Environment 2020). Commonwealth Environmental Water Office (CEWO) has also had agreements in place with Ngarrindjeri and Nari Nari for several years prior to this, and water managers have begun consulting with other Indigenous organisations to

scope more effective policy options to create benefits for Indigenous people and the environment (Murray–Darling Basin Authority 2020b).

The MDBA and CEWO have partnered with the Murray Lower Darling Rivers Indigenous Nations (MLDRIN) and Northern Basin Aboriginal Nations (NBAN) on the First Nations Environmental Water Guidance (FNEWG) project. The objective of this project is to integrate Indigenous outcomes into current water-management processes and better understand and integrate Indigenous knowledge relevant to the environmental watering objectives across the Basin (Murray–Darling Basin Authority 2020b). However, the extent to which Indigenous values and knowledge are considered in practice remains to be seen.

The *Water Act* requires the Commonwealth Environmental Water Holder to use environmental water holdings for the purposes of ‘protecting or restoring the environmental assets of the MDB... so as to give effect to relevant international agreements’ (Commonwealth of Australia 2007, s105(3)). The conservation of rivers, wetlands and their biodiversity, with priority afforded to wetlands and species covered by international agreements, is based on non-Indigenous values, rules and knowledge (Jackson and Nias 2019) and does not adequately address Indigenous social, cultural and spiritual objectives (Finn and Jackson 2011). Such a framework does not take into account Indigenous language groups and the boundaries of their Country, or the relationships between Indigenous peoples and Country (Weir 2009). Improvements are needed in policy and management of environmental flows that better account for Indigenous perspectives, such as the concept of cultural flows, and how benefits for Indigenous people can be realised (Moggridge and Thompson 2021).

Water owned by Indigenous organisations has generated clear cultural and ecological benefits (Davies *et al.* 2021). Cultural flows are ‘water entitlements that are legally and beneficially owned by the Aboriginal nations and are of a sufficient and adequate quantity and quality to improve the spiritual, cultural, environmental, social and economic conditions of those Aboriginal nations’ (Murray Lower Darling Rivers Indigenous Nations 2007, p. 2). Cultural flows are not recognised in the Basin Plan; basin states and territories are required to have ‘regard’ for cultural flows only (Commonwealth of Australia 2012, s10.54). However, the most recent ‘Closing the Gap’ framework includes a commitment to improving Indigenous access to, and control over, land and water for ‘cultural wellbeing’ (Coalition of Aboriginal and Torres Strait Islander Peak Organisations, Coalition of Australian Governments 2020). This commitment includes national targets for the volume of water under (Target 15) Indigenous control and ownership (Coalition of Aboriginal and Torres Strait Islander Peak Organisations, Coalition of Australian Governments 2020).

These recent developments indicate that there is recognition among decision-makers of the need for more

equitable and just rules and policies for Indigenous access, ownership and use of water. This includes redressing power imbalances and inequities that originated in colonial and post-colonial attitudes and policies and persist under neoliberal market economic structures (Hartwig *et al.* 2020). Implementation of this shift in policy towards Indigenous interests will require accurate information on water holdings by Indigenous organisations in the Basin, as well as information on the extent of Indigenous engagement in environmental water management, consultation and decision-making. The distribution of environmental flows on Country in relation to Indigenous territories has never been mapped at Basin-scale.

In this paper, we assess where and how environmental water was allocated in the Basin and discuss how this relates to areas where Indigenous groups have claimed or gained recognition as Traditional Owners and custodians of the land and its waters through the Native Title process or are engaged with government agencies on aspects of water management. Note that although all land in the Basin is Indigenous Country, the borders of Indigenous nations have never been mapped, and, to do so, would be extremely problematic, if not impossible. Therefore, it is not possible to systematically map the watering of Indigenous nations’ Country. Instead, we mapped the amounts of environmental water allocated to the Country represented by various Indigenous organisations. The borders do not necessarily represent the extent of Indigenous nations because these borders are determined by legal processes of the settler-state of Australia, rather than by the Indigenous nations themselves. We assess how this information can facilitate Indigenous engagement in environmental water ownership and management. This will better enable environmental water managers to protect and restore flow-dependent ecosystems in the Basin by including Indigenous people in their plans and actions.

## Materials and methods

To develop an approach to the mapping framework, we engaged with two Indigenous organisations, namely, Yorta Yorta Nations Aboriginal Corporation and Northern Basin Aboriginal Nations (NBAN), and two responsible for environmental watering policy and management under the Basin Plan, namely, CEWO and MDBA. All expressed the need for a synthesis of the distribution of environmental watering events in relation to Indigenous Country in the Basin. In particular, we asked for advice on what boundaries to use for mapping Indigenous areas, namely, language groups, as detailed on the AIATSIS map (Horton 1996), Native Title claims (National Native Title Tribunal 2021) or boundaries of Indigenous organisations (cf. below).

All the data used in this paper were from publicly available sources, so human research ethics approval was not required.

## Indigenous boundaries

GIS is subject to constraints regarding the selection of coverages, attributes, analysis and decision outcomes (Harris and Weiner 1998). The spatial parameters in GIS of points, lines, polygons and pixels divide the area of interest into discrete units according to a positivist scientific epistemology and do not represent ambiguity (Williamson 1985; Rundstrom 1995). This ontology conflicts with Indigenous spatio-temporal concepts in which boundaries are diffuse, overlapping and dynamic (Potter *et al.* 2016). Hard sovereign borders are largely a settler-state construction (Porter 2016). Boundaries frequently represent places of coming together for trade or spiritual gatherings and can shift on the basis of seasonal or vegetation patterns (Brazenor *et al.* 1999). The boundaries of each group's Country have been known and understood through systems of intergenerational cultural knowledge for millennia (Brazenor *et al.* 1999). Therefore, cadastral maps of Country will not fully capture the spatial ontologies of Indigenous Nations (Brazenor *et al.* 1999; Porter 2016).

However, 'hard' boundaries allow Indigenous groups to fit within the cadastral mapping system used to determine legal rights by the Commonwealth and basin states and the Australian Capital Territory. Therefore, while the boundaries used do not represent the true boundaries of Indigenous nations, mapping environmental watering of wetlands is an important issue within the current context of Indigenous advocacy for stronger water-management powers within a post-colonial legal system. Under a variety of Commonwealth, state and territory laws, particular regions have been defined for the purposes of supporting the delivery of services to Indigenous peoples, for consultation on cultural heritage, and to recognise some limited rights to land for particular groups. Despite there being Indigenous traditional owners for all lands and waters in the Basin, who deserve to have their rights to ownership of lands and waters recognised, Indigenous people have been substantially dispossessed and only limited areas have received recognition from governments (Strelein and Tran 2013; Marshall 2017; Fig. 1). Furthermore, this recognition is constrained by the laws of the Commonwealth, states and territories, which require Indigenous groups to overcome 'unreasonable and unyielding barriers of proof' (Pearson 2003, p. 2). Therefore, these areas proffer limited rights and do not overcome historical dispossession (Strelein and Tran 2013).

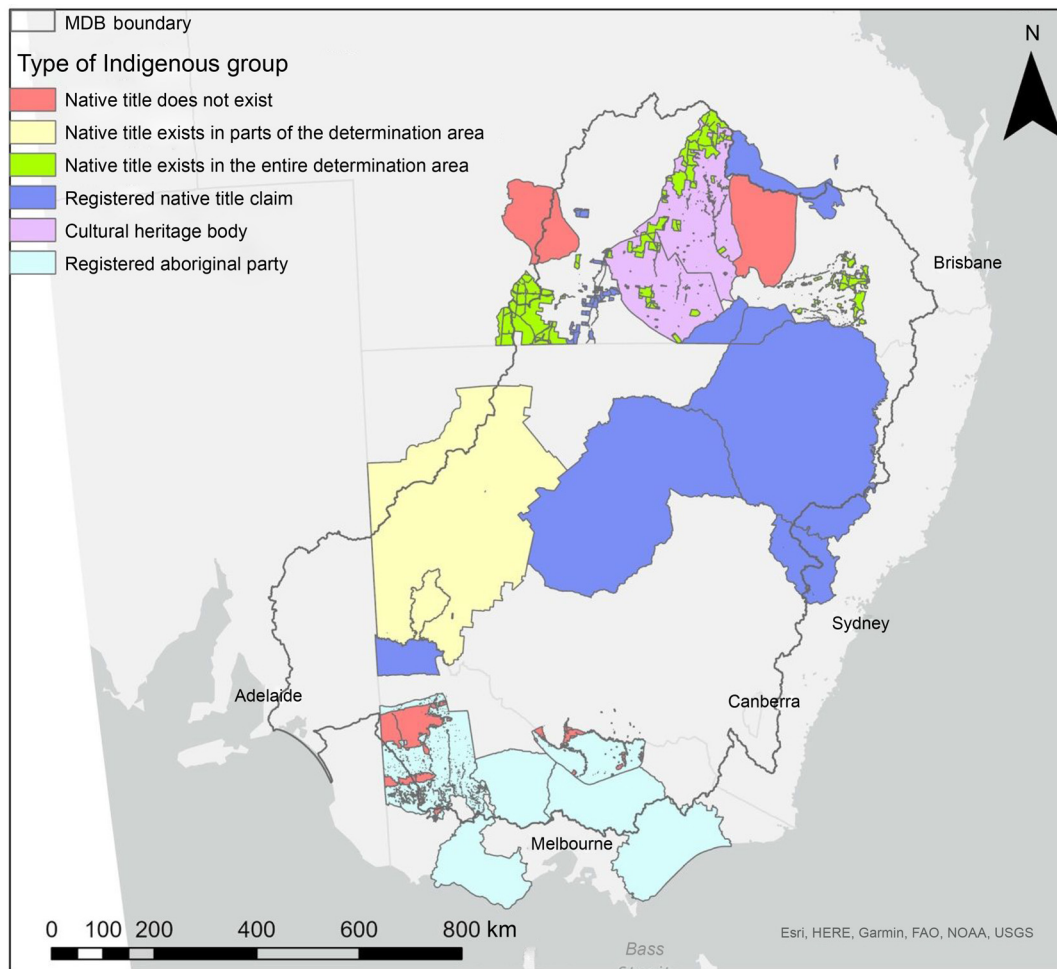
To determine hard boundaries that are acceptable for all Indigenous nations, if not a true representation of the boundaries of their Country, participatory GIS methods would be necessary (Potter *et al.* 2016). However, the scale and degree of consultation required for this is well beyond the scope of this study. The AIATSIS map of Indigenous Australia (Horton 1996) is based in part on work by Tindale (1974) and represents the spatial relationships of cultural and language groups, with 'soft' boundaries, many of which are disputed. It explicitly presents only the general

locations of Indigenous groups (Tindale 1974). It is therefore unsuitable for an analysis of this type. Native-title claim areas and Aboriginal Land Councils (ALCs) in NSW, Registered Aboriginal Parties (RAPs) in Victoria and Cultural Heritage Bodies (CHBs) in Queensland (hereafter, Indigenous organisations) are based on hard borders (hereafter, Indigenous boundaries). Native Title has been criticised for the use of spatio-legal property boundaries that do not align with Indigenous understandings of Country, for failing to recognise that there are traditional owners for every part of Australia and for failing to recognise overlapping land rights (Brazenor *et al.* 1999; Burke 2011). Therefore, areas that are not under Native Title or subject to current claims, or areas that do not have a RAP or CHB that is recognised by the state, do not indicate a lack of Indigenous connection to, and sovereignty over Country. All country within the Basin, and in Australia in general, is Indigenous Country. Therefore, all Indigenous nations deserve cultural flows and land and water should be considered under the sovereignty of Traditional Owners whether or not it is granted so by basin governments.

Nevertheless, these deficient boundaries are used in this analysis for two reasons. (1) They provide examples of the extent of environmental watering of Country of different Indigenous organisations, and point to the variability and gaps in watering that are likely to affect other Indigenous nations in the Basin whose country is not depicted, or is poorly depicted, in this analysis. Further, this initial and incomplete analysis points to the need for better-resourced and more systematic analysis that includes all the Indigenous nations in the Basin. (2) Although these boundaries are imposed on Indigenous nations and, by no means, represent all the nations that exist in the Basin, these are the boundaries of Indigenous organisations that currently have some recognised authority under Commonwealth and state laws. Future reforms to restore Indigenous nations' rights to own and manage water in the Basin will likely begin with dialogue with existing Indigenous organisations. Therefore, this incomplete analysis points to the need for better-resourced and more systematic analysis to facilitate return of water ownership and cultural flow-management opportunities for all the Indigenous nations in the Basin and can be used to indicate where environmental water has been used in relation to Indigenous organisations and Country to inform them and the agencies responsible for environmental water.

We have included Native Title claims that are in progress or have been dismissed in our analysis for the following reasons: (1) all native title claims include detailed mapping of the boundaries of each claim area; the dismissal of a Native Title claim does not alter intrinsically these boundaries or the sense of attachment, responsibility and belonging that Indigenous groups have for that area; (2) dismissal of a claim does not negate recognition of the claimant group as Traditional Owners; government agencies may still engage in joint management agreements after a claim has been dismissed





**Fig. 1.** Types of Indigenous group boundaries used in analysis. Source: (National Native Title Tribunal 2021).

(Agreements, Treaties and Negotiated Settlements Project 2011); (3) criteria for determination of Native Title claims have changed; for example, early claims required proof of continuous occupancy and use (e.g. Seidel 2004) but 'connection with the land and waters' no longer necessarily requires physical occupation or continued or recent use (Australian Law Reform Commission 2022); accordingly, cases that have been dismissed in the past under such criteria may be successful under an appeal or a new claim; and (4) claims in progress are included because the average claim may take at least 6 years to settle (claims have taken up to 16 years) and government agencies may enter into management agreements with Indigenous groups regardless of whether a claim is in progress.

### The mapping process

We used vector datasets, visualised using ArcGIS Pro (ver. 2.6.2, Environmental Systems Research Institute, Redlands, CA, USA, see <https://www.esri.com/en-us/arcgis/products/arcgis-pro/overview>). All maps were orthorectified to GDA94/MGA Zone 55. To map environmental water use

within Indigenous boundaries, we generated a map of floodplain and palustrine areas of the Basin from the Australian National Aquatic Ecosystem (ANAE) Classification of the Basin (Brooks 2021) by deleting all other areas. This was rasterised to a pixel size of 500 m<sup>2</sup> to quicken data processing. There are at least three other maps of Basin floodplains, based on different defining criteria (Kingsford *et al.* 2004; Chen *et al.* 2012; Murray–Darling Basin Authority 2017), but the ANAE map is the most recent and detailed map available, and it is accepted by governments (Brooks 2021). However, many wetland areas on this map cannot be physically watered by environmental water releases from dams. The 'managed floodplain' refers to areas that can be deliberately watered (Murray–Darling Basin Authority 2017). Although a map of the managed floodplain exists, it is imprecise and, therefore, not adequate for our analysis.

We created a map of Indigenous organisations by compiling determined positive, active and in progress or otherwise resolved (dismissed) Native Title claim areas with Registered Aboriginal Parties in Victoria and Cultural Heritage Bodies in Queensland (Fig. 1). We include dismissed claims and claims

in progress because these are still areas over which an Indigenous group has asserted a continued connection to Country. All boundaries representing the same Indigenous group were merged into single features (Supplementary Fig. S1). In Victoria, boundaries of Registered Aboriginal Parties are considered to provide a better representation of Traditional Owner groups than Native Title determinations, despite neither boundary perfectly or completely representing the Country of Indigenous nations (Parliament of Victoria 2012, p. 36). Areas without granted or claimed Native Title, a RAP or CHB are outside the scope of our analysis, because hard boundaries cannot be ascribed to the traditional owner group of this Country, and we cannot therefore derive any area measurements. In NSW, the boundaries of Aboriginal Land Councils do not align with those of Indigenous nations, but we mapped environmental water use to their boundaries because they represent current Indigenous governance institutions (Supplementary Fig. S2). The area of floodplain within each Indigenous boundary was estimated using the 'summarise within' tool in ArcGIS and removed any Indigenous organisations without any floodplain area within their borders.

We then plotted the environmental watering locations and annual volumes collated by Chen *et al.* (2021) as point features in ArcGIS Pro. Chen *et al.* (2021) calculated flood extent (2014–15 to 2018–19) on the basis of the area that would be flooded to a depth of 0.5 m (considered an 'ecologically effective flood') by the volume of environmental water delivered to each site. Following this methodology, we multiplied the highest annual volume by 0.2 for each site to determine the number of hectares that could possibly be inundated to a depth of 0.5 m by the largest flood event over the 5-year period (maximum area inundated). We used the 'zonal statistics as table' tool to sum and tabulate these events for each Indigenous area. The area flooded was then divided by the area of floodplain within each Indigenous boundary to estimate the percentage of the floodplain that had been flooded within that boundary. We repeated this process for each Indigenous boundary using the model-builder tool.

For wetland sites that cover multiple Indigenous organisations, we manually estimated the portion of the wetland area within each boundary by using the area-measurement tool. The 'River Murray channel riparian zone' watering event is a fresh and overbank flow, that inundated the floodplains of the central Murray River (extending from Hume Dam to Lock 10; Hale *et al.* 2019; Stewardson and Guarino 2019). It is unclear how much of this volume was overbank flow, or what the average depth of this flood was. However, Stewardson and Guarino (2019, table 2, p. 31) stated that 7716 ha were flooded in the Central Murray. Therefore, we take this as the maximum area inundated for this event. The maximum area, as well as the annual volumes, are split among Indigenous organisations adjacent to the Central Murray. We assume that 3858 ha is inundated on each side of the river. The length of river that

each organisation borders is divided by the total length of the Central Murray to determine the portion of the 3858 ha that is assigned to that Indigenous organisation. Yorta Yorta is the only Traditional Owner group with area mapped on both sides of the Central Murray. Therefore, we sum the length of their NSW and Victorian river borders to determine their portion. The estimated portions of each floodplain within overlapping Indigenous organisations are included in Supplementary Table S1.

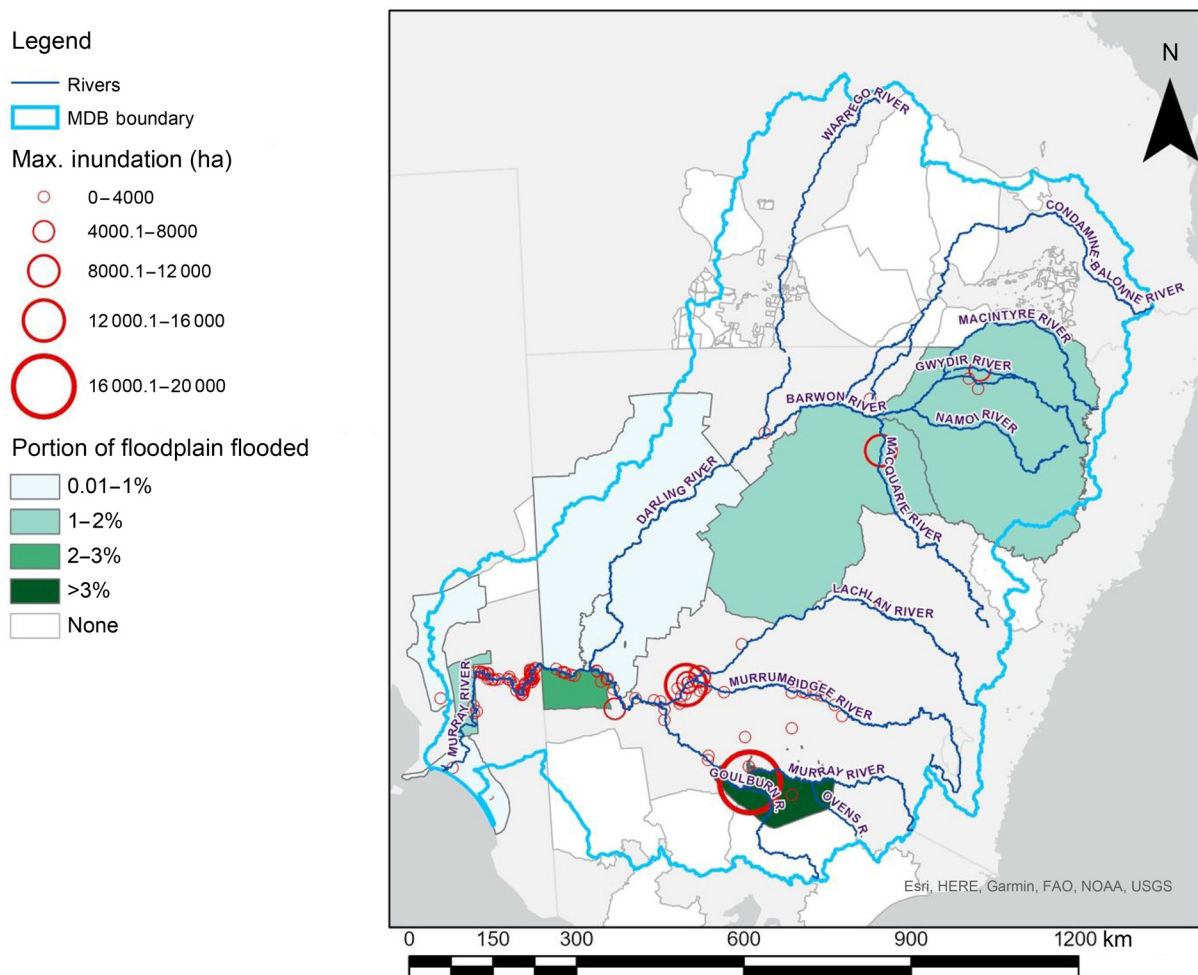
## Indigenous engagement in environmental watering

We reviewed documented examples of Indigenous engagement in environmental watering (Jackson and Nias 2019; Murray–Darling Basin Authority 2020c, 2021b; Department of Agriculture Water and the Environment 2021; Woods *et al.* 2021) and categorised the degree of engagement into (1) little to no involvement, (2) involvement in monitoring and (3) partnerships with water managers. We included all examples published by the MDBA, although this list is not exhaustive.

## Results

The proportion of the ANAE-derived floodplain that was flooded to a depth of 0.5 m between 2014–15 and 2018–19 in each Indigenous organisation shows that although one organisation's recognised area (Yorta Yorta) had nearly 13% of its floodplain watered, the average was 2.93%. Some 18 of 26 (69%) organisations with floodplains had none of their recognised areas watered (Fig. 2, Supplementary Table S2). Most (72%) of Aboriginal Land Councils in NSW with some floodplain had not received any environmental water (Fig. 3, Supplementary Table S3). Whereas the average portion of the floodplain watered was 2.22%, Leeton and District had over 80% of its floodplain watered (largely as a result of watering of the mid-Murrumbidgee wetlands). Furthermore, the five ALCs with the highest floodplain inundation portions (all above 5%) were all in the southern Basin. However, as noted above, there are areas of ANAE wetlands that cannot be influenced by held environmental water. Therefore, we would expect that many organisations would receive little to no environmental water, as the supporting infrastructure is not in place.

Indigenous peoples have been engaged at various levels with water managers (Table 1). Of the 16 examples, 5 had little to no involvement with Indigenous stakeholders in environmental watering outcomes, mostly in the northern Basin; 4 involved Indigenous engagement in the monitoring of environmental or cultural outcomes, and 6 had ongoing partnerships between Indigenous groups and water managers to plan watering events and monitor outcomes, all in the southern Basin. There were fewer sites watered in the



**Fig. 2.** Maximum inundation from environmental watering events (excluding flow events) and percentage of the areas of granted and claimed Native Title, Registered Aboriginal Parties and Cultural Heritage Bodies flooded by Commonwealth environmental water from 2014–15 to 2018–19.

northern Basin and less engagement in decision-making. Basin-wide, there was less Indigenous engagement for environmental watering events involving higher volumes of water.

Relationships between Indigenous organisations and water managers took various forms. Since 2016, the Ngarrindjeri Regional Authority has had a formal partnership with CEWO to deliver environmental water to Teringie wetlands. They established this through a prior environmental watering relationship with the Nature Foundation SA (Jackson and Nias 2019). In another example, the Barkindji Marua Environment Elders Team (BMEET) has a partnership with the Murray–Darling Wetlands Working Group (MDWWG), which is a smaller, non-government environmental water holder (compared to the CEWO).

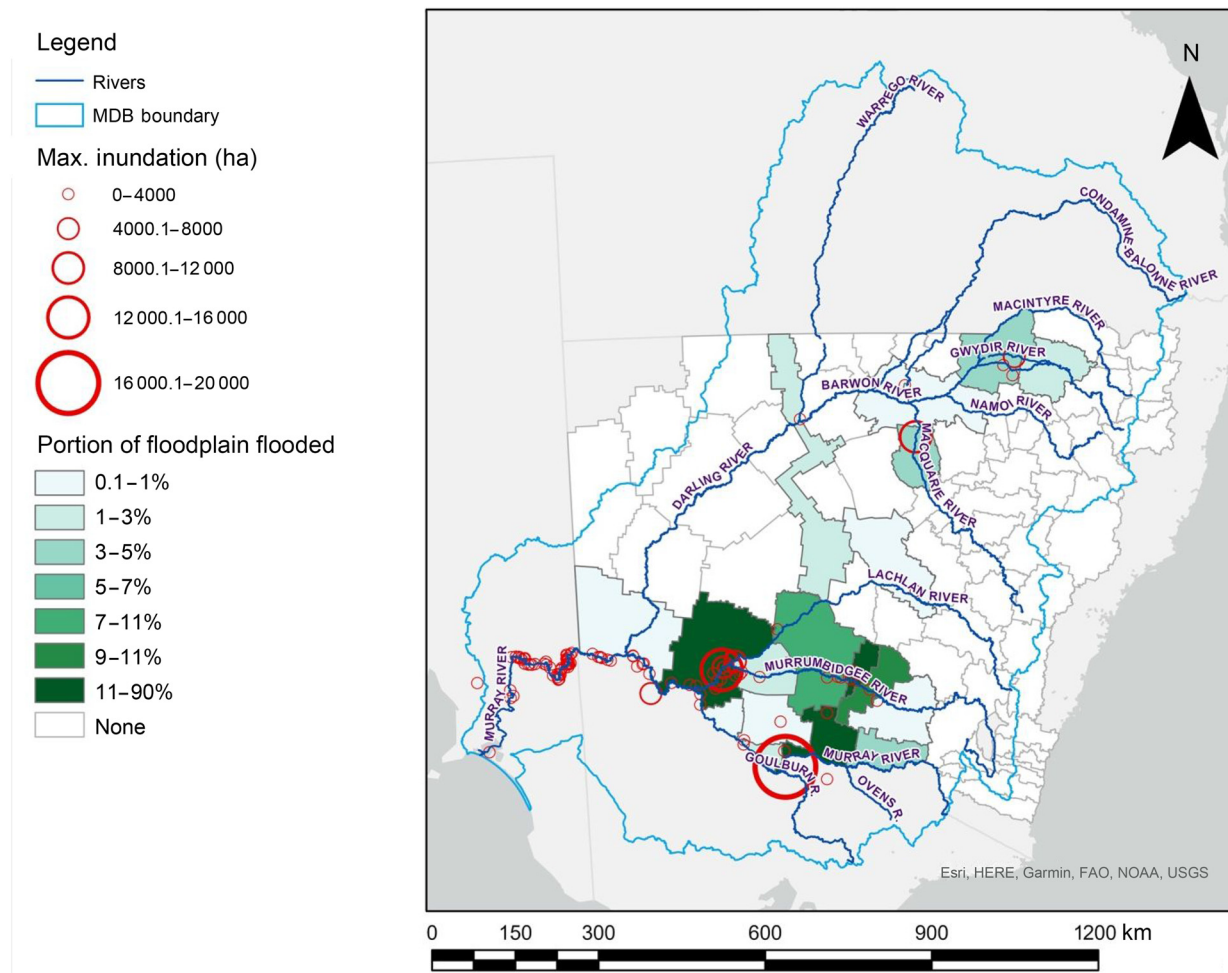
Our results showed that partnerships usually occur when Indigenous authority is acknowledged in some capacity. For example, Nari Nari, with support from The Nature Conservancy, gained direct ownership of the Gayini Nimmie–Caira property in 2019 for the purposes of delivering

environmental flows, and sustainable land management. Management of the property considered ecological, Indigenous cultural heritage and economic values, determined through a land and water management plan (western science) and Healthy Country planning processes (traditional ecological knowledge; Woods *et al.* 2021). Furthermore, Indigenous authority is recognised through Native Title (Ranch Billabong), Indigenous Protected Areas (Toogimbie IPA) or management agreements (for example, although they do not own the land, BMEET have a licence to occupy and manage Fletchers Creek reserve). However, even where land access rights have been recognised by the state, this has not come with concomitant access to cultural flows.

## Discussion

In the northern Basin, environmental watering focused on large Ramsar-listed wetlands, whereas in the southern





**Fig. 3.** Maximum inundation from environmental watering events (excluding flow events) and percentage of the area of NSW Aboriginal Land Councils flooded with Commonwealth environmental water from 2014–15 to 2018–19.

Basin, watering has occurred at both large and small wetland sites. This shows that environmental watering is not spatially equitable for Indigenous organisations. Therefore, any co-benefits for Indigenous nations created from watering are limited to wetlands that have been prioritised by CEWO.

Some water managers are engaging in partnerships with Indigenous nations, indicating an increasing awareness of the Indigenous cultural significance of particular wetlands and rivers, for example, in the First Nations Environmental Water Guidance (FNEWG) Project (Murray–Darling Basin Authority 2020b) and some site-specific partnerships. However, environmental watering actions are driven primarily by the requirements of the *Water Act*, the Basin Plan and by international treaty obligations to prioritise the conservation of particular ecological values. Strong Indigenous cultural values and associations at wetlands such as the Barmah and Millewa forests, Macquarie Marshes and Narran Lakes, are often intangible and are based on relationships that are not easily quantifiable (Jackson 2006; Marshall 2017). Culturally

important wetlands may be overlooked unless they are also of high environmental conservation value.

Environmental watering involves restoring the connectivity of rivers and wetlands (Department of Agriculture Water and the Environment 2018; Jackson 2022) and watering events have tended to focus on in-channel flow events (80% of events from 2012–19) or Ramsar-listed wetlands (Chen *et al.* 2021). The focus on connectivity can benefit water quality and habitat conditions for fish and waterbirds, but there can be instances where environmental flows maintain connectivity but have negative cultural impacts (Moggridge and Thompson 2021). In the FNEWG project, Indigenous groups ‘stressed the importance of considering outcomes beyond fish, waterbirds and vegetation’ (Murray–Darling Basin Authority 2020b). By taking a whole-of-Country perspective on environmental watering, cultural values and Indigenous wellbeing are included in the outcomes, along with benefits to flow-dependent ecosystems and their biodiversity. This approach requires the engagement of Indigenous peoples in environmental watering decisions.



**Table 1.** Environmental watering and an associated level of engagement with Indigenous groups in the Murray–Darling Basin from 2018 to 2020.

| Environmental watering site         | Catchment                             | Type  | When watered                               | Volume   | Indigenous group engaged                                  | Description of Indigenous engagement  |
|-------------------------------------|---------------------------------------|---|--|--|---|---|
| Dharriwaa–Narran Lakes              | Narran                                | Site specific (wetland–floodplain)          | February–April 2020                        | 90 GL  | Euahlayi (Yuwaalaraay)                                    | Participation in monitoring of outcomes   |
| Coombool Swamp, Chowilla floodplain | Lower Murray                          | Site specific (billabong)                   | September 2019–January 2020                | 7 GL   | First Peoples of the River Murray and Mallee              | Indigenous assessment after 5 GL delivered, with further 2 GL delivered as a result   |
| Guttrum Forest                      | Central Murray                        | Site specific (wetland–floodplain)          | December 2019                              | Return flows from Campaspe and Goulburn        | Barapa Barapa and Wemba Wemba                             | Participation in monitoring of outcomes   |
| King River                          | Ovens                                 | Flow (river channel)                        | June 2019                                  | 39 ML  | Taungurung  | Water owned by Taungurung released as e-flow. Participation in monitoring of outcomes   |
| Warrego                             | Warrego                               | Flow pulse (river channel)                  | April 2018–May 2019                        | Pulses to billabongs                           | NBAN (Barkindji, Ngemba, Euahlayi, Murrawarri, Ngiyampaa) | <b>No involvement</b>   |
| Baaka–Barwon–Darling                | Barwon–Darling, Border Rivers, Gwydir | Northern connectivity event (river channel) | April–July 2018                            | 23 GL  | NBAN (Barkindji, Ngemba, Euahlayi, Murrawarri, Ngiyampaa) | <b>No involvement</b>   |
| Baaka–Barwon–Darling                | Barwon–Darling, Border Rivers, Gwydir | Northern fish-flow event (river channel)    | June–September 2019                        | 27–36 GL                                       | NBAN (Barkindji, Ngemba, Euahlayi, Murrawarri, Ngiyampaa) | <b>Community ‘drop-in’ sessions</b>   |
| Baaka–Barwon–Darling                | Barwon–Darling, Border Rivers, Gwydir | Northern waterhole top-up (river channel)   | January–February 2021                      | 8 GL   | NBAN (Barkindji, Ngemba, Euahlayi, Murrawarri, Ngiyampaa) | <b>No involvement</b>   |
| Teringie Wetlands                   | Lower Murray                          | Site specific (wetland–floodplain)          | March and April 2019                       | 500 ML   | Ngarrindjeri  | <u>Ngarrindjeri released the water through their partnership with CEWO</u>  |
| Sugar Shack Wetlands                | Lower Murray                          | Site specific (billabong)                   | 2015–16                                    | 59 ML  | Ngarrindjeri  | <u>Traditional Owners involved directly with watering</u>   |
| Fletchers Creek                     | Lower Darling                         | Site specific (5-km area, river channel)    | December 2013, May 2016 and April–May 2019 | 360 ML in 2013, 200 ML in 2016, 170 ML in 2019 | Barkindji   | <u>Barkindji Maraura Elders Environment Team have built partnership with environmental water holders. Participation in monitoring of outcomes</u> |
| Gayini Nimmie-Caira                 | Murrumbidgee                          | Site specific (wetland–floodplain)          | Since 2019                                 | ~257 GL  | Nari Nari   | <u>Nari Nari owns the property. Water is managed (but not owned) by Nari Nari</u>   |
| Toogimbie IPA                       | Murrumbidgee                          | Site specific (wetland–floodplain)          | Since 2016                                 | >4331 ML                                       | Nari Nari   | <u>Water is managed by Nari Nari in partnership with CEWO &amp; DPIE</u>  |
| Booberoi Creek                      | Lachlan                               | ‘Fresh’ connectivity events (river channel) | December 2018 and February 2019            | 300 ML in December, 304 ML in February         | Ngiyampaa   | Participation in monitoring of watering outcomes  |
| Ranch Billabong                     | Wimmera                               | Site specific (billabong)                   | December 2018 and March 2019               | 7 ML + 6 ML                                    | Wotjobaluk peoples (with Barengi Gadjin Land Council)     | <u>Partnership with water managers to deliver environmental water</u><br><u>Participation in monitoring of watering outcomes</u>                  |

(Continued on next page)

**Table 1.** (Continued).

| Environmental watering site | Catchment    | Type                               | When watered  | Volume | Indigenous group engaged | Description of Indigenous engagement                   |
|-----------------------------|--------------|------------------------------------|---------------|--------|--------------------------|--|
| Margooya Lagoon wetland     | Lower Murray | Site specific (wetland–floodplain) | November 2020 | 15 ML  | Tati Tati Kaiejin        | <b>No opportunity to discuss watering requirements</b> |

Sources: Jackson and Nias (2019); Murray–Darling Basin Authority (2020c, 2021b); Department of Agriculture Water and the Environment (2021); Tati Tati Kaiejin (2021); Woods *et al.* (2021).

For the Description of Indigenous engagement column: bold indicates little to no Indigenous involvement in environmental watering outcomes; italic indicates Indigenous engagement in the monitoring of environmental or cultural outcomes; underline indicates partnership between Indigenous groups and managers to plan events and monitor outcomes.

There is an increasing risk that wetlands will continue to receive less water than they need because of the pressures on water resources as a result of global warming, irrigation diversions and the lack of action to manage constraints to improve the delivery of environmental water (Kahan *et al.* 2021). In the future, constraints and other pressures indicate that fewer wetlands will receive overbank flows and floods of the magnitude, extent and duration required to meet their water requirements. Environmental watering on the floodplain may become increasingly restricted to small wetlands where water can be delivered by pumps or modifications to the floodplain by installing channels, levee banks and weirs. The question for Indigenous peoples is whether cultural and socio-economic values can be adequately maintained under a regime of environmental watering that may increasingly focus on small areas of wetlands (e.g. billabong or oxbow lake systems and not broader floodplain forest ecosystems).

Relationships between Indigenous people and The Nature Conservancy and the Nature Foundation have been important for building partnerships with CEWO. Such partnerships require resources, skills and knowledge of administrative procedures (Robinson *et al.* 2015; Jackson and Nias 2019). Our results have confirmed the findings of Jackson and Nias (2019), namely that partnerships and more inclusive environmental watering outcomes are more likely to occur when Indigenous nations have secure land title. For example, Gayini and the Toogimbie Indigenous Protected Area (IPA) are owned and managed by the Nari Nari Tribal Council. Although not directly owned, Fletchers Creek is under the management of The Barkindji Maraura Elders Environment Team (BMEET). Therefore, the assessment of engagement levels presented above can be used by water managers to identify groups where more equitable and effective management arrangements are necessary, especially in the northern Basin and where Indigenous authority is not legally recognised by the Commonwealth, basin states and territory governments (see Fig. 1).

We were able to map only Indigenous organisations with publicly available boundary shapefiles. Only a small proportion of the Basin is subject to active Native Title determinations, so our results cannot conclude whether Native Title

enhances a group's influence over environmental watering decisions. Nevertheless, increasing Indigenous control of land and water is likely to lead to more effective partnerships and outcomes (Jackson and Nias 2019).

### Policy pathways

CEWO has recently developed partnerships with Indigenous organisations to provide water to important cultural sites (Jackson and Nias 2019) and has committed to building relationships with Indigenous groups to inform water planning and monitor outcomes (Department of Agriculture Water and the Environment 2021). The MDBA also calls for 'culturally appropriate governance structures [and] genuine co-design of programs' (Murray–Darling Basin Authority 2020b). Although there is strong rhetoric about the need to improve Indigenous engagement, future iterations of the Basin Plan should also formally empower Indigenous people to care for Country in the Basin. In consultations with the MDBA, Indigenous participants 'stressed the importance of empowering First Nations to reactivate their rights as stewards and guardians of waterways' (Murray–Darling Basin Authority 2020b). Below, we present and discuss three options for more equitably redistributing decision-making power over watering decisions.

### Cultural water entitlements

Many Indigenous groups and representative organisations advocate for cultural flows (Marshall 2017; Mooney and Cullen 2019; Moggridge and Thompson 2021), which would provide some level of control over watering decisions. All nations in the Basin deserve cultural flows returned to them, and, to this, water must not be conditional on formal recognition of rights through Native Title. Nonetheless, the spatial data we provide could be used to support Indigenous nations that currently have not had watering on their Country to call for increased funding for cultural water entitlements.

Although reallocating water from current agricultural users is contentious, there is support for providing more funding to cultural water acquisition for Indigenous groups (Jackson *et al.* 2019). Greater ownership of water entitlements is also a target in the National Agreement on Closing the Gap to address

Indigenous disadvantage (Australian Government 2021). As mentioned above, an initial AU\$40 million was allocated by the Federal Government to acquire water for Indigenous peoples in the Basin (Long 2018). In 2020, the Victorian government began formally handing back cultural water to Aboriginal Corporations and is investing in increasing the amount of water that Indigenous groups have ownership over (O'Donnell *et al.* 2021). However, Indigenous organisations in the Basin currently control a small and decreasing volume of cultural water (Hartwig *et al.* 2020, 2021). Therefore, there is scope for these efforts to expand.

### More equitable partnerships

Partnerships between Indigenous groups and water managers have provided cultural and environmental co-benefits in several cases. The MDBA aims to involve Indigenous people to ensure cultural co-benefits from environmental watering (Murray–Darling Basin Authority 2020b). However, existing relationships with water managers have been important for building stronger partnerships in the past. Such arrangements tend to require long-term funding for Indigenous partner organisations to build capacity (Jackson and Nias 2019). Indigenous groups with fewer resources and capacity need support to realise benefits from partnerships. Therefore, water managers will need to invest in building relationships with Indigenous groups to build stronger partnerships. This would align with the MDBA and CEWO's goal of improving engagement processes with Indigenous groups (Murray–Darling Basin Authority 2020a, p.125).

### A separate environmental-flow category, with the objective of caring for Country

Another option is for governments to assign some environmental water to Indigenous organisations to manage in a similar manner as they have for environmental organisations. This would allow Indigenous nations to care for Country in accord with cultural practices. In the context of diminishing water availability, the merits of further dividing the already inadequate environmental water allocation need to be considered as opposed to acquiring more water for cultural and environmental purposes. Further, in the case of Commonwealth-owned environmental water, this would require an amendment to the *Water Act* to add cultural practices as a priority.

## Conclusions

We identified major variation in the distribution of environmental water used on Country within the borders of Indigenous organisations in the Murray–Darling Basin. Therefore, water managers should work with Indigenous stakeholders to determine the extent of spatial inequities in watering and how they may best be addressed. The 2024

review of the *Water Act* and the review of the Basin Plan by 2026 provide opportunities to address inequities. It is evident that environmental flows are a cost-effective way of restoring the environment and meeting the conservation objectives of water managers in the Basin (Grafton *et al.* 2016). Additionally, the existence of a large environmental water reserve could empower Indigenous nations to restore the environments within their traditional estates, and rebuild socio-ecological relationships for future generations (Jackson and Nias 2019). However, this requires investment and policy change by one or all the avenues outlined above.

In the absence of legislative change, water managers could use the data from this study to identify areas where further engagement with First Nations Australians could meet their environmental needs and increase cultural co-benefits. Indigenous organisations could use these findings to call for inequalities in water holdings to be addressed, as proposed in the National Agreement on Closing the Gap.

## Supplementary material

Supplementary material is available [online](#).

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