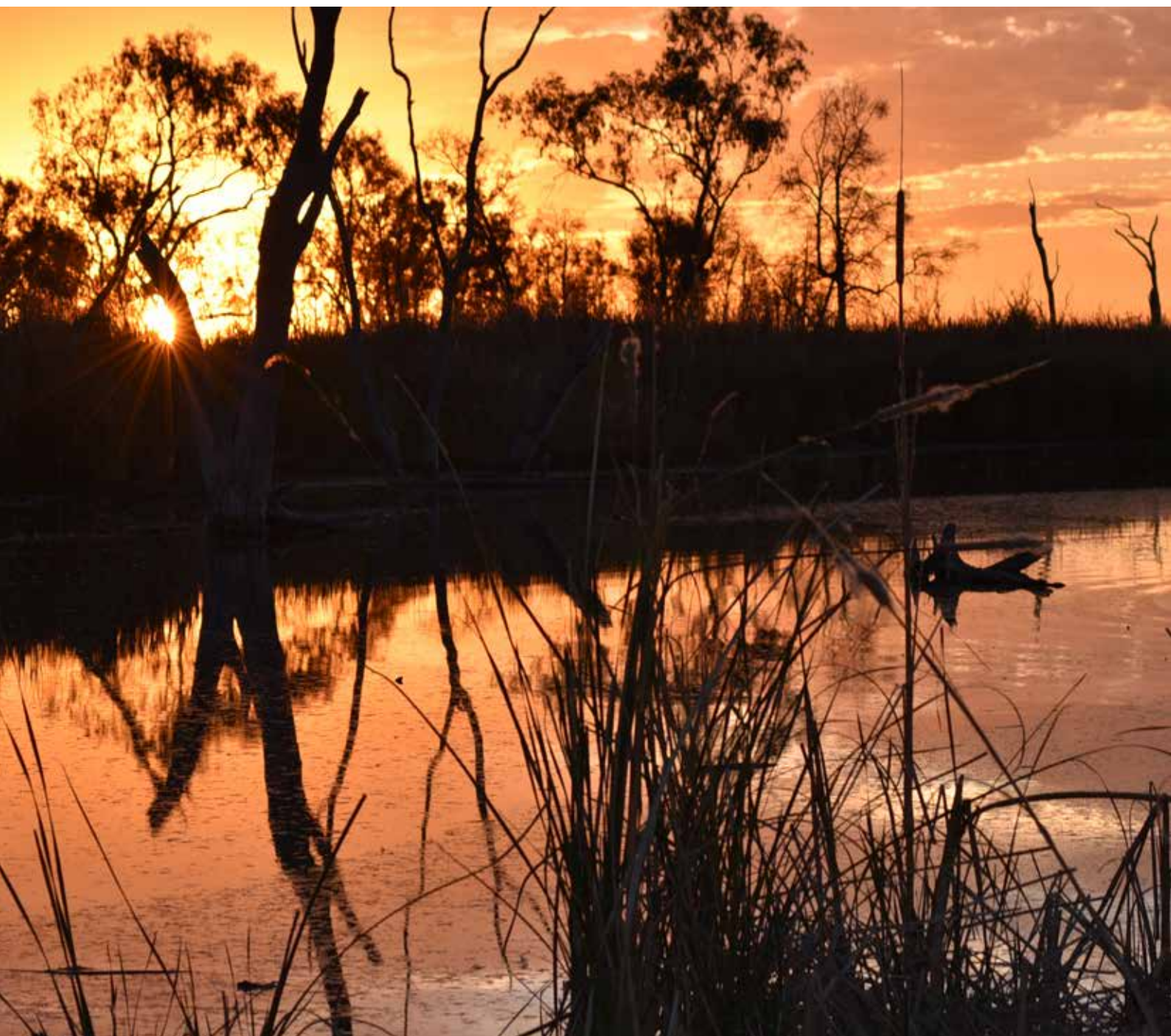




Office of  
Environment  
& Heritage

Environmental Water Use in New South Wales

# Outcomes 2015–16



Front cover: Sunset at Waterbird Lagoon – Gwydir State Conservation Area, May 2016. Daryl Albertson, OEH

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# Foreword

The commencement of the 2015–16 water year coincided with a strengthening El Niño and a continuation of the relatively dry conditions and below average rainfall experienced across the Murray-Darling Basin since 2013–14. However, the water year concluded with a weakening of the El Niño conditions and development of a negative Indian Ocean Dipole resulting in above average rainfall across the Murray-Darling Basin.

During 2015–16, the NSW Office of Environment and Heritage (OEH) delivered 553,370 megalitres of environmental water across the NSW portion of the Murray-Darling Basin to protect and enhance the ecological health of river and floodplain ecosystems. This included the delivery of more than 298,000 megalitres of Commonwealth environmental water in partnership with the Commonwealth Environmental Water Office (CEWO).

Environmental water delivery was primarily focused on maintaining refuge habitat and ecosystem function in core areas, including allowing for periods of wetland drying. Of note were deliveries of environmental water to priority reaches of the Gwydir River during periods of minimal flow, to protect large refuge pools and maintain native fish populations. Post flow monitoring showed an increase in the relative abundance of native fish species.

A delivery of environmental water over a period of two months to the Millewa forest Ramsar wetland on the Murray River resulted in an explosion of insects that provided food for a range of higher order predators including birds, small mammals, reptiles, fish and frogs. Species observed included the endangered Australasian bittern, with its eerie booming call. Large numbers of other nesting birds were also identified, including the white bellied sea-eagle and the internationally protected eastern great egret.

In 2015, OEH took part in the Regional Wellbeing Survey by sponsoring a series of questions relating to water for the environment. Early results from the survey show that NSW communities *outside* of the water industry have very little understanding of the concept of ‘environmental water’. Despite this lack of awareness, these communities show moderately strong support for environmental water when there are linkages to improved outcomes for fish, birds and native plants.

The 2015–16 water year also saw work to develop Long Term Water Plans (LTWPs) move ahead strongly. These plans will describe the outcomes we are targeting with environmental water management and the watering requirements of key environmental assets, including wetlands, fish, birds and other dependent biota. Nine LTWPs are being developed in consultation with environmental water advisory groups, water managers, government agencies and scientists. These plans will guide environmental water use within the NSW section of the Murray-Darling Basin over the next 20 years.

**Michael Wright**  
*Acting Chief Executive*  
*Office of Environment and Heritage*



Murrumbidgee Environmental Water Advisory Group field trip to Hobblers Lagoon. Photo: Peter Morton, landholder

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# Water for the environment

The NSW Office of Environment and Heritage (OEH) manages environmental water on behalf of the NSW Government. OEH considers collaborative partnerships with regional communities and other government agencies to be an integral part of managing environmental water to protect and improve the environmental values of rivers, floodplains and wetlands. OEH also acknowledges the economic importance of floodplain agriculture and works with its partners to optimise the benefits of delivering environmental water to our floodplains for targeted environmental outcomes.

OEH is responsible for ensuring that environmental water is managed in accordance with relevant statutory plans, including water sharing plans established under the [Water Management Act 2000](#) and the [Basin Plan](#) established under the Commonwealth *Water Act 2007*. An important principle is to manage environmental water in a way that is consistent with natural, seasonal flow patterns that occurred before river regulation.

This report provides an overview of the environmental watering actions undertaken by OEH during 2015–16 and the ecological outcomes achieved for New South Wales (NSW). This document reports on water that is:

- held by NSW under water access licences
- held in prescribed allocations under water sharing plans
- provided by the Commonwealth Environmental Water Holder
- provided through such programs as [The Living Murray](#).

It does not report on environmental water that is released in accordance with the rules in water sharing plans managed by the NSW [Department of Primary Industries – Water](#).

Find out more about [environmental water management planning](#).

## Environmental water managed by OEH

‘Adaptive’ environmental water is committed from a water access licence for a specified environmental purpose, with the support of a statutory water use plan. Water access licences have been purchased from willing sellers or have been created by recovering water savings from infrastructure projects.

Allocations are received by adaptive environmental water licensees on the same terms as those that apply to other licensees of the same category. For example, if a general security licence is purchased and committed as adaptive environmental water, the same allocations apply as for other general security licences for the same water source.



Mallowa wetlands, November 2015 delivery of Commonwealth environmental water. Photo: Jane Humphries, OEH

## Water for the environment (continued)

Each regulated valley in NSW has an environmental water advisory group (EWAG) consisting of members with a range of expertise and experience. EWAGs are the primary means for community input into decisions regarding OEH's management of environmental water and typically include water managers, other water users, landholders, environmental interest groups, Aboriginal groups, independent scientists, and a variety of government agencies.

OEH produces annual environmental watering priority statements on the basis of advice from EWAGs. These statements prioritise environmental water use in the Murray-Darling Basin over the coming year, subject to climatic factors and water availability and in accordance with the Basin Plan. The priority statements are consistent with the more detailed annual environmental watering plans developed for each valley. Priorities are re-assessed throughout the water year to account for variables such as climate and water allocations to ensure the desired environmental outcomes are achieved.

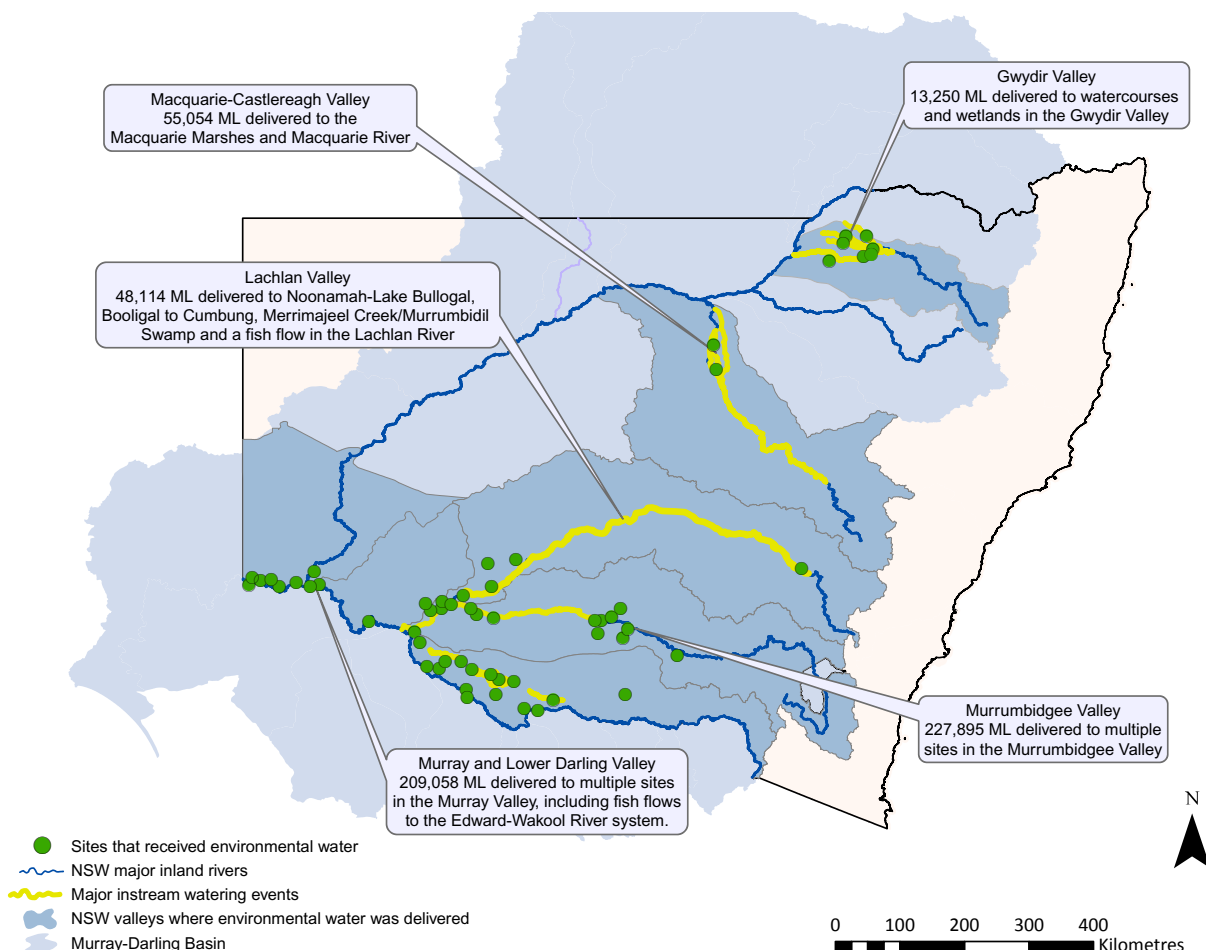
OEH is also developing Long Term Watering Plans (LTWPs) for each of the nine NSW surface water resource areas. These plans will contain clear objectives and targets for our rivers and wetlands, including for

fish, plants and waterbirds, and their water requirements, informed by local, traditional and scientific knowledge. Planning will be over a longer timeframe (out to 20 years) to help build the strategic context for our actions. The first two of these are being developed in the Gwydir and Macquarie-Castlereagh catchments with work well underway. All LTWPs will be published by June 2019.

At the same time as we are developing LTWPs, Department of Primary Industries (DPI) Water is developing water resource plans, outlining the rules of access for all water users and including planned environmental water provisions. Both projects are part of the implementation of the Basin Plan. They will be developed together to achieve a balance of outcomes between the environment and other water users, consistent with the agreed sustainable diversion limits.

### NSW environmental watering event sites 2015-16

The map below illustrates the locations of the environmental watering events and the major instream flows for 2015-16 across the Murray-Darling Basin.



NSW environmental watering event locations for 2015-16.

# Valley report: Gwydir water resource

The Gwydir catchment covers 26,596 square kilometres. The smaller eastern upland creeks mainly flow into the Gwydir River upstream of Copeton Dam. Downstream on the western floodplain the Gwydir River splits into its main distributaries, the Mehi River (south), Carole Creek (north) and Lower Gwydir (or Big Leather) and Gingham (central) watercourses. The Gingham and Lower Gwydir watercourses include four areas listed under the Convention on Wetlands of International Importance (the Ramsar Convention). Three sites are on privately owned land within the Gingham system and one is in the Gwydir Wetlands State Conservation Area within the Lower Gwydir.

Gwydir wetlands support floodplain vegetation including river red gum, coolibah and belah woodlands, and aquatic species such as spike rush and water couch. The Lower Gwydir watercourse also supports the state's largest stand of marsh club rush, a critically endangered ecological community listed in the NSW Threatened Species Conservation Act 1995.

Many Gwydir wetlands provide feeding and breeding habitat for many waterbirds, including brolgas, black-necked storks, ibises, spoonbills, and migratory species listed under international agreements, such as painted snipes, terns and sandpipers. The importance of the Gwydir wetlands for waterbirds is widely recognised with 76 species recorded historically (50 breeding species). Large-scale colonial waterbird breeding events with tens to hundreds of thousands of birds can occur during periods of large-scale floodplain flooding.

Wetlands associated with Mallowa Creek have historically supported significant bird breeding events. Improved environmental water availability since 2012 now allows the supply of environmental water to this area.

The Mehi River and Carole Creek are regulated streams where environmental water is delivered specifically to benefit native fish and the aquatic ecological community. Under the Fisheries Management Act 1994 many native fish found in the Gwydir system are listed as threatened or vulnerable. The aquatic community found in the western catchment has been greatly modified since European settlement through river regulation, the introduction of non-native species and changes in land use. These pressures have resulted in the listing of this community as an endangered ecological community.

The Kamilaroi (Gomeri) people are the traditional owners of the Gwydir catchment, with more than 160 cultural heritage sites recorded in and around the wetlands. The area's wetlands, floodplains and rivers are considered special places to the local Aboriginal people, who place great importance on maintaining their ecological health.

The Gwydir EWAG provides advice, ensuring that community, industry, scientific and governmental expertise guides the effective management of environmental water in the Gwydir Valley.



Mallowa Creek watercourse, September 2015. Photo: Daryl Albertson, OEH

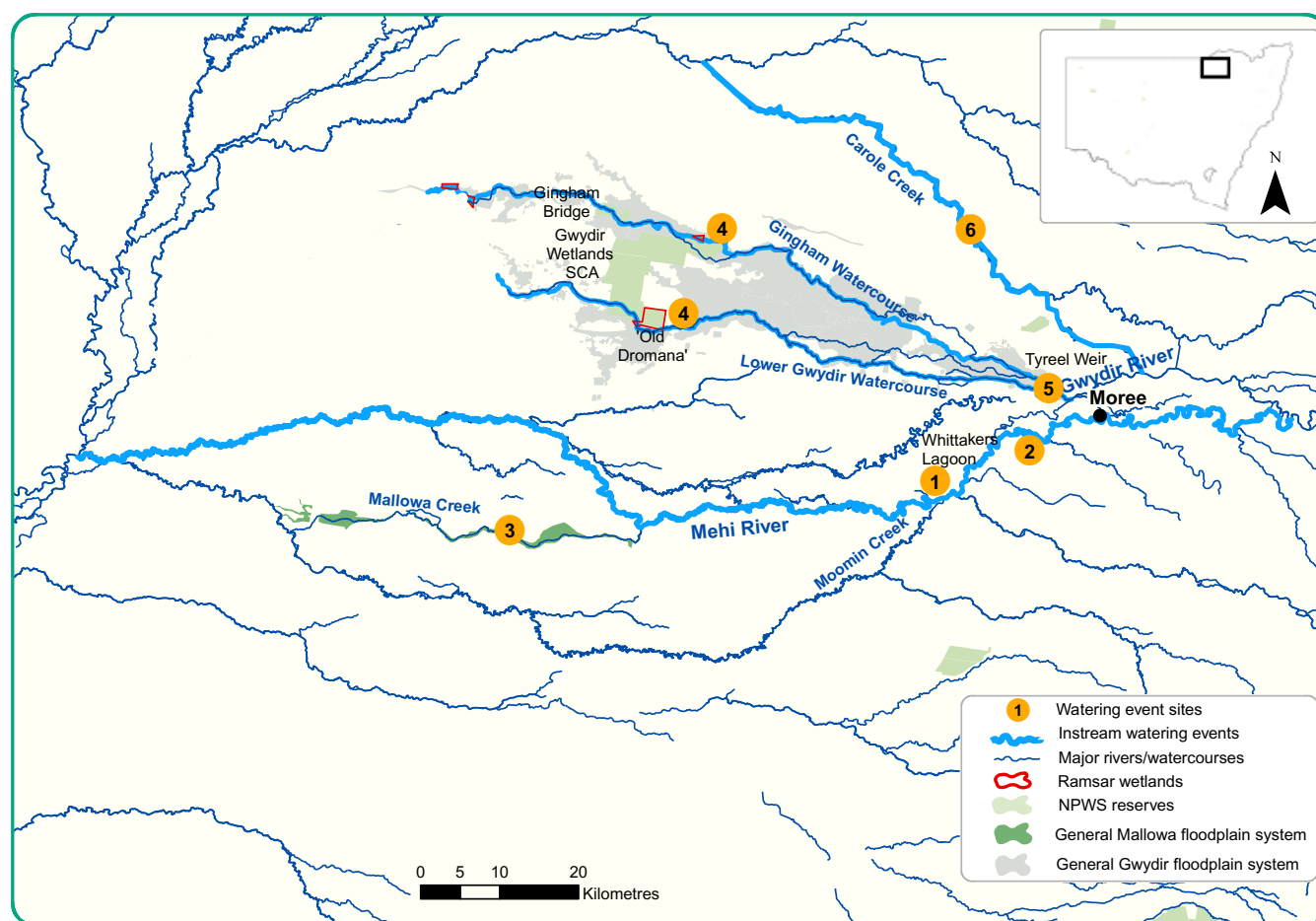


### Gwydir Water Resource Plan area environmental watering targets for 2015–16

The Gwydir Water Resource Plan area (Figure 1) as defined in the Basin Plan, includes unregulated and regulated rivers and creeks. Environmental watering targets for 2015–16 were located in the western catchment and included targeted reaches in the Gwydir and Mehi Rivers, Carole Creek, and the watercourse

and wetland areas of the Gingham, Lower Gwydir and Mallowa. Figure 1 shows the environmental watering targets for the Gwydir Water Resource Plan area in 2015–16.

**Figure 1** Environmental watering events in the Gwydir Water Resource Plan area, 2015–16. Event numbers correspond to those in Table 1.





University of New England student Chris showing local children a turtle at Gingham Waterhole Munwonga, being part of the Gwydir Wetlands State Conservation Area, April 2016. Photo: Jane Humphries, OEH

## Catchment condition in 2015–16

Mostly low natural flows interspersed with drying phases that have been experienced since 2013–14, continued in 2015–16. Environmental assets in the eastern and central parts of Gingham and Lower Gwydir were maintained by these natural low flows, which were supplemented by small environmental water deliveries. Inflows to Mallowa were small and made up almost entirely from environmental water, resulting in only the eastern areas being inundated. Environmental assets in the western areas of these watercourses experienced a continued drying phase and are in declining condition. The upper sections of the main rivers and creeks remain in moderate condition, while downstream western sections are in a drying phase.

## Watering aims

With moderate resource availability anticipated, and following moderate environmental watering in 2014–15, environmental watering in 2015–16 aimed to be reactive to natural triggers and to acknowledge the importance of natural drying phases in rivers and wetlands.

Environmental watering aims were to:

- ensure wetlands connected to the river receive water when natural flow triggers occur
- deliver low flows to protect and maintain core refuge habitat within river pools and connect pools in target reaches after extended periods of low or no flow.

## Valley report: Gwydir water resource (continued)

### Water delivery

A total of 13,250 megalitres of managed environmental water was delivered to river and wetland targets across the Gwydir Valley (Table 1). The delivery of water for wetlands was in response to natural flow triggers. Wetland areas in the eastern and central portion of the Gingham and Lower Gwydir received small volumes of environmental water along with moderate natural inflows protected under the water sharing plan. Similarly, small volumes of environmental water were

delivered to the Mallowa Creek watercourse in response to natural flow triggers, inundating the eastern area of the watercourse.

Following an extended drying period, targeted reaches of the Gwydir and Mehi rivers and Carole Creek received small environmental water flows to protect key refuge river pools during April and May 2016 (Table 1).

**Table 1** Environmental water delivered in the Gwydir Valley during the 2015–16 water year

Location	Start date	Finish date	Megalitres of water delivered			
			NSW	CEW	EWA	Total
1 Whitakers Lagoon	28 Aug 2015	6 Sep 2015	100	–	–	100
2 Mehi River instream Pools protection flow April 2016	7 Nov 2015	11 Nov 2015	–	964*	–	3,164
	13 Apr 2016	10 May 2016	–	2,200	–	
3 Mallowa watercourse and wetlands	9 Nov 2015	22 Nov 2015	–	336*	–	3,486
	23 Dec 2015	9 Jan 2016	–	1,800*	–	
	24 Jan 2016	5 Feb 2016	–	1,350*	–	
4 Gingham and Lower Gwydir wetlands (50:50) <i>*(A portion of the Gwydir River instream pools delivery Event 5, was delivered to the Gingham wetlands)</i>	10 Jan 2016	20 Jan 2016	–	750	750	2,700
	4 Feb 2016	4 Feb 2016	–	600	600	
	5 May 2016	3 Jun 2016	–	–	(1,185) <sup>#</sup>	
5 Gwydir River instream (i.e. pools protection flow)	13 Apr 2016	21 May 2016		–	3,400 (includes #1,185 above)	3,400
6 Carole Creek instream (i.e. pools protection flow)	22 Apr 2016	15 May 2016	–	400	–	400
<b>Total</b>			<b>100</b>	<b>8,400</b>	<b>4,750</b>	<b>13,250</b>

Note: Location numbers in the table relate to watering events marked on the map in Figure 1.

NSW = NSW licensed environmental water

CEW = Commonwealth licensed environmental water

EWA = Environmental water allowance accrued under the *Water Sharing Plan for the Gwydir Regulated River Water Source 2002*.

\* These events were managed by the Commonwealth Environmental Water Office (CEWO) with support from the regional OEH office and delivered through CEW licences.



## Ecological outcomes

The eastern and central Gingham, Lower Gwydir and eastern Mallowa sites that received environmental water in 2015–16 are in good to intermediate condition, with good floristic structure and groundcover and a low percentage of exotics or terrestrial species. Woodland and forest sites had an intermediate canopy cover and good understorey condition.

Sites in the western areas of all these systems that were not inundated are in poorer condition, with a lower level of groundcover and moderate levels of non-native and/or terrestrial native cover.

Across the Gingham, Lower Gwydir, Mallowa and Mehi sites, nine species of frogs including large numbers of both barking and spotted marsh frogs, along with recently laid egg-masses, were recorded in Spring 2015 surveys. Lower species numbers were identified in November 2015 as the water had receded; however, total frog abundance was higher, probably due to the warmer temperatures and the successful recruitment of marsh frogs.

Despite a low total area of environmental watering in 2015–16, ground surveys highlighted how the Gwydir wetlands can support diverse woodland and waterbird assemblages with the spring survey recording 135 bird species. Forty-three of these were waterbird species and included four listed as vulnerable under the NSW Threatened Species Conservation Act 1995 and six species listed on international migratory bird agreements. Overall waterbird abundance was low compared to wetter years (i.e. 2011 and 2012) and breeding activity was low with no colonial waterbird breeding activity recorded.

Low flow environmental deliveries into priority river reaches protected the large refuge pools from drying and maintained native fish communities, with minimal losses resulting from the drying of smaller, shallower pools. Long Term Intervention Monitoring (LTIM) surveys recorded several species of native fish in the Gwydir, including western carp gudgeon, spangled perch, bony bream, eel-tailed catfish, fly-speckled hardyhead, and olive perchlet. It could be expected that native species diversity would have increased due to environmental water providing a fresh flush of water and stimulating fish breeding.



Latham's snipe in central Gingham watercourse.  
Photo: Curtis Hayne, OEH volunteer

## Water plans

The following plans guided how environmental water was allocated and managed in the Gwydir Valley during 2015–16:

- *Water Sharing Plan for the Gwydir Regulated River Water Source 2002* (Regulation under the *Water Management Act 2000*)
- *Adaptive Environmental Water Use Plan for the Gwydir Water Management Area* (NSW Commissioner for Water 2012)
- *Environmental Watering Plan for the Gwydir Valley 2015–16* (OEH 2015)
- *Gwydir Wetlands Adaptive Environmental Management Plan* (NSW Department of Environment, Climate Change and Water 2011)
- *Commonwealth Environmental Water Use Options 2015–16: Gwydir River Valley* (CEWO 2015)
- *Finding Common Ground: floodplain farming and wetland conservation 'A Planning Strategy to Support Decision Making for Local Environmental Water in the Gwydir Wetland 2013–17'* (OEH 2014).

# Lifeline thrown for native fish in the Gwydir river system

During a long hot summer, the Gwydir river system, downstream of the Tareelaro Weir to the Gwydir and Lower Gwydir rivers, Gingham watercourse, Mehi River and Carole Creek, reverted to a series of pools. Native fish had sought refuge in the remaining pools but were at risk of becoming stressed due to receding water levels and declining water quality.

A replenishment flow for riparian users was scheduled to occur 50 days after the river ceased to flow; however, environmental water managers were concerned that a large pulse to 'restart' the river in 2009 had dispersed stagnant deoxygenated water, resulting in large-scale native fish deaths. To reduce the chance of those conditions being repeated, OEH proposed a small flow to reconnect pools within the river before the larger replenishment flow occurred.

In April 2016, in consultation with the Gwydir EWAG, OEH began delivering water into the Gwydir and Mehi rivers and Carole Creek. The aim of this was to provide a small and gradual rise in water levels and flow ahead of the larger replenishment flow scheduled by WaterNSW to occur in late May.

The gradual reconnection of river reaches with environmental water supported native fish to migrate away from poor water quality impacts, such as deoxygenation and other high nutrient effects.

In addition to the reconnection of river reaches, the flow supported a slow release of carbon into the rivers, increasing instream productivity. Overall, field observations undertaken prior to, during and after the release indicated that the health of the river and its fish community had been protected by the release.

OEH delivered a total of 6000 megalitres of water from environmental accounts held in Copeton Dam by both the NSW and Australian governments over the course of several weeks through April and May 2016.

The low flow in April 2016 also allowed the subsequent larger replenishment event to travel a greater distance, achieving even better outcomes for fish and the river ecosystem.

Pre-flow monitoring showed that in the smaller, shallower pools both native and exotic fish perished, as these pools dried quickly. Many of these fish were smaller in size than those more mature seeking refuge in the deeper pools. As the connecting flow moved downstream there was little to no impact detected in those fish communities seeking refuge in the more permanent pools.



1. Dry section of the Gwydir River, early April 2016.

2. Dead fish in drying shallow pools.

3. Low environmental flows reconnecting pools in the Gwydir River. Photos: Jane Humphries, OEH

# Valley report: Macquarie-Castlereagh water resource

The Macquarie River covers 75,000 square kilometres and extends north-west from the Great Dividing Range to the Darling Riverine Plains. Major tributaries include the Cudgegong River, Talbragar River and Bell River. The Macquarie Marshes are the catchment's largest wetland system and the main target of environmental water flows. The Marshes include a network of smaller wetlands and streams which support areas of semi-permanent vegetation such as reed beds and water couch, as well as the largest river red gum woodlands in the northern Murray-Darling Basin.

The Macquarie River and Macquarie Marshes, parts of which are Ramsar-listed, provide important support for business and social networks in the local community, with approximately 90% of the Marshes supporting primary production. The river and associated wetlands are also intrinsic to the culture and wellbeing of traditional Aboriginal communities. The Wailwan people of the mid and lower Macquarie River have had more than 500 Aboriginal cultural heritage sites recorded in the wider marshes area, including carved trees, ceremonial and burial sites, oven mounds and stone artefacts.

The Macquarie Cudgegong EWAG is chaired by NSW Local Land Services (LLS), and includes representatives from communities, environmental interests, water users, the irrigation industry and Commonwealth and NSW government agencies. The group meets regularly and provides advice on environmental water priorities and management within the catchment.

## Macquarie-Castlereagh Water Resource Plan area environmental watering targets for 2015-16

The Macquarie-Castlereagh Water Resource Plan area is defined in the Basin Plan and includes the Macquarie, Castlereagh and Bogan River catchments (Figure 2).

Environmental watering actions were planned for the following areas in the 2015-16 water year:

- two of the three 'water management areas' within the Marshes (northern and southern)
- the mid-Macquarie River channel and riparian areas (Burrendong to Marebone Weir)
- the lower Macquarie River channel and riparian areas (Marshes to the Barwon River).

These environmental watering targets are illustrated in Figure 2 and are prioritised because of their high biodiversity and social and cultural values.

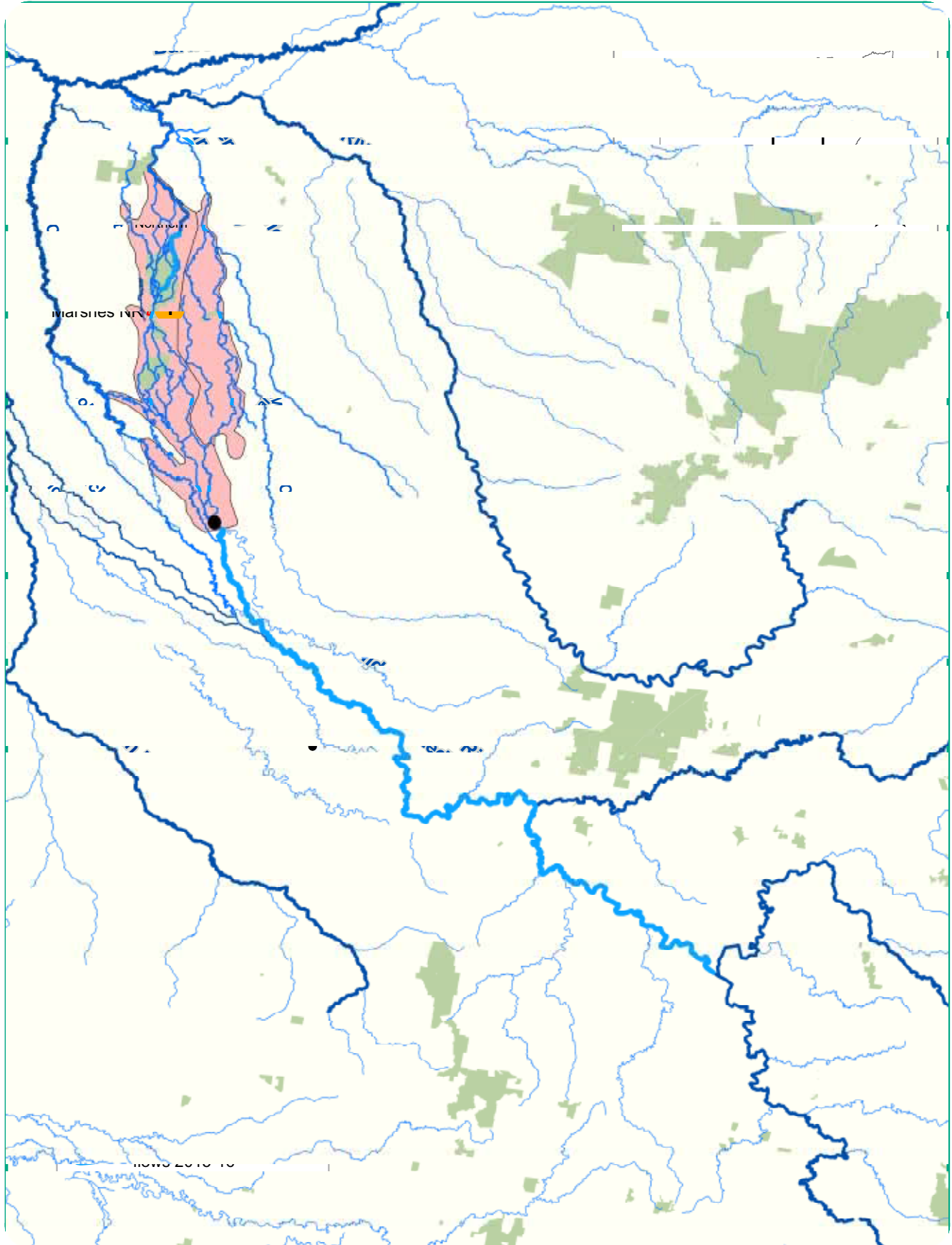


Monkeygar Swamp, Macquarie Marshes, Spring 2015. Photo: Tim Hosking, OEH



## Valley report: Macquarie-Castlereagh water resource (continued)

**Figure 2** Environmental watering events in the Macquarie-Castlereagh Water Resource Plan area, 2015-16. Event numbers correspond to those in Table 2.





Tadpole surveys with local landholders, Macquarie Marshes, Spring 2015. Photo: Joanne Ocock, OEH

## Catchment condition in 2015–16

Rainfall in the catchment had been well below average since July 2012, with Burrendong Dam inflows below the 80th percentile of historic records. Rainfall received during July 2015 provided a tributary flow into the Marshes which primed the system for the managed delivery of environmental water over winter-spring 2015.

In areas not inundated between 2013 and 2016, initial field observations indicate that terrestrial plants now make up a substantial percentage of groundcover. Tree condition in most areas was found to be generally good but declining in some areas, such as the northern Marshes woodlands. The northern Marshes was subject to a large-scale fire in March 2016 that burnt most of the reed bed area.

## Watering aims

Under the dry resource availability scenario, the primary aims of environmental watering in 2015–16 were to:

- enhance tributary flows to the northern Macquarie Marshes to maintain semi-permanent wetland vegetation, replenish groundwater reserves and support habitat for waterbird foraging and native fish
- retain some water in accounts for 2016–17 (i.e. carryover) to sustain refuge habitat for native fish in the Macquarie River channel between Warren and Oxley should dry conditions continue.



## Valley report: Macquarie-Castlereagh water resource (continued)

### Water delivery

A total of 52,554 megalitres of environmental water was delivered to wetland and instream targets between August and October 2015 (Table 2). A further 2500 megalitres was delivered during a period of supplementary access in June 2016.

**Table 2** Environmental water delivered in the Macquarie Valley during the 2015–16 water year

Location	Start date	Finish date	Megalitres of water delivered			
			NSW	CEW	EWA	Total
1 Macquarie Marshes (north and south) and mid-Macquarie River	6 Aug 2015 at Marebone Weir	17 Oct 2015 at Marebone Weir	4,047	12,114	36,393	52,554
2 Macquarie Marshes (south) and mid-Macquarie River	27 Jun 2016 at Marebone Weir	30 June 2016 at Marebone Weir	375	2,125	–	2,500
<b>Total</b>			<b>4,422</b>	<b>14,239</b>	<b>36,393</b>	<b>55,054</b>

Note: Location numbers in the table relate to watering events marked on the map in Figure 2.

NSW = NSW licensed environmental water (General Security and Supplementary licences)

CEW = Commonwealth licensed environmental water

EWA = Environmental water allowance accrued under the *Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source 2003*.



Magpie geese grazing in a water couch meadow, Macquarie Marshes. Photo: Tim Hosking, OEH



## Ecological outcomes

A planned early season delivery of environmental water to the Macquarie River was delayed by one week to allow a small 'fresh' to prime the river and parts of the Marshes. The aim was to maximise inundation in the northern Marshes sub-system by favouring higher flow rates into Bulgeraga Creek in combination with Macquarie River flows.

Rainfall during the flow event brought new allocations and, after consideration, the EWAG recommended a second pulse to complement the initial flow which was of relatively short duration (27 days). This was achieved approximately 11 days after the first pulse concluded.

A warm and dry October–November 2015 may have reduced the extent of inundation achieved by the second pulse; however, an increased duration of flooding was achieved in many areas. Anecdotal evidence suggests the pulsing of flows was a successful strategy to balance the extent and duration of flooding with the limited volume of available water.

Trees that were inundated by the flow within the northern Marshes river red gum woodlands showed improved condition. Monitoring of floodplain vegetation after the flow demonstrated that the condition of floodplain vegetation in these areas was considered intermediate to good.

Moderate waterbird diversity was observed during the event, with some notable species recorded including Australian painted snipe and Australasian bittern. Only small to moderate numbers of waterbirds were seen, primarily being common duck species such as the grey teal. Very small numbers of migratory shorebirds were recorded. No recorded colonial bird breeding events occurred.

## Water plans

The following plans guided environmental water management in the Macquarie-Castlereagh Water Resource Plan area during 2015–16:

- *Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source 2003* (Regulation under the *Water Management Act 2000*)
- *Adaptive Environmental Water Use Plan for the Central West Water Management Area* (NSW Commissioner for Water 2013)
- *Macquarie-Castlereagh Water Resource Plan Area 'Statement of Annual Environmental Watering Priorities 2015–16'* (OEH 2015)
- *Environmental Watering Plan for the Macquarie-Castlereagh Water Resource Plan Area 2015–16* (OEH 2015)
- *Macquarie Marshes Adaptive Environmental Management Plan* (OEH 2010).

# Valley report: Lachlan water resource

The Lachlan catchment covers an area of 90,000 square kilometres. The Lachlan River, which travels for about 1400 kilometres, originating near Gunning and terminating at the Great Cumbung Swamp in NSW, supports many wetlands of high ecological value. These include the Booligal Wetlands, Great Cumbung Swamp and Lachlan Swamps, all of which are listed in the [Directory of Important Wetlands in Australia](#).

The Booligal Wetlands supports lignum, river red gum, black box and river cooba communities, providing habitat for many colonial waterbirds, including the great egret, glossy ibis and sharp-tailed sandpiper. The Lachlan Swamps provides habitat for many vulnerable bird species, including the brown treecreeper, grey-crowned babbler and magpie goose, as well as the vulnerable Mossgiel daisy and Menindee nightshade. Both of these major wetlands provide breeding grounds for the Australasian bittern, blue-billed duck and freckled duck, which are listed under the NSW [Threatened Species Conservation Act 1995](#). The southern bell frog has also been recently rediscovered in the lower Lachlan following the delivery of environmental flows since 2012. Prior to this it had not been detected for more than 30 years.

The Great Cumbung Swamp acts as a drought refuge, and contains one of the largest areas of common reed and river red gum in NSW. Several waterbirds listed in international bilateral agreements frequent the swamp, including the great egret, glossy ibis, common greenshank, Latham's snipe, white-bellied sea-eagle and sharp-tailed sandpiper.

Since 2006, environmental water has been delivered to the mid-Lachlan anabranches (section of a stream that diverts from the main channel and rejoins downstream) and large wetland complexes in the lower Lachlan. These wetland sites are highly valued by the community, and are vital for maintaining river and floodplain health. The wetlands, rivers and creeks in the Lachlan catchment also have important Aboriginal cultural heritage values. They include significant sites found throughout the catchment, such as scarred trees, earthen mounds and artefacts.



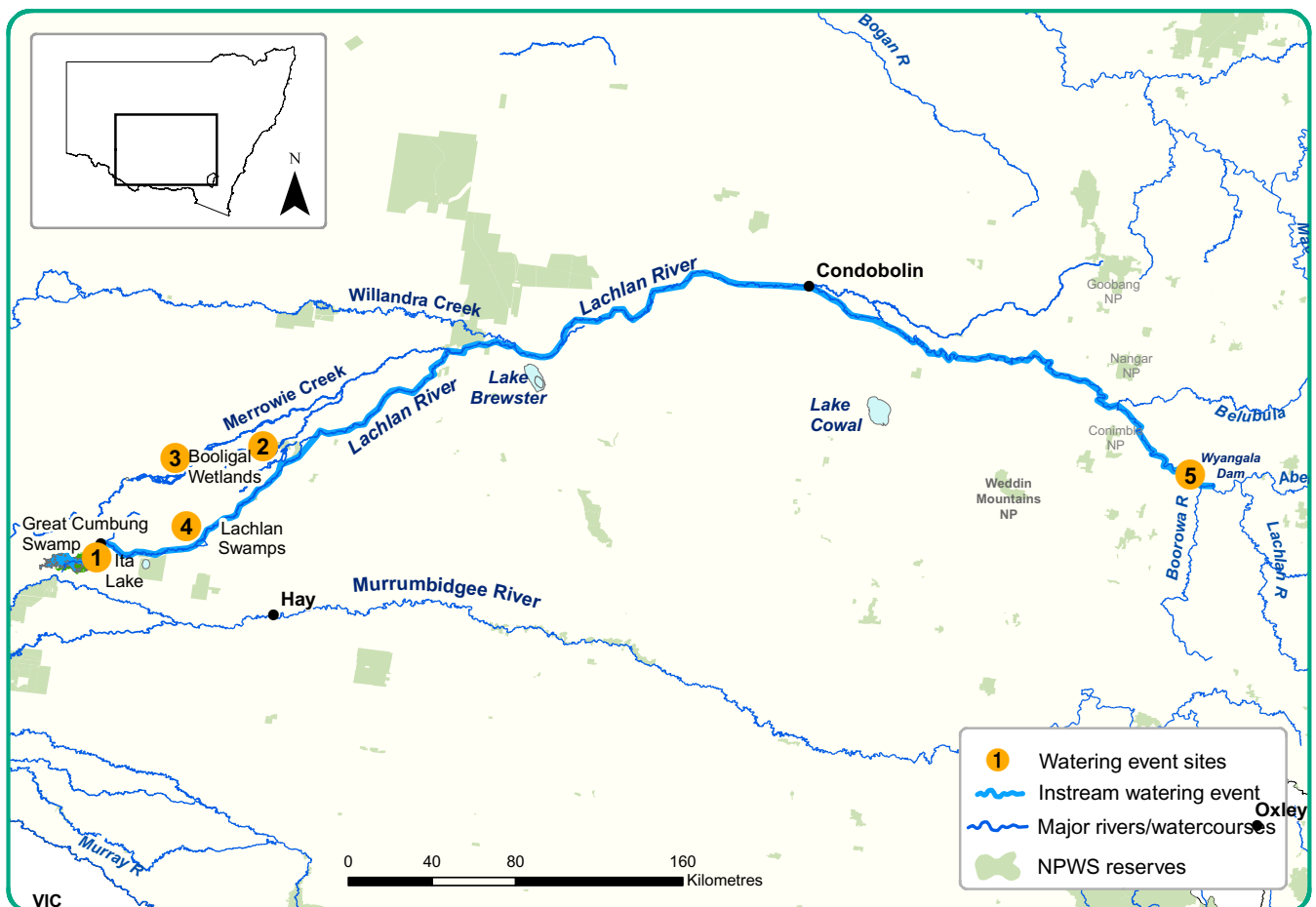
Traditional owner and EWAG member Peter Harris shows local children a photo of himself and others at this site in the early 1960s, Murrin Bridge, April 2016. Photo: Joanne Lenehan, OEH

The Lachlan EWAG is chaired by the Central Tablelands LLS; it consists of community and agency representatives, including Aboriginal traditional owners, local landholders, water user groups and Commonwealth and NSW government agencies with a role in water management. The EWAG meets quarterly to plan annual watering actions and review outcomes of environmental watering. The group had a gathering with Aboriginal community representatives on Murrin Bridge in April 2016, and since then has met regularly with the Lake Cargelligo and Murrin Bridge community to discuss and plan for the use of environmental water to support local cultural values.

## Lachlan Water Resource Plan area environmental watering targets for 2015–16

The Lachlan Water Resource Plan area is defined in the Basin Plan and incorporates all distributaries located in the lower Lachlan. Environmental watering targets for 2015–16 are shown in Figure 3.

**Figure 3** Environmental watering events in the Lachlan Water Resource Plan area, 2015–16. Event numbers correspond to those in Table 3.





### Catchment condition in 2015–16

The Lachlan Water Resource Plan area experienced below average to average rainfall during the 2015–16 water year. The lower Lachlan catchment experienced good rainfall in autumn/early winter, although below average conditions were experienced over most of the year. The upper catchment experienced sufficient inflows in July and August 2015 to provide some allocation to general security licences (reaching 25%) and to trigger a 'translucent' release by Water NSW, in accordance with the Water Sharing Plan for the Lachlan Regulated River Water Source, of 72,000 megalitres from Wyangala Dam in late August 2015. Translucent releases allow a proportion of inflows to the dam to be released to the Lachlan River to mimic natural river flows.

Conditions in the Lachlan wetlands remained variable across the water resource plan area. Although the health of the lower Lachlan floodplain had significantly improved since the end of the Millennium Drought (2010–12), recovering vegetation is now displaying signs of stress.

### Watering aims

Under a dry resource availability scenario, environmental water delivery for 2015–16 aimed to maintain the ecological function and resilience of environmental assets by:

- maintaining critical habitats, including drought refuges, and wetlands in critical phases of recovery
- preventing further decline in stressed wetland vegetation communities, in particular, river red gum, black box and lignum communities
- providing flow variability and longitudinal connectivity within the Lachlan River channel to provide access to habitat and suitable conditions for native fish and frog breeding, recruitment and movement
- extending the duration of naturally occurring freshes or high flows in the mid to lower Lachlan
- maintaining and improving the condition of instream riparian vegetation through in-channel freshes
- improving the complexity and health of priority waterbird habitat to maintain species richness and population recovery.



Paul Packard (OEH) undertaking ecological response monitoring, Moon Moon National Park. Photo: Joanne Lenehan, OEH

## Water delivery

A total of 48,114 megalitres of managed environmental water was delivered to wetland and river targets across the Lachlan catchment (Table 3). Targets included providing fish flows to the Lachlan River below Lake Brewster, providing water to key drought refuge areas in the lower Lachlan, including the Great Cumbung Swamp and Booligal wetlands, and supporting southern bell frog populations at Lake Bullogal in the lower Lachlan (Table 3).

**Table 3** Environmental water delivered in the Lachlan Valley during the 2015–16 water year

Location	Start date	Finish date	Megalitres of water delivered			
			NSW	CEW	EWA	Total
1 Booligal to Cumbung	9 Aug 2015	9 Oct 2015	8,020	24,058	–	32,078
2 Merrimajeel Creek Murrumbidil Swamp	2 Sep 2015	15 Sep 2015	362	1,088	–	1,450
3 Booligal Swamps	18 Oct 2015	11 Nov 2015	499	1,497	–	1,996
4 Noonamah – Lake Bullogal	9 Nov 2015	15 Nov 2015	85	–	–	85
5 Lachlan River – perch fish flow	11 Nov 2015	15 Dec 2015	3,126	9,379	–	12,505
<b>Total</b>			<b>12,092</b>	<b>36,022</b>	<b>–</b>	<b>48,114</b>

Note: Location numbers in the table relate to watering events marked on the map in Figure 3.

NSW = NSW licensed environmental water

CEW = Commonwealth licensed environmental water

EWA = Environmental water allowance accrued under the *Water Sharing Plan for the Lachlan Regulated River Water Source 2003*

## Ecological outcomes

Preliminary results of larval fish, frog and vegetation monitoring conducted by the CEWO under the LTIM project are incorporated in this section of the report, with further details available on the [CEWO LTIM website](#).

Environmental water provided to the Noonamah-Bullogal continues to maintain refuge functions of ground tanks and black box wetlands for the endangered southern bell frog.

A translucent flow event was triggered in the Lachlan River on 29 August 2015 and lasted 15 days in total. Prior to this, NSW and Commonwealth environmental water had been delivered to the lower Lachlan River, targeting fish and inundation of the Great Cumbung Swamp. This event was suspended while translucent flows were in the system, then recommenced to enhance the benefits from the environmental pre-watering and translucent event as well as provide a recession flow to slow the otherwise rapid falls in river heights.

The inundation of more than 9000 hectares of wetland habitat in the Great Cumbung Swamp, to consolidate benefits from the 2013 environmental water delivery, resulted in vigorous growth in the core of the reed

beds, with 23 species of birds and four species of frogs recorded at just one site. Large numbers of pelicans as well as straw-necked ibis, spoonbills and egrets were observed in areas of the Great Cumbung Swamp. Following flows to Moon Moon Swamp, colonial water bird species were recorded as breeding, including the little pied cormorant, little black cormorant and Australasian darter; other notable species were also observed at the site, including the glossy ibis and pink-eared duck. The filling of additional low-lying wetlands and floodplain spread was described by Lachlan EWAG Aboriginal representatives as reminiscent of historical flows, which were key to sustaining Aboriginal cultural and living practices.

Environmental water flows to Murrumbidgil Swamp supported the recovery of river red gum wetlands and waterbird nesting habitat, while also triggering a successful breeding response and recruitment of the spotted marsh frog and the great banjo frog. The small flows delivered to these Booligal wetlands also facilitated breeding of the spotted marsh frog, giant banjo frog, Peron's tree frog and eastern sign-bearing froglet, with calling by these species strongly correlated with wetland inundation.

## Valley report: Lachlan water resource (continued)

In late spring 2015, environmental flows were delivered to approximately 620 kilometres of Lachlan River channel below Lake Brewster to provide cues for movement and spawning of golden perch, and other native fish known to respond to flow triggers. Although LTIM and DPI Fisheries monitoring did not detect any evidence of golden perch spawning there was a positive spawning response from other native fish, including Murray cod, flat headed gudgeon, Australian smelt and carp gudgeon. That is, substantial numbers of larvae of these fish species were caught and estimates of spawning dates correlated with environmental water delivery. As with a similar flow in 2014, there was very little evidence of carp spawning in response to translucent and managed environmental flows.

### Water plans

The following plans guided how environmental water was allocated and managed in the Lachlan Valley during 2015–16:

- *Water Sharing Plan for the Lachlan Regulated River Water Source 2003* (Regulation under the *Water Management Act 2000*)
- *Adaptive Environmental Water Use Plan for the Lachlan Water Management Area* (NSW Commissioner for Water 2012)
- *Environmental Watering Plan for the Lachlan Valley 2015–16* (OEH 2015)
- Lachlan Environmental Water Management Plan (Lachlan Riverine Working Group, website: [www.lrwg.com.au](http://www.lrwg.com.au))
- *Commonwealth Environmental Water Use Options 2015–16: Lachlan River Valley* (CEWO 2015).



Eastern end of the Great Cumbung Swamp after an environmental flow. Photo: Paul Packard, OEH



# Valley report: Murrumbidgee water resource

The Murrumbidgee catchment covers 81,527 square kilometres. This includes a 1690 kilometre stretch of river that supports many floodplain wetlands (some of which are listed under the Ramsar Convention), and a number of national parks, nature reserves and conservation areas with important wetland values. These wetland systems provide habitat and breeding opportunities for native flora and fauna, as well as refuge areas during times of low flows.

Wetlands throughout the Murrumbidgee support threatened species listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and NSW Threatened Species Conservation Act 1995; these include the Australian painted snipe, regent honeyeater, regent parrot, superb parrot, austral pipewort, Australasian bittern, southern bell frog, chariot wheels, and Menindee nightshade.

The mid-Murrumbidgee wetlands, listed under the Directory of Important Wetlands in Australia, support a variety of wetland-dependent vegetation, including river red gum, spike rush and water lilies. The Lowbidgee floodplain incorporates the Nimmie-Caira and Redbank floodplains. Vegetation supported by these wetlands includes river red gum, black box, lignum, common reed, cumbungi, river cooba, nitre goosefoot and cane grassland.

Cultural heritage sites in the Murrumbidgee Valley include Tuckerbil Swamp, which contains an ancestral burial ground significant to the Wiradjuri people. The Narrungadera Wiradjuri community have strong connections to both Fivebough and Tuckerbil swamps, which are listed under the Ramsar Convention.

The Murrumbidgee EWAG is chaired by the LLS and consists of community and agency representatives, including Aboriginal people, local landholders, water user groups, environmental groups and Commonwealth and NSW government stakeholders. The group provides strategic advice on managing environmental water in the Murrumbidgee catchment.

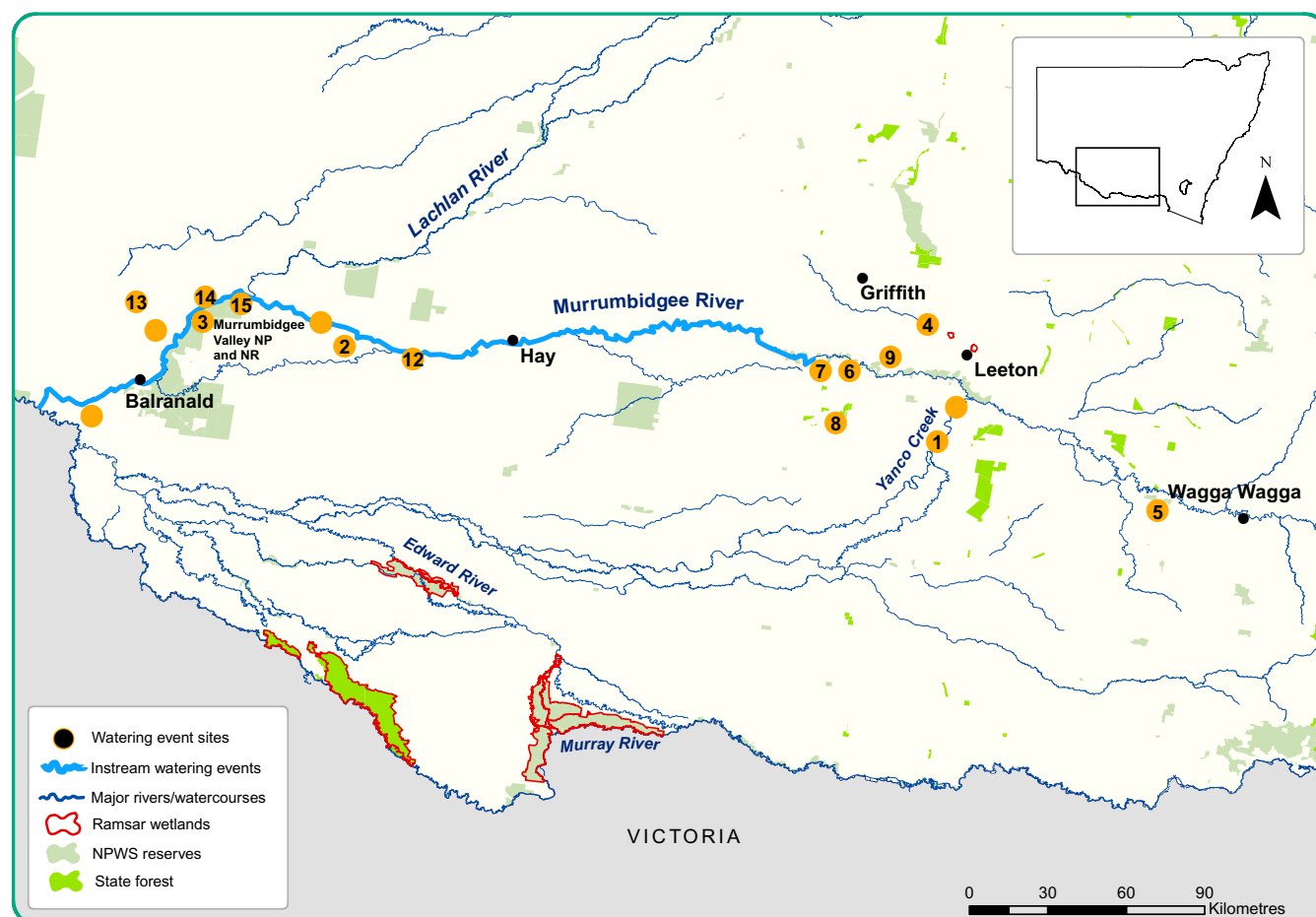
## Murrumbidgee Water Resource Plan area environmental watering targets for 2015–16

The Murrumbidgee Water Resource Plan area is defined in the Basin Plan and includes significant environmental water assets such as the mid-Murrumbidgee wetlands, the Lowbidgee wetlands, Junction wetlands, Western Lakes, Yanco-Billabong Creek system and the Murrumbidgee River channel (Figure 4). Environmental watering targets for 2015–16 are shown in Figure 4.



Erin Lenon (CEWO), David Gooden (landholder) and James Maguire (OEH) at Yellow Clay Creek. Photo: James Dyer, OEH

## Valley report: Murrumbidgee water resource (continued)



**Figure 4** Environmental watering events in the Murrumbidgee Water Resource Plan area, 2015-16. Event numbers correspond to those in Table 4.

### Catchment condition in 2015-16

The Murrumbidgee catchment condition in 2015-16 varied considerably across the catchment. However, it is generally accepted that the condition of the Murrumbidgee River floodplain has improved from that experienced during the Millennium Drought.

A combination of 60% average available general security allocations (as at 15 March 2015), 153,000 megalitres of available environmental water allowances and dry/neutral climate conditions meant that 2015-16 was best described as a 'moderate' year. Environmental watering actions undertaken during 2015-16 resulted in good responses from wetland vegetation, waterbirds and frogs.

## Watering aims

Under moderate resource availability scenario conditions, environmental water delivery in the Murrumbidgee Valley for 2015–16 aimed to maintain ecological health and resilience. However, with the possibility of drying conditions a dry resource availability scenario was also considered. Accordingly, a number of watering actions were planned consistent with these scenarios, including:

- if a rain-triggered tributary flow in the Murrumbidgee River occurs, an environmental flow would be added to extend the duration of the natural flow to ensure the mid-Murrumbidgee wetlands continue to recover from the Millennium Drought
- environmental watering delivered to targeted wetlands to benefit wetland vegetation, waterbirds, native fish populations, frogs (including the southern bell frog) and turtles. Some of the flow objectives included improving/maintaining the diversity of wetland types, preventing further decline of stressed wetlands, reinstating a wetting-drying cycle for ephemeral floodplain wetlands, supporting colonial waterbird breeding in Lowbidgee wetlands and providing suitable instream conditions for native fish breeding and recruitment. Targeted environmental assets included the mid-Murrumbidgee, Yanco Creek, the Junction wetlands, Western Lakes and Nimmie-Caira.

## Water delivery

A total of 227,895 megalitres of managed environmental water was delivered to wetland and river targets across the Murrumbidgee Valley (Table 4). Sources of environmental water included NSW and Commonwealth licensed environmental water and the environmental water allowance made available under the *Water Sharing Plan for the Murrumbidgee Regulated River Water Source 2003* (Table 4).



Little pied cormorant chicks at Yarradda Lagoon, mid-Murrumbidgee. Photo: James Maguire, OEH



## Valley report: Murrumbidgee water resource (continued)

**Table 4** Environmental water delivered in the Murrumbidgee Valley during the 2015–16 water year

Location	Start date	Finish date	Megalitres of water delivered			
			NSW	CEW	EWA	Total
1 Yanco Creek	1 Jul 2015 15 Oct 2015	13 Aug 2015 11 Nov 2015	4,566	26,338		30,904
2 Nimmie-Caira system	17 Oct 2015	9 Feb 2016		18,000	50,528	68,528
3 Yanga National Park	17 Nov 2015	12 Dec 2015		10,000	1,605	11,605
4 Murrumbidgee Irrigation Area wetlands (includes Ramsar sites Fivebough and Tuckerbil swamps)	31 Nov 2015 23 Apr 2016	1 Mar 2016 25 May 2016			4,392	4,392
5 Sandy Creek wetland	1 Apr 2016	12 May 2016	165	106		271
6 Yarradda Lagoon	1 Sep 2015	7 Dec 2015		1,394		1,394
7 Tombullen to Carrathool mid-Murrumbidgee wetlands	31 Aug 2015 8 Sep 2015	6 Sep 2015 12 Sep 2015			11,933	11,933
8 Coleambally Irrigation Area	29 Mar 2016	25 May 2016			4,527	4,527
9 Gooragool Lagoon	1 Jul 2015	N/A (transfer)	3,470			3,470
10 North Redbank system	21 Oct 2015	10 Feb 2016		35,000	29,000	64,000
11 Junction wetlands	9 Feb 2016	15 Jun 2016		2,000		2,000
12 Toogimbie wetlands	15 Mar 2016	1 May 2016		933		933
13 Hobblers Lake & Penarie Creek	15 Mar 2016	13 Apr 2016	910	5,000		5,910
14 Marimley Lake	15 Mar 2016	13 Apr 2016	90			90
15 Waugorah Lake	29 Mar 2016	9 Apr 2016			970	970
16 Nap Nap Swamp to Waugorah Creek	6 May 2016	30 Jun 2016	6,753	9,557		16,310
17 Molley's Lagoon	17 Jun 2016	30 Jun 2016			658	658
<b>Total</b>			<b>15,954</b>	<b>108,328</b>	<b>103,613</b>	<b>227,895</b>

Note: Location numbers in the table relate to watering events marked on the map in Figure 4.

NSW = NSW licensed environmental water

CEW = Commonwealth licensed environmental water

EWA = Environmental water allowance accrued under the *Water Sharing Plan for the Murrumbidgee Regulated River Water Source 2003*

## Ecological outcomes

Vegetation surveys were undertaken as part of the CEWO's LTIM program to determine the response of vegetation species to environmental watering actions. At wetlands where environmental water was delivered in spring there was a strong response by aquatic and semi-aquatic species. Of note is Yarradda Lagoon in the mid-Murrumbidgee which received environmental water over the last two years, resulting in significant increases in the coverage of spiny mud-grass, an important aquatic species that was known to dominate this wetland in the late 1990s. The Lowbidgee and Nimmie-Caira were also found to support a high diversity of aquatic native vegetation. Spike rush species are the most dominant group through the Lowbidgee system, while nardoo and water milfoil are abundant through wetlands in the Nimmie-Caira.

Southern bell frogs were also found to be active throughout the Nimmie-Caira, with adults and tadpoles recorded at LTIM sites, and small numbers of calling southern bell frogs at several Lowbidgee wetlands.

Thirty-two waterbird species were recorded across the Murrumbidgee, with pacific black ducks and grey teals confirmed breeding at wetland sites. The migratory sharp-tailed sandpiper (listed on migratory bird agreements JAMBA, CAMBA and ROKAMBA) was also recorded in the Nimmie-Caira. Small flocks of great egrets (JAMBA, CAMBA) were recorded at Nimmie-Caira and Lowbidgee wetlands. It is likely that these wetlands provide important foraging grounds for the egret rookery which has established at Tarwillie Swamp in the Redbank system.

The largest counts of waterbirds were recorded at Yarradda Lagoon (in the mid-Murrumbidgee) and Piggery Lake. Large numbers of black swans (50–60 birds) and Eurasian coot (170 birds) were observed at Piggery Lake. Yarradda Lagoon also supported flocks (50–60 birds) of coot, hoary-headed grebe and pink-eared duck. These three species often move to wetlands on re-flooding to exploit temporary peaks in invertebrate prey.

## Water plans

The following plans guided how environmental water was allocated and managed in the Murrumbidgee Valley during 2015–16:

- *Water Sharing Plan for the Murrumbidgee Regulated River Water Source 2003* (Regulation under the *Water Management Act 2000*)
- *Adaptive Environmental Water Use Plan for the Murrumbidgee Water Management Area* (NSW Commissioner for Water 2013)
- *Environmental Watering Plan for the Murrumbidgee Valley 2015–16* (OEH 2015)
- *Commonwealth Environmental Water Use Options 2015–16: Murrumbidgee River Valley* (CEWO 2015).



Spoonbill at Cherax Swamp. Photo: Peter Morton, landholder

# Valley report: Murray and Lower Darling water resource

The Murray and Lower Darling rivers are extensive systems that traverse NSW, Victoria and South Australia. The Murray River stretches for more than 1800 kilometres and makes up part of the border between NSW and Victoria. The Murray and Lower Darling include a floodplain area of 98,300 square kilometres that contains a mosaic of wetland types, ranging from ephemeral wetlands and creeks to permanently wet lagoons and rivers.

The Murray and Lower Darling valleys support important habitat for critically endangered, endangered, threatened and vulnerable fauna listed under the Australian Government's Environment Protection and Biodiversity Conservation Act 1999. This includes the southern pygmy perch, silver perch, trout cod, southern bell frog, superb parrot, colonial nesting birds and migratory bird species. The Millewa Forest makes up over half of the Barmah-Millewa Forest icon site under The Living Murray; it contains the largest river red gum forest in Australia, extending across the border of NSW and Victoria.

Several sites in the region support the southern bell frog and bush stone curlew, as well as many other fauna and flora species listed in the Fisheries Management Act or NSW Threatened Species Conservation Act 1995.

The Murray Valley has records of more than 968 cultural heritage sites. Most of these are within the Millewa Forest (Yorta Yorta and Cummeragunja Nations), Werai Forest (Wamba Wamba/Wemba Wemba and Barapa

Barapa/Perrepa Perrepa Nations) and the eastern portion of Koondrook Forest (Barapa Barapa/Perrepa Perrepa and Yorta Yorta, Cummeragunja and Perrepa Perrepa Nations).

OEH is working with local communities to improve the health of wetlands, rivers and floodplains in the Murray Valley catchment. This includes the Murray Lower Darling EWAG, which is chaired by the LLS and consists of community and agency representatives, including Aboriginal people, local landholders, water user groups, the Murray-Darling Freshwater Research Centre, Murray Darling Wetlands Working Group and Commonwealth and NSW government stakeholders. The group provides advice to OEH on managing environmental water within the valley.

Non-government organisations have provided invaluable cooperative support to OEH in the delivery of environmental water projects. These include Murray Irrigation, landholders (using privately owned infrastructure at several sites), and the Murray Darling Wetlands Working Group.



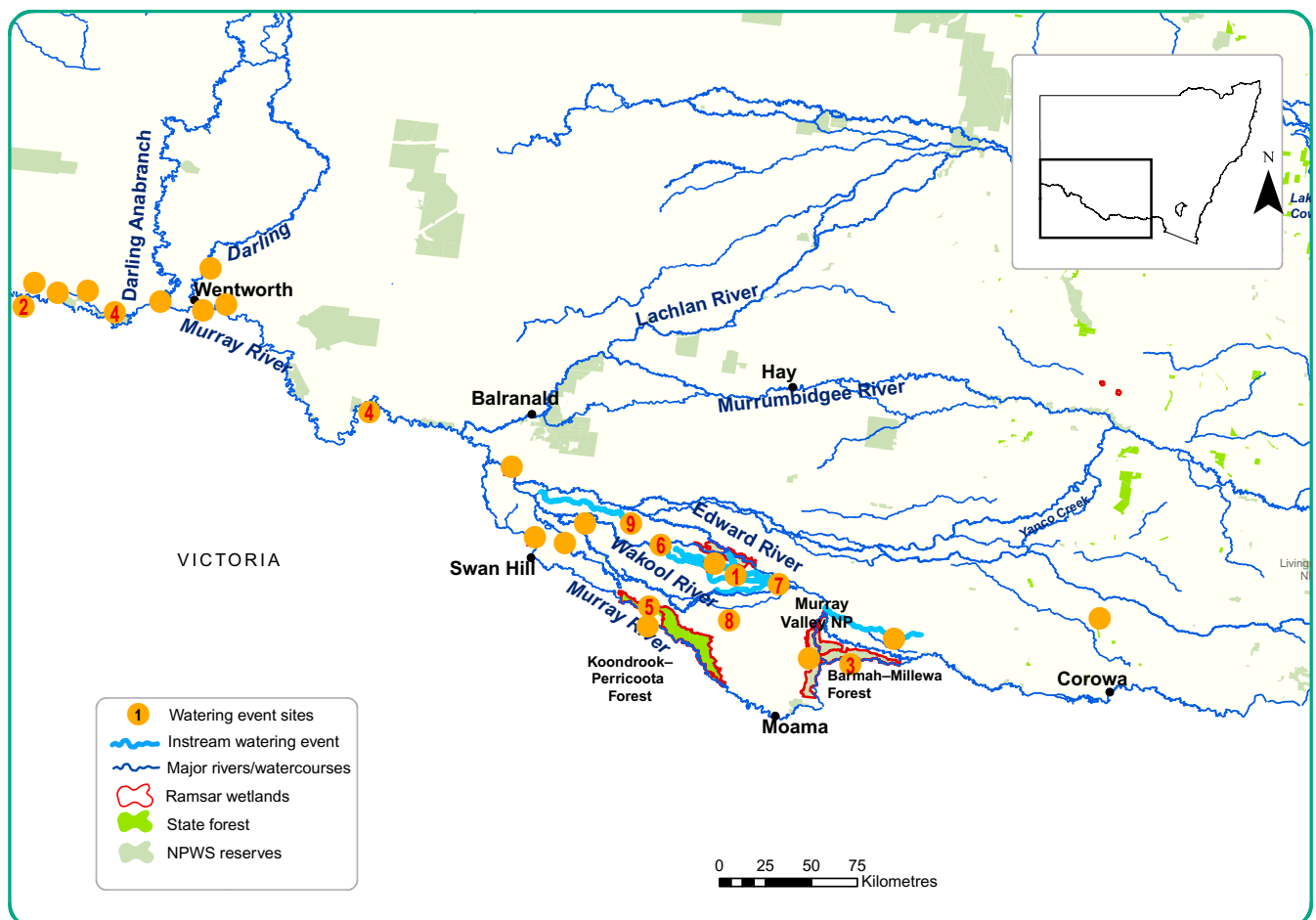
Landholders Peter, Beryl and Tim Mills during an environmental watering event at Andruco Lagoon, November 2015.  
Photo: Sascha Healy, OEH



## Murray and Lower Darling Water Resource Plan area environmental targets for 2015–16

The Murray and Lower Darling Water Resource Plan area is defined in the Basin Plan (Figure 5). This area supports hydrologically and ecologically complex freshwater habitats, as well as productive agricultural industries. Environmental watering targets for 2015–16 are shown in Figure 5.

**Figure 5** Environmental watering events in the Murray and Lower Darling Water Resource Plan area, 2015–16. Event numbers correspond to those in Table 5.



### Catchment condition in 2015–16

The El Niño event declared in May 2015 contributed to higher temperatures and below average rainfall over eastern Australia, with a number of notable heatwaves and record-breaking temperatures from October to December 2015.

According to the Bureau of Meteorology, rainfall for 2015 was average to below average for most parts of the Murray-Darling Basin but has been well above average since May 2016 due to the El Niño weakening to a neutral Southern Oscillation phase.

The environmental assets targeted for environmental water were considered to range from poor to moderate condition.

### Watering aims

Under a moderate to dry resource availability scenario in the Murray and Lower Darling Valley for 2015–16, water delivery aimed to maintain ecological health by:

- supporting the survival and viability of threatened species and aquatic communities
- maintaining environmental values and ecosystem functions, including allowing drying to occur consistent with natural wetting-drying cycles, and
- maintaining refuges.

### Water delivery

A total of 209,058 megalitres of managed environmental water was delivered in 2015–16 to wetland and river targets across the Murray and Lower Darling (Table 5), with the aim of supporting fish breeding and wetland habitat maintenance.



Consultant Clayton Sharpe (CPS Enviro P/L) performing an electrofishing survey at Thegoa Lagoon, Wentworth, commissioned by OEH in June 2016. Photo: Mark Henderson, OEH

**Table 5** Environmental water delivered in the Murray and Lower Darling valleys during the 2015–16 water year

Location	Start date	Finish date	Megalitres of water delivered				
			NSW	CEW	EWA	TLM	Total
1 Elimdale Wetland	18 Sep 2015 20 May 2016	28 Sep 2015 24 May 2016	150 50				200
2 Cliffhouse	28 Sep 2015	4 Oct 2015	100				100
3 Murray River – Barmah-Millewa Forest	26 Jun 2015	10 Nov 2015		84,700		53,110	137,810
4 Lock 8, 9 and 15 weirpool manipulation	1 Aug 2015	30 Apr 2016		5,249			5,249
5 The Pollacks	2 Oct 2015 3 Dec 2015	20 Nov 2015 28 Dec 2015	1,000 500				1,500
6 Colligen Creek – Niemur River	1 Aug 2015	28 Jan 2016		15,740			15,740
7 Edward-Wakool Yallakool Creek fish flows	1 Aug 2015	28 Jan 2016		14,449			14,449
8 Private Property Wetlands Project (Murray Irrigation) including unnamed creek	17 Sep 2015	1 Feb 2016	1,224				1,224
9 Murrian-Yarrien Creek System	16 Sep 2015	3 Nov 2015	3,862				3,862
10 Tuppal Creek	16 Sep 2015	27 Nov 2015	2,464	2,000			4,464
11 Rilveraside	29 Sep 2015 14 Apr 2016	13 Oct 2015 4 May 2016	172 98				270
12 Grand Junction	13 Nov 2015	8 Jan 2016	1,000				1,000
13 Andruco Lagoon	11 Nov 2015 7 Dec 2015	22 Nov 2015 9 Dec 2015	150 30				180
14 Jimaringle, Cockran & Gwynne's creeks	19 Oct 2015 2 May 2016	24 Jan 2016 12 May 2016	810				810
15 Brechin	22 Oct 2015	24 Jan 2016	230				230
16 Woodleigh Lagoon	17 Oct 2015 13 Feb 2016	18 Oct 2015 14 Feb 2016	60 40				100
17 Fletcher's Creek	16 Dec 2015 21 Mar 2016	23 Dec 2015 28 Mar 2016	79 117				196
18 Reed beds – Millewa	11 Nov 2015	10 Feb 2016	311	8,000	5,754	2,435	16,500
19 Lake Victoria	3 May 2016	17 May 2016	250				250
20 Nampoo	3 May 2016	12 May 2016	150				150
21 Barham Lake	19 Jan 2016	7 Mar 2016		115			115
22 Thegoa Lagoon	24 Jun 2016	30 Jun 2016	235				235
23 Carrs, Capitts & Bunberoo creeks	4 Apr 2016	16 May 2016		950			950
24 Wee Wee Creek	24 May 2016	4 Jul 2016	2,474				2,474
25 Speewa Creek	25 May 2016	23 Jun 2016	1,000				1,000
<b>Total</b>			<b>16,556</b>	<b>131,203</b>	<b>5,754</b>	<b>55,545</b>	<b>209,058</b>

Note: Location numbers in the table relate to watering events marked on the map in Figure 5.

NSW = NSW licensed environmental water

CEW = Commonwealth licensed environmental water

EWA = Environmental water allowance accrued under the *Water Sharing Plan for the NSW Murray and Lower Darling Regulated Rivers Water Sources 2003*

TLM = The Living Murray



### Ecological outcomes

Ecological outcomes resulting from the delivery of environmental water to sites in the Murray and Lower Darling valleys included the provision and enhancement of habitat for the southern bell frog, improvement in the condition of mature river red gum and black box species and supporting recently established river red gum and black box communities. The condition of endemic wetland plant communities and the provision of habitats for water-dependent fauna such as fish, frogs and waterbirds has also been enhanced by environmental water deliveries.

The endangered southern bell frog, listed under the NSW Threatened Species Conservation Act 1995, was recently recorded at a number of environmental watering sites, including Cliffhouse Wetland, Andruco Lagoon, Brechin Swamp, Jimaringle, Cockran and Gwynnes creeks and in the Murrian-Yarrein system. There were numerous frog species recorded at Speewa Creek, Wee Wee Creek, Thegoa Lagoon, Woodleigh, Rilverstone and Tuppal Creek sites. Other recorded species include the plains froglet, common eastern froglet, Peron's tree frog, common spadefoot frog, spotted marsh frog, giant banjo frog, eastern banjo frog and the barking marsh frog.

There was also notable improvement in vegetation condition of river red gum and black box understorey species such as lignum at some of the sites that received environmental water, including the Brechin Wetland and private property wetlands in the Murray Irrigation Area. The emergence of aquatic plants such as the native mud grass, small spike rush, nardoo and juncus species was also evident at many watered sites.

There was a diverse and abundant waterbird response to environmental watering, including species such as black swans, Australian pelicans, Australasian grebes, chestnut teals, great egrets and brolgas. Many other iconic species were identified at numerous wetlands around the Murray-Lower Darling.

### Water plans

The following plans guided how environmental water was allocated and managed in the Murray and Lower Darling valleys during 2015–16:

- *Water Sharing Plan for the NSW Murray and Lower Darling Regulated Rivers Water Sources 2003* (Regulation under the *Water Management Act 2000*)
- *Murray and Lower Darling Valleys: Annual Environmental Watering Plan 2015–2016* (OEH 2015)
- *Murray and Lower Darling Water Resource Plan Area: Statement of annual environmental watering priorities 2015–16* (OEH 2016)
- *2015–16 Basin Annual Environmental Watering Priorities* (Murray–Darling Basin Authority 2015)
- *The Living Murray environmental watering outlook 2015–16* (MDBA 2015)
- *Integrated planning for the use, carryover and trade of Commonwealth environmental water: Lower Murray–Darling Region 2015–16* (CEWO).



Environmental watering at The Pollack, November 2015. Photo: Dan Hutton, Forestry Corporation of NSW

# Booming bitterns enjoy the benefits of environmental water that led to nesting in wetlands along the Murray River

Native fish, birds and plants all benefited from environmental watering of the renowned Millewa forest Ramsar wetland in 2015–16. This combined agency approach, including OEH water managers, also led to an endangered Australasian bittern population being observed at the site over spring and summer, together with a large number of other nesting birds.

Strategic use of available environmental water provided the best possible conditions for the wetlands and river red gum forests to respond. The delivery occurred over a number of months, triggering an explosion in food availability with insect numbers surging, providing food for higher order predators like birds, small mammals, reptiles, fish and frogs.

Waterbirds responded to this increase in food availability. Australasian bitterns were heard calling during the delivery of environmental water to Millewa forest. The eerie booming call of the Australasian bittern is thought to be responsible for the bunyip legend. Other cryptic waterbirds such as the little bittern were also observed and heard calling within the wetlands.

Monitoring revealed large numbers of colonial nesting waterbirds including nankeen night herons, eastern great and intermediate egrets, little pied and little black cormorants, and Australian white and straw-necked ibis. Whistling kites, swamp harriers and white bellied sea-eagles were also observed at Moira Lake, Reed Beds Swamp and Duck Lagoon. The white bellied sea-eagle and eastern great egret are listed on bilateral migratory bird agreements between Australia, Japan, China and the Republic of Korea.

Surveys also demonstrated the importance of a healthy wetland for woodland birds, which responded to the increased biomass and vegetation layers by feeding and breeding.

Around the same time, golden and silver perch responded to a planned pulsed flow in the system by breeding and moving through newly connected creeks and wetlands to feed and grow.

The health of river red gums on the Millewa floodplain visibly improved while a suite of wetland plants also responded positively including several species with Aboriginal cultural importance including old man weed, common reed, river mint and cumbungi. Environmental watering also facilitated the growth and reproduction of Moira grass. The Moira grass plains, a critical wetland type within the forest, has been impacted by changes in the water regime within the forest as river regulation has increased.

The results are a positive indication that water managers are on the right track in developing the strategies to keep sections of the floodplain healthy and productive for plants, animals and people alike, especially when available water is limited.



Three Australasian bitterns in flight at Millewa forest.  
Photo: Alana Wilkes, CEWO



Ecologist Rick Webster surveying Reed Beds Swamp.  
Photo: Emma Wilson, OEH



# NSW environmental water holdings

Table 6 summarises current NSW licensed water for the environment. It should be noted that this does not include 'planned' water for the environment which is allocated under water sharing plans.

**Table 6** Environmental water holdings to 30 June 2016 (megalitres)

Valley	NSW environmental water holdings				The Living Murray
	High security	General security	Supplementary	Unregulated	Long term cap equivalent
Gwydir	1,249	17,092	3,141	–	–
Macquarie	–	48,419	1,451	2,916	–
Lachlan	1,795	36,569	–	–	–
Murrumbidgee	–	28,508	5,680	6,162	–
Murray – lower Darling Basin	2,027	30,000*	–	–	221,487
Barwon-Darling	–	–	–	1,539	–
<b>Total</b>	<b>5,071</b>	<b>160,588</b>	<b>10,272</b>	<b>10,617</b>	<b>221,487</b>

\* Conveyance

Note: OEH considers these figures to be accurate at the time of printing.

Find out more about [environmental water holdings](#).



Nampoo wetland, located on the Murray in south-west New South Wales (endangered southern bell frog site). Photo: Sascha Healy, OEH

## NSW environmental water trade

OEH's [Environmental Water Business Plan](#) allows for the periodic trading of water allocations in the accounts of OEH water access licences to pay for some of the costs of managing water for the environment. Funds may also be used to purchase allocations or implement small-scale projects that improve environmental watering outcomes.

In 2015–16, OEH sold 1000 megalitres in the Lachlan and 480 megalitres in the Gwydir. An agreement was reached with the water users to protect identified high priority wetlands in the mid-Murrumbidgee reach which involved a transfer of 3470 megalitres. In addition, 2243 megalitres of carryover space was rented in the Murray to allow for environmental watering in 2016–17. Trading will continue to occur in future years so as to manage the portfolio for maximum environmental benefit.



# Environmental water monitoring

## Long Term Intervention Monitoring project

The Long Term Intervention Monitoring (LTIM) project is a key response by the CEWO to the requirements of the *Water Act 2007* to manage Commonwealth-held environmental water across the Murray-Darling Basin. This project is consistent with the Basin Plan, specifically in accordance with the plan's environmental watering plan. It also aligns with the CEWO's Commonwealth Environmental Water: Monitoring, Evaluation, Reporting and Improvement Framework.

The goal of the LTIM project is, through monitoring and evaluation, to improve decision-making, governance and reporting regarding Commonwealth environmental water use. OEH, together with a number of other

government agencies, provides support to the CEWO by helping in the monitoring project. This support also benefits NSW by providing better information for the management of all NSW environmental water.

Indicators used in the LTIM process include fish populations and movement, waterbird breeding and diversity, hydrology, water quality, vegetation diversity, macroinvertebrates, inundation modelling, wetland productivity and blackwater events (dark vegetation discolouration of the water usually associated with low dissolved oxygen levels).



LTIM project monitoring, Booligal Wetlands, October 2015, by the Institute for Applied Ecology, University of Canberra on behalf of the CEWO. Photo: Joanne Lenehan, OEH



## Environmental water monitoring (continued)

### OEH monitoring, evaluation and reporting strategy

The Basin Plan requires coordination, consultation and cooperation among agencies for the effective delivery of environmental watering strategies, priorities and monitoring. OEH actively collaborates with a range of parties in monitoring and evaluation to ensure that duplication of effort does not occur and contributions and information are shared.

The large-scale delivery of environmental flows is a relatively new form of ecosystem rehabilitation and managers require an evaluation of the ecosystem responses to environmental water delivery to inform adaptive management. This is achieved through a consistent, scientifically-defensible framework for monitoring environmental flows across NSW.

By monitoring ecosystem responses to environmental water, OEH is able to better plan and manage the use of environmental water, meet reporting obligations under the Basin Plan and provide relevant information to the community. The collection of information to inform operational decisions for the delivery of water to riverine and wetland assets focuses on:

- longer-term, annual and event-scale objectives
- hydrological and ecological outcomes.

The monitoring program also:

- considers well-defined objectives and questions specified prior to commencement of the monitoring effort
- is relevant to management
- supports collaborative learning and information sharing
- provides critical components for the decision-making and environmental water management process.



David Preston from OEH checking water quality in Carole Creek, May 2016. Photo: Jane Humphries, OEH



Little bitterns hatching in a nest of Cumbungi adjacent to Paika Lake. Photo: Peter Morton, landholder

# Our partners

Management and delivery of environmental water by OEH relies on cooperation with a number of NSW agencies, the Australian Government and other partners. OEH would like to acknowledge the contribution of the following partners:

**Environmental Water Advisory Groups (EWAGs)** provide invaluable advice and expertise, including local knowledge and experience, when advising OEH on managing environmental water.

**Private and public landholders** provide advice and on-ground support to OEH during watering events, as well as access to their properties in many cases.

The **Commonwealth Environmental Water Holder**, supported by the **Commonwealth Environmental Water Office (CEWO)**, makes decisions on the use and management of environmental water holdings that have been purchased by the Australian Government through the water market or acquired through investment in water savings infrastructure. Commonwealth environmental water is allocated to NSW events undertaken by OEH and its partners. The NSW and Australian Governments work cooperatively to ensure the best environmental outcomes from managing environmental water.

The **NSW Department of Primary Industries – Water** is responsible for implementing the Water Act 1912 and Water Management Act 2000. It determines water availability, manages flow events in unregulated and regulated rivers, monitors water use, and implements and monitors the outcomes of rules-based planned environmental water under water sharing plans.

The **NSW Department of Primary Industries – Fishing and Aquaculture** provides specialist technical and policy advice on fisheries management in water recovery and environmental water-use projects and plans.

**WaterNSW** manages river operations and water delivery in regulated river systems across NSW under licence to the NSW Government.

**Local Land Services (LLS)** works with regional communities to respond to key natural resource management issues facing their catchments. It also represents local communities on environmental water advisory groups in NSW.

The **Murray-Darling Basin Authority** is the Australian Government agency responsible for managing the water resources within the basin, including preparing a Basin Plan and coordinating the management of water recovered for The Living Murray icon sites. River Murray Operations is part of the authority and has been crucial in the success of environmental water projects by providing information and cooperation in flow management, as well as coordination and facilitation for various operational advisory groups throughout the Murray Valley.

**Irrigation companies**, including Murray Irrigation, Murrumbidgee Irrigation and Coleambally Irrigation, help deliver environmental water projects by using their infrastructure.

**Universities and other organisations** that support OEH in monitoring and research include:

- Charles Sturt University
- University of New England
- University of New South Wales
- University of Technology, Sydney
- Macquarie University
- Murray-Darling Freshwater Research Centre.



The **Murray Lower Darling Rivers Indigenous Nations** (MLDRIN) was formed in 1998 and is a confederation of Indigenous Nations or traditional owners in the lower southern part of the Murray-Darling Basin, representing 24 nations. MLDRIN is an expression of the way the Indigenous Nations have always done business – by caring for Country and talking to their traditional neighbours upstream and downstream on the Murray and its sister rivers, creeks, lakes, billabongs and waterways. MLDRIN also provides advice as a member of the Murray Lower Darling Environmental Water Advisory Group, when delivering environmental water.

**Northern Basin Aboriginal Nations** (NBAN) is an organisation that represents 22 Sovereign First Nations in the Northern Murray-Darling Basin in natural resource and water management. NBAN is only the second organisation to successfully bring Sovereign First Nations together under one common cause. Within the Murray-Darling Basin there are 46 Sovereign First Nations represented by both NBAN and MLDRIN. NBAN has recently attended the Gwydir EWAG as an observer.

The **Southern Connected Basin Environmental Watering Committee** was established by the Murray-Darling Basin Ministerial Council in October 2014 and has been meeting regularly since February 2015. The committee membership consists of state and Commonwealth environmental water holders and managers of planned environmental water, key river operators and waterway managers.

This committee coordinates the efficient and effective delivery of all environmental water in the Southern Connected Basin and makes decisions on the planning and use of the TLM portfolio, River Murray Increased Flows and River Murray Unregulated Flows.



Caption: OEH working with its partners at the annual water for the environment management workshop, May 2016.  
Photo: Natalie Young, OEH.



**Find out more:**

**[www.environment.nsw.gov.au/environmentalwater](http://www.environment.nsw.gov.au/environmentalwater)**