Australian Government

Commonwealth Environmental Water Office

Commonwealth Environmental Water

Portfolio Management Plan

Northern Unregulated Rivers

2017–18

Front cover image credit: Darling River at Toorale. Photo by Commonwealth Environmental Water Office.

Back cover image credit: Monitoring and research at Toorale. Photo by Commonwealth Environmental Water Office.

The Commonwealth Environmental Water Office respectfully acknowledges the traditional owners, their Elders past and present, their Nations of the Murray-Darling Basin, and their cultural, social, environmental, spiritual and economic connection to their lands and waters.

This report should be attributed as '*Commonwealth Environmental Water Portfolio Management Plan: Northern Unregulated Rivers 2017–18*, Commonwealth of Australia, 2017'.

Commonwealth environmental water portfolio management planning

Commonwealth environmental water Holder

The Commonwealth Environmental Water Holder is a statutory position established under the *Water Act 2007* and is responsible for managing the Commonwealth's environmental water holdings. This water must be managed to protect and restore the rivers, wetlands and floodplains (and the native animals and plants they support) of the Murray-Darling Basin. Mr David Papps is the current Commonwealth Environmental Water Holder. He is supported by staff of the Commonwealth Environmental Water Office (CEWO). The CEWO employs six local engagement officers who live and work in regional centres across the Murray-Darling Basin.

Commonwealth environmental water

Commonwealth environmental water holdings are water entitlements that have been acquired by the Australian Government through investments in water-saving infrastructure and purchases on the water market. The holdings are a mix of entitlement types held across 19 catchments. The rules governing the entitlements vary across states and across catchments. Commonwealth environmental water entitlements are subject to the same fees, allocations, carryover and other rules as equivalent entitlements held by other water users.

There are broadly three options for managing Commonwealth environmental water:

- delivering water to a river or wetland to meet an identified environmental demand
- leaving water in storage and carrying it over for use in the next water year (referred to as 'carryover')
- trading water, that is, selling water and using the proceeds to buy water in another catchment or in a future year, or investing in complementary 'environmental activities'.

Purpose of the document

This document sets out the plans for managing the Commonwealth environmental water portfolio in the Northern Unregulated Rivers for 2017–18. Efficient and effective management of Commonwealth environmental water requires the utilisation of all portfolio management options. By taking a multi-year approach to planning, portfolio management tools such as use, carryover and trade can be managed for maximising environmental outcomes.

The portfolio management plans support transparent, coordinated and adaptive management of Commonwealth environmental water, consistent with the Basin-wide environmental watering strategy and having regard to the Basin annual environmental watering priorities. To learn more about the planning approach see *Portfolio Management Planning: Approach to planning for the use, carryover and trade of Commonwealth environmental water, 2017–18* (available at: http://www.environment.gov.au/water/cewo/publications under 'Planning approach').

Delivery partners

Commonwealth environmental water is managed with advice from a range of partners. In the northern unregulated rivers, our partners include the Queensland Departments of Natural Resources and Mines and Agriculture and Fisheries, New South Wales Office of Environment and Heritage (NSW OEH), New South Wales Department of Primary Industries – Water and Fisheries, Sunwater and WaterNSW.

Your input

The management of Commonwealth environmental water relies on considerable advice and assistance from local organisations, state governments and others. Individuals and groups within the Murray-Darling Basin community are encouraged to submit suggestions for the management of Commonwealth environmental water. Please contact the CEWO via: ewater@environment.gov.au.

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1. Environmental watering in the northern unregulated rivers

1.1. The northern unregulated rivers

The northern unregulated rivers include the Moonie River, Condamine-Balonne River, Nebine Creek, Warrego River and Barwon-Darling River systems (Figure 1). These rivers have many common features, and for planning purposes, are grouped together. Reaches of the Border Rivers where the Commonwealth holds significant unregulated entitlement are also considered part of the unregulated rivers in terms of environmental water management[1]. The catchments of the northern regulated rivers drain about 60 per cent of the Murray-Darling Basin above Menindee Lakes, and include many significant ecological assets, as discussed subsequently.

Flow in these river systems is dominated by flows from occasional rainfall events rather than being usually 'controlled' by public dams and other infrastructure as occurs in 'regulated' catchments of much of the Basin to the south[2]. However, the majority of water use and entitlement is in the form of diversion of river flows and water during periodic unregulated flow events that breaks out of rivers and becomes overland flows across floodplains. Large-scale irrigation in the region is supported by large capacity pumps that divert water during unregulated flow events into on-farm storages ('ring tanks') for later use. Small-scale diversion of unregulated flows direct to cropped areas or small storages also occurs in areas where floodplains are limited or flows are too unreliable (e.g. effluent channels) to support large scale irrigation.

The northern unregulated river systems are characterised by highly variable rainfall and ephemeral (intermittent) river flows. Significant flow events generally result from heavy rainfall in elevated headwater areas. Runoff into rivers from lowland areas usually making only a minor contribution as rain that falls on the flat floodplains tends to evaporate or seep into the ground rather than becoming streamflow. In some northern unregulated systems, no flow periods of several months are common and may extend to several years during prolonged dry conditions. The degree of intermittency varies between rivers. Most of the Lower Balonne system and the Moonie, Warrego, Nebine and Paroo systems are highly intermittent, experiencing no flow for 50 percent or more of the time on a long term basis. The Barwon-Darling has more regular flows, but is occasionally intermittent (experiencing no flow up to 5 percent of the time).

The northern unregulated rivers include headwater and slopes zones but for most of their length flow through flat semi-arid rangelands. For example, the Barwon-Darling River from Mungindi to Menindee flows for 1,640 kilometres through semi-arid lowland. The distributary channels below St George - the Culgoa, Narran and Bokhara/Ballandool/Birrie rivers - in total traverse a similar length through the Lower Balonne floodplain.

The flat landscape, low local runoff and intermittent flow conditions have led to the evolution of distinctive ecology in lowland river reaches. Aquatic and floodplain species are adapted to high flow variability and 'boom and bust' cycles. This is characterised by episodes of intense reproduction and high productivity by opportunistic plants and animals - (the 'boom') associated with periods of flooding, followed by periods of stress and reduced production - 'the bust' (Arthington and Balcombe 2011; Sheldon et al. 2010).

[1] There is a Portfolio Management Plan for the Border Rivers, covering regulated entitlements

[2] There are still some dams and water supply schemes (notably in the Condamine-Balonne and Border Rivers).

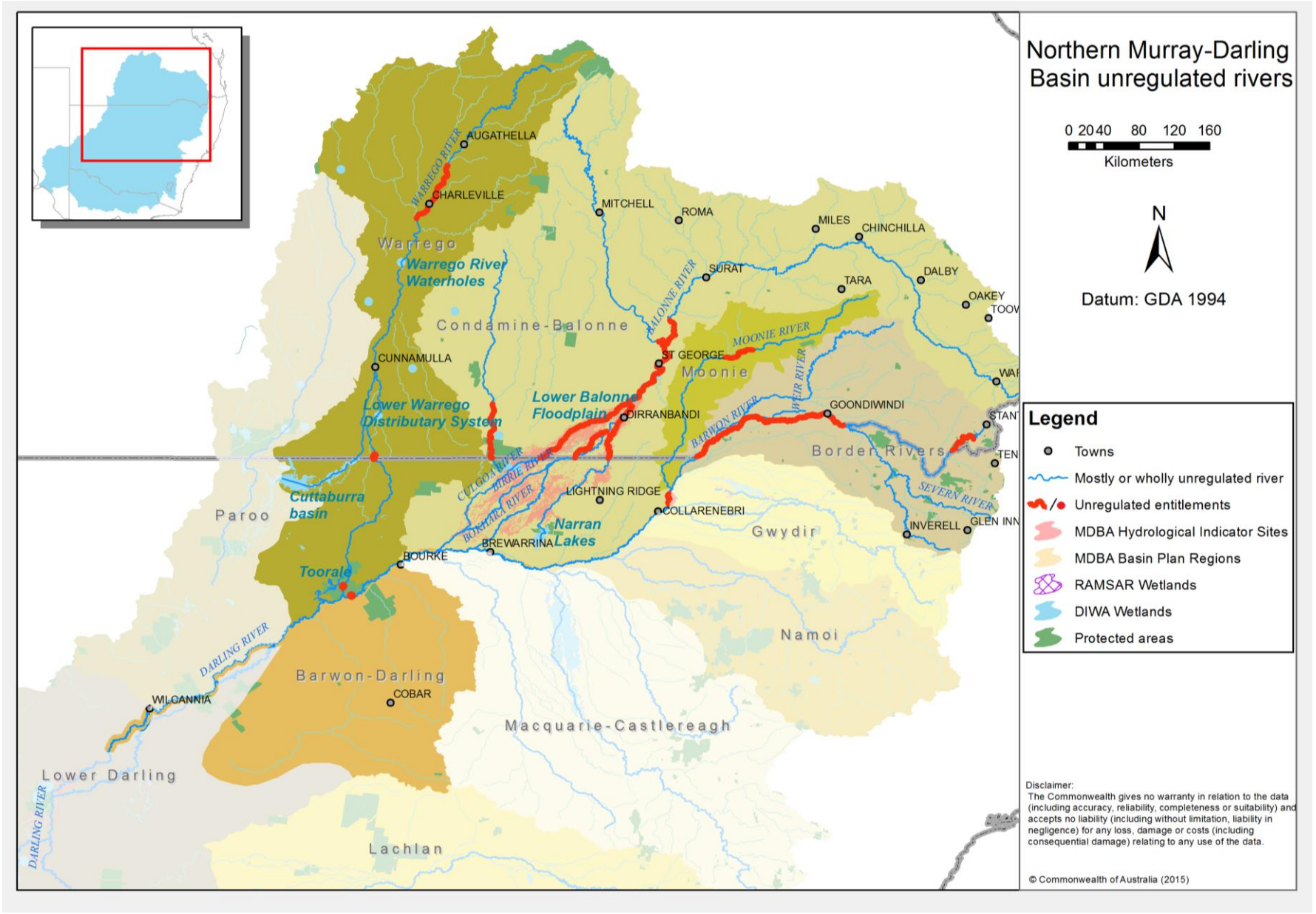

Figure 1: Map of the northern unregulated rivers.

Environmental assets of the northern unregulated rivers

There are many environmental assets in the northern unregulated rivers that are of international and national significance. These environmental assets include species and communities of fish, waterbirds and vegetation, and important habitats such as wetlands and drought refuges. These ecological populations and habitats are connected by the Barwon-Darling River, providing a critical drought refuge and movement corridor for fish and waterbirds. These are described below, and in more detail in Attachment A.

Fish species in northern unregulated rivers listed as threatened at the state and/or Commonwealth level include Murray cod and silver perch. Additionally, these rivers support important remnant populations of olive perchlet, purple spotted gudgeon, and eel tailed catfish that are less prevalent or no longer present in the southern Basin. There are a number of species that do not occur in the southern Basin, including Rendahl's and Hyrtl's tandan.

Waterbird species, including international migratory species, visit habitats along northern unregulated rivers. These species include the great egret, glossy ibis, and rainbow bee-eater. Additionally, nationally threatened waterbirds (including Australian painted snipe and Australasian bittern) and species listed as threatened in NSW (including the brolga, freckled duck and blue-billed duck) live in habitats along the northern unregulated rivers. Any watering actions that contribute to maintaining waterbird habitat or support waterbird breeding within the northern unregulated rivers may also benefit waterbird populations more broadly across the Murray-Darling Basin and beyond, by increasing the opportunity for recruitment and recovery. Additionally, there is increasing evidence of the connection between waterbird populations observed in the Narran Lakes and other wetlands along northern unregulated rivers with other important nearby ecological assets such as the Macquarie Marshes and the Gwydir Wetlands. The range of many waterbird species extends further afield from the Macquarie Marshes to key ecological assets including the Booligal Wetlands, Barmah-Millewa Forest, Coorong and Lower Lakes.

Native vegetation along the northern unregulated rivers is also highly significant. An example is the ecological community of coolibah-black box woodland on the Culgoa River floodplain which is listed as endangered under Commonwealth legislation. Important riparian and floodplain vegetation in the dryland catchment areas include lignum, river red gum, river cooba black box, and coolibah. There is a high proportion of remnant vegetation in good condition in some areas, including the floodplains of the Warrego and Culgoa rivers.

The northern unregulated rivers support **wetlands** that provide internationally significant waterbird and migratory bird habits, primarily because of their geomorphology (e.g. standing water for periods) and vegetation. An important example is the Narran Lakes. Parts of this lake system are listed under the Ramsar convention of wetlands of international importance. Additionally, the northern unregulated rivers support nationally significant wetlands, including the Cuttaburra Basin in the Warrego includes the nationally significant Yantabulla Swamp, the Talyawalka Anabranch-Teryaweynya Creek, and the Balonne River Floodplain.

In between boom periods river channels typically dry to a series of disconnected waterholes, which are **drought refuges** that are reconnected by the next significant flow event. Semi-permanent and permanent waterholes in the main river channels and distributary creeks and anabranch systems are critical to ensuring the survival of species between boom periods and their capacity to recolonise the system in subsequent flow periods. Much of the riverine fauna (e.g. fish, turtles, invertebrates) of the northern unregulated systems is dependent upon the persistence of a network of refugial waterholes during frequent and often prolonged no flow periods.

The Barwon-Darling river channel connects all the rivers, lakes and wetlands in the northern Basin, providing a critical dry period refuge and movement corridor for fish and waterbirds, as well as habitats for other aquatic species including turtles, mussels, and shrimp. This longitudinal connectivity is particularly important for regional communities of native fish and other aquatic species. Diverse in-stream habitats including channels, deep pools, riffles, benches, snags, gravel beds and aquatic and riparian vegetation support a significant native fish community and a healthy community of. Lakes and wetlands along the floodplain provide water bird breeding sites and staging posts for migratory species.

1.2. Environmental objectives and outcomes in the northern unregulated rivers

The long-term environmental objectives and expected outcomes for the Murray-Darling Basin are described in the Basin Plan's environmental watering plan and the Basin-wide environmental watering strategy (the Strategy). The Strategy includes quantified environmental outcomes at both a Basin-scale and for each catchment—outcomes relevant for the northern unregulated rivers catchment are described in Attachment B.

Basin state governments are also developing long-term watering plans for each catchment. These plans will identify the priority environmental assets and ecosystem functions in the catchment, the objectives and targets for these assets and functions, and their watering requirements. Once developed, these plans will provide the key information on the long-term environmental water demands in the catchment. Prior to the development of long-term watering plans, the CEWO will continue to draw on existing documentation on environmental water demands developed by state governments, local natural resource management agencies and the Murray-Darling Basin Authority (MDBA).

Based on these strategies and plans, and in response to best available knowledge drawing on the results of environmental watering monitoring programmes, the outcomes being targeted by environmental watering in the northern unregulated rivers are summarised in Table 1 below. The objectives for water-dependent ecosystems will continue to be revised as part of the CEWO's commitment to adaptive management.

Table 1: Summary of long-term expected outcomes from environmental watering in the northern unregulated rivers

BASIN-WIDE OUTCOMES (Outcomes in red link to the Basin-wide Environmental Watering Strategy)	**EXPECTED OUTCOMES FOR NORTHERN UNREGULATED RIVERS ASSETS**		
	IN-CHANNEL ASSETS	**OFF-CHANNEL ASSETS**	
		Wetlands, lagoons and billabongs	**Anabranches and effluent creeks**
VEGETATION	Maintain riparian and in-channel vegetation condition, growth and survival	Maintain and improve wetland vegetation condition, growth and survival in targeted sites. Maintain floodplain vegetation (with use of unregulated holdings and flows).	
WATERBIRDS		Maintain foraging, roosting and breeding habitats at targeted sites on the floodplain to support waterbirds.	
FISH	Provide flows that improve habitat conditions and support different life stages (migration, spawning, recruitment, refuge)	Support natural flow variability and connectivity between the river channel, wetlands anabranches and floodplains	
INVERTEBRATES	Provide habitat (e.g. pools and riffles) and conditions (low flows, freshes, scouring flows) to maintain /improve micro and macroinvertebrate condition and diversity.		
OTHER VERTEBRATES	Provide habitat and conditions to support survival and recruitment of native aquatic fauna (e.g. platypus, native water rat, frogs, turtles)		
CONNECTIVITY	Support longitudinal connectivity in the major unregulated streams	Support lateral and longitudinal (anabranches) connectivity between the river and wetlands and floodplains	
PROCESSES	Support primary production, nutrient and carbon cycling and biotic dispersal and movement		
WATER QUALITY	Maintain water quality within channels and pools	Support more natural water temperature, flow regimes and connectivity to support nutrient cycling and water quality benefits	
RESILIENCE	Provide refuge habitat for fish and other aquatic fauna		

Information sourced from: CEWO (2014), Davie and Mitrovic (2014), Kingsford (1999), McGinness and Arthur (2011), MDBA (2012), NSW DWE (2009a, b), SKM (2009, 2012), Thoms et al. 2005, Australian Wetlands (2009),

1.3. Environmental flow requirements

Occasional flow events are important features of the northern unregulated rivers. In some rivers, these flow events may only occur once or several times in a year. Although seasonal flow patterns have largely been preserved in the unregulated northern rivers, diversions during unregulated flow events and flow changes due to small public regulated water schemes (such as the Condamine-Balonne) and in-stream weirs with diversions to private infrastructure have reduced the volume, duration and frequency of flows that support in-stream and floodplain communities, and terminal wetlands in some areas. End of system flows have been reduced in all systems. Low flow regimes have also been affected in some areas including an increase in the percentage of time with no flow and the maximum period between events that refill waterholes and re-establish hydrological connectivity throughout the system.

The MDBA assessed the environmental flow requirements of streams across the Basin in 2012. In 2016 the MDBA re-assessed the environmental water requirements of the Barwon-Darling and Condamine-Balonne systems, based on an improved science base (MDBA 2016).

The CEWO has worked closely with water recovery teams of Commonwealth and state government to ensure that unregulated entitlements recovered in the northern unregulated rivers provide flows that contribute towards meeting the environmental flow requirements. Where long term outcomes are not being met, short-term or urgent environmental demands, if feasible, can be addressed progressively into the future by using event based mechanisms and other active management approaches, discussed in section 2.

1.4. Monitoring and adaptive management

Operational monitoring is undertaken for all Commonwealth environmental watering actions and involves collecting data such as volumes delivered, impact on the river system's hydrograph, area of inundation and river levels. The CEWO monitors stream flows in the northern Basin using real-time data from river gauges, to quantify how Commonwealth unregulated entitlements are enhancing river flows. River flow data in conjunction with official announcements of water harvesting access in Queensland systems (Lower Balonne, Border Rivers, Warrego) are used to estimate the contribution Commonwealth unregulated entitlements make to flows. Water accounting is based on the assumption that water is used at all available opportunities (when flow conditions are triggered) up to allowed limits. This reflects the use pattern of the majority of irrigators in unregulated systems and hence the volumes and pattern of flows that are likely to have been reinstated to the systems.

Long Term Intervention Monitoring (LTIM) is also being undertaken at the junction of the Warrego and Darling Rivers Selected Area (at Toorale). It aims to evaluate the contribution of Commonwealth environmental water delivery in relation to the expected outcomes at the local and Basin scale. At Toorale, this includes considering both local catchment-based Commonwealth unregulated flow contributions and residual inflows from upstream unregulated and regulated sources. Some of the key findings of 2015–16 monitoring of the junction of the Warrego and Darling Rivers LTIM selected area include:

- Commonwealth environmental water from upstream in Queensland made a small (4%) contribution to flows down the Warrego River at Toorale for around 16 days in February/March 2016.
- This flow reconnected previously isolated waterholes which contributed to invertebrate abundance and diversity within this zone and maintained these stable habitats for frogs and waterbirds.
- This flow also stimulated breeding and recruitment of several native fish species including golden perch and Hrytl's catfish.
- During 2015–16 no Commonwealth environmental water allocation was available from the Toorale licenses for the Warrego River due to very low flows.

Further information on the monitoring activities is available at:
http://www.environment.gov.au/water/cewo/catchment/northern-unregulated-rivers/monitoring

Monitoring can also include observations of environmental outcomes, including by state partners. For example, the NSW OEH makes observations and collects data at the Narran Lakes. The outcomes from these monitoring activities, and any other available relevant data, are used in adaptive management to inform portfolio planning and decision-making.

2. Portfolio management in 2017–18

Dams, weirs and other infrastructure used to regulate river flows have a detrimental impact impact on the environment. They change the timing, size and speed of natural flows, create barriers to fish movement, trap nutrients and sediment, and cause problems such as cold water pollution. Compared to the southern Basin, the northern unregulated Basin has less of these regulating structures. This is a positive for the environment but it also can limite options for discretionary use of environmental water. Water cannot be ordered from public storages at a particular time – environmental water can only be sourced as a share of an unregulated flow event, determined by entitlement conditions, or possibly in the future, released from private storages. Carryover and management of account balance cannot generally be used to influence the timing and volumes of environmental water in river systems. There is limited public infrastructure such as dams, weirs and other structures in the region to regulate environmental flows to target particular assets.

Most Commonwealth unregulated entitlements are left in-stream to provide environmental benefits by restoring flows that were formerly extracted and improving flow variability. The ongoing use of existing and future unregulated entitlements in the northern Basin (excluding the Toorale Warrego River entitlements and NSW supplementary water holdings) has been approved by the Commonwealth Environmental Water Holder in 2012. This decision is the default management arrangement for these entitlements but does not preclude alternative uses.

Event based mechanisms are being designed to allow more active management of unregulated entitlements so as to achieve greater ecological outcomes. These mechanisms may include use of in-stream and on-farm infrastructure to store and release water, and temporary purchase, conditional purchase, and forward purchase. Active management could be used to enhance overall flows, alter the timing or rate of flow or to direct flow to a different watercourse or an off-stream asset. Use of private irrigation infrastructure to divert, store, supply and/or re-direct environmental water, may play a key role in increasing the duration of some key flow events due to the lack of public infrastructure in the region for this purpose.

Priorities and intentions for active management in the northern unregulated rivers in 2017–18 were determined using the following steps (shown schematically in Figure 2):

1. Antecedent flows and current catchment conditions were reviewed to identify general environmental water requirements across the northern unregulated rivers region going into 2017–18 (Section 2.1).
2. Some that are feasible or could be become feasible within the coming year or next have been prioritised. There are also areas where there is no need to augment or modify existing in-stream use now or in the future.
3. For catchments with generally high environmental water requirements (from Step 1) and feasible active management options (Step 2), requirements were examined in detail and ranked by urgency. This step focused on the Lower Balonne and Barwon-Darling systems where requirements have been comprehensively assessed and long term flow indicators identified (Table **4** and Table 5).
4. Urgent environmental water requirements with feasible active management options were collated to identify regional priorities for 2017–18 (Table 5).

Figure 2: Prioritisation process for the northern unregulated rivers

2.1. Antecedent and current conditions and the demand for environmental water in 2017–19

The last four years have been characterised by long periods of low and very low stream flow across the northern unregulated rivers. These low and very low flow periods were broken by a period of moderate to high flows which occurred during spring of 2016 in some northern catchments. Prior to these flows it had been six years (2011–12) since significant stream flow and floods were uniformly experienced (Table 2), with the exception of the Condamine-Balonne and Moonie Rivers which had moderate to high flows in 2012–13. Above average day and night-time temperatures combined with lower than average rainfall resulted in flows across all unregulated systems recede following the spring flows. By early autumn 2017, flow patterns in all unregulated systems were dominated by low and very low flow conditions.

A range of ecological assets in the northern unregulated rivers remain under stress due to the prolonged periods of low to moderate flow. For example, the available ecological monitoring in the Condamine-Balonne indicates that despite the spring 2016 flows:

- The spring 2016 flows were sufficient to fill both Clear and Back Lakes of the Narran Lakes and inundate surrounding areas of lignum. However large areas of lignum shrubland which provide waterbird breeding and foraging habitat within the Ramsar wetland site have not been inundated since April 2013 and remain under stress.
- The last large-scale waterbird breeding event observed in the northern unregulated catchments was in March 2012, at Narran Lakes.
- The Birrie and Bokhara rivers, inner channels of the Lower Balonne distributary system, experienced only short periods of flow in the last four years.
- It has been more than five years since woodland communities on the Culgoa River floodplain in the area around the Queensland-NSW border, including the threatened coolibah- blackbox ecological community, have been inundated from river flows.
- Prior to the spring 2016 flows, the Barwon-Darling Rivers experienced a severe and prolonged dry spell. The average flow in the Darling River (Wilcannia) for the three year period leading up to spring 2016 was significantly lower than in any other 3-year period in the observed record (45 years), and less than 5 per cent of the average of annual flows in the last 45 years.

Annual flows at key ecological sites in the northern unregulated rivers between 2007 to 2017 are summarised in Table 1.

Table 2: Annual flows at key sites in the northern unregulated rivers 2007 to 2017 (updated 30 April)

Catchment	Gauge (period of records)	Recent annual streamflow[1]									
		2007–08	2008–09	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17
Border Rivers - Upper (Queensland)	*Severn River at Farnbro (from 1962)*	High	Low	Very Low	Highest on record	Low	Mod	Very Low	Mod	Very Low	High
- Lower	*Macintyre River at Goondiwindi (from 1972)*	Low	Low	Very Low	Highest on record	Mod	Mod	Low	Very Low	Very Low	High
Moonie	*Nindigully (from 1969)*	High	Mod	Very High	Highest on record	Very High	High	Low	Very Low	Very Low	High
Lower Balonne	*St George (from 1971)*	Mod	Very Low	Very High	Highest on record	Very high	High	Low	Low	Low	Mod
Nebine Creek[2]	*Roseleigh Crossing (from 2007)*	Very High	Mod	Highest since 2007	Mod	High	Very Low	Low	Low	High	Mod
Warrego - Upper (Queensland)	*Augathella (from 1967)*	Very High	Mod	High	Highest on record	Very High	Low	Very Low	Low	Lowest on record	Mod
- Mid (Queensland)	*Wyandra (from 1966)*	Very High	Low	Very High	Very High	Very High	Lowest on record	Very Low	Low	Low	Mod
- Lower (NSW)	*Ford's Bridge (from 1972)*	Very High	Very Low	Very High	Very High	Very High	Very Low	Very Low	Low	Very Low	Mod
Barwon-Darling - Upper	*Collarenebri (from 1980)*	Mod	Low	Mod	Very High	Highest on record	High	Low	Low	Very Low	Mod
- Mid	*Bourke (from 1972)*	Mod	Low	Mod	Very High	Very High	Mod	Very Low	Very Low	Very Low	Mod
- Lower	*Wilcannia (from 1972)*	Mod	Low	High	Very High	Very High	Mod	Very Low	Very Low	Very Low	Mod

Notes to Table 2:

[1] Annual catchment streamflow was defined at key locations as follows:

Very low: up to 17.5 per cent rank	Low: 17.5 – 37.5 per cent rank	Moderate: 37.5 – 62.5 per cent rank
High: 62.5 – 82.5 per cent rank	Very high: greater than 82.5 per cent rank	

A rank of 10 per cent means that 10 per cent of the years in the observed record have lower flows than occurred in that year, with 90 per cent of years having higher flows, Data is sourced from NSW Department of Primary Industries –Water (NSW gauge sites) and Queensland Department of Natural Resources and Mines (Queensland gauge sites).

[2] Indicative only. Gauged flow data is insufficient to accurately classify annual streamflow in the Nebine Creek catchment.

2.2. Feasibility of active management by catchment

The *Water Act 2007* provides for the trade of Commonwealth environmental water (allocations and entitlements) and specifies the conditions under which sales may occur. To improve environmental outcomes must be the primary reason for trade of Commonwealth Environmental water. The Commonwealth Environmental Water Holder has no plans to trade entitlements in 2017-18. In most northern unregulated catchments the trade of water allocation is not an appropriate or available strategy, and an alternative method would be to enter contracts with water licence holders as part of an event based mechanism.

The recent work by the CEWO to develop event based mechanisms has focused on the Narran Lakes. Findings will be extended to other catchments in due course.

Feasibility of active management in northern unregulated catchments is assessed in Table 3, using the criteria on operational readiness and environmental demand listed in Figure 2. Overall conclusions include:

- Any development and implementation of new event based mechanisms in 2017–18 is likely to focus on actions in the Lower Balonne. Further due diligence work would test whether the regulatory and compliance regime would support the implementation of these measures.

- Active management of the Commonwealth's unregulated holdings on the Warrego River at Toorale will continue in accordance with the existing 5-year strategy for utilisation of these entitlements, approved by the Commonwealth Environmental Water Holder in December 2013 (Attachment C). Water available after license conditions are triggered will be directed either downstream to enhance low or fresh flows in the lower Warrego and Darling rivers, or to wetland areas on the Warrego Western Floodplain, depending on the relative environmental demand in these areas at the time of the flow. The strategy includes a decision tree that helps determine environmental priorities and volumes to be used or carried over. Factors considered include antecedent flows, current in-stream and wetland conditions, the size and duration of the flow and implications for environmental water availability in future years.

- Active management in the Barwon–Darling River also has potential. Management of environmental flows from multiple sources (tributaries and entitlement types) is likely to be most effective in this system, leading to more complex operational issues around the coordination, protection and measurement of actively managed flows than in self-contained locations such as the Narran River. The Barwon-Darling may be a focus for scoping and development of active management options in 2017–18, informed by any trial actions undertaken in the Lower Balonne. Any progress would be subject to due diligence, and consideration of the regulatory and compliance frameworks in place.

Table 3: Potential for active management in northern unregulated river catchments

Catchment	Environmental need			Feasibility				Possible actions *[italicised actions are the proposed focus of development in 2017–18]*	Key issues	Priority for 2017–18
	Specific environmental demands for catchment or target asset?	Long-term shortfall in meeting demand	Active management contributes to environmental requirement	Established market or willing buyers & sellers?	Flexible statutory trading options	CEWO water trading framework	Operationally feasible in 2017–18			
Lower Balonne (Queensland)	YES	YES	YES	YES	NO But trade possible outside statutory system	YES Under development	YES	- *Waterhole filling flow in Lower Balonne distributary channels* - *Narran Lakes 25 GL inflow* - *Narran Lakes 50 GL inflow* - *Support waterbird breeding event in Narran Lakes* - Enhance medium to large fresh in the Culgoa River for fish migration	- Measurement and compliance measures to ensure additional purchased flows achieved - Risk of diversion of additional purchased flows and substitution for planned environmental water	YES
Warrego NSW (Toorale)	YES	YES	YES	N/A	N/A	NO	YES	- Enhance flows to: *The Warrego and Darling rivers to improve low or small fresh flows and provide opportunities for native fish (movement, spawning, recruitment) OR* *Toorale Western floodplain for wetland vegetation and waterbird habitat*	- Measurement and accounting of managed and overall flows - Timely access to infrastructure in wet conditions and due to remote location	YES
Barwon-Darling (NSW)	YES	YES	YES	YES	YES	NO	POSSIBLE In 2017–18	- *Dry spell breaking low flow to maintain basic aquatic habitat & water quality* - Small fresh for connectivity for most of system - Small fresh at Louth for system wide connectivity - Larger fresh at Bourke for fish migration - Water off-stream wetland for waterbird, vegetation and potential cultural benefits	- Protection of any additional purchased in-stream flows - Risk of substitution of additional purchased volumes for planned environmental water - Requires investigation of target water products, locations, timing and hydrological outcomes - Requires development of event based mechanisms and contracts - Coordination of managed flows over long distances	YES
Border Rivers	YES For some assets		YES	YES	YES	YES Specialised system unlikely to be required	UNLIKELY In 2017–18	- *Improve wetland connectivity in lower Macintyre River by obtaining additional unregulated access*	- Protection of additional flows - Infrastructure delivery and access arrangements - Accounting & compliance	NO
Warrego Queensland	NO	NO	NO	NO	NO	NO	NO	- Water off-stream wetland - Augment flows to Cuttaburra Creek	- Suitable wetland(s) not identified - Demand is likely to be met under existing conditions/recovery	NO
Moonie (Queensland)	NO	NO	NO	NO	NO	NO	NO	- Water off-stream wetland to benefit waterbird habitat/breeding and wetland vegetation - Augment end of system flows into the Barwon River	- Suitable wetland(s) not identified - Limited volumes held or available for purchase - Protection of in-stream flows in the Moonie & Barwon-Darling	NO
Nebine Creek (Queensland)	NO	NO	NO	NO	NO	NO	NO	- None identified	- Lack of data on flows, long term hydrology, environmental values	NO

2.3. Priority environmental demands

Comprehensive long term environmental water requirements for the Lower Balonne and Barwon-Darling systems have been identified during development of the Basin Plan and in the Northern Basin Review process (MDBA 2016). Prioritisation of environmental demands in these catchments is shown in Table 4 and Table 5. High flow/volume/duration demands that are out of scope for active management are also identified. The volumes of additional actively managed flows that are likely to be available would not make a material contribution to meeting these demands.

Priority demands in the different catchments were collated and ranked qualitatively to obtain a prioritised list of urgent environmental demands in the northern unregulated rivers going into 2016–17. This step is shown in Table 6.

Table 4: Environmental demands and priorities for active management of Commonwealth environmental water in the Lower Balonne for 2017–18

Umbrella environmental asset	Specific site /ecological process	Flow/volume, stream gauge	Duration (Days)	Average required frequency (maximum interval)	Likelihood of being met in the long term[A]	Watering history (from all sources of water)												2017–18	
						2005–06	2006–07	2007–08	2008–09	2009–10	2010-11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	Predominant urgency of environmental demand for water	Potential for <u>active management</u> of environmental water?[B,C]
						Low	Very low	Moderate	Very Low	Very High	Highest on record	Very High	High	Low	Low	Low	Moderate		
Lower Balonne River channels	Lower Balonne distributary channels - drought refuge (waterholes)[1,2]	Flow reaches end of all channels within a three month period, indicated by[1]: 30 ML/day Birrie River @ Talawanta 30 ML/day Bokhara River @ Bokhara 30 ML/day Culgoa River @ Weilmorigle 30 ML/d Narran River @ Narran Park	1 day	Annually	Not Met											No end of system flow		<u>High</u> Water is required annually to fill waterholes. While a filling flow has occurred in all of the last 12 years, the spell (interval) between events has exceeded 350 days, a critical threshold representing the average persistence time of key refugial waterholes in the Narran and Culgoa Rivers[2], on three occasions (grey shading).	**Low to Moderate** Likely to be met in the Culgoa and Narran River through existing Resource Operations Plan conditions and in-stream CEW. Active management (augmentation of flows) could be considered to meet requirements in the Bokhara River for threatened fish species Action consistent with the 2016–17 Basin Environmental Watering Priority to: *Maintain waterholes in the Lower Balonne floodplain to provide critical refuge for water-dependent species*
	Culgoa River - longitudinal connectivity[3,4]	Small in channel fresh 1 000 ML/day @ Brenda	7	8 to 9 in 10 years	Not Met													<u>High</u> A small fresh is required in most years to provide for basic ecological functions	**Moderate** Active management could be used to enhance flows in near miss events at all available opportunities given that this near annual demand is not likely to be met in the long term.
	Narran River – fish migration[3,4]	Large in-channel fresh 1 700 ML/day @ Wilby Wilby (August - May)	14	4 to 6 in 10 years	Not Met													<u>High</u> A small fresh needed this year to maintain healthy fish populations and provide for dispersal and recruitment. The interval since last flow (3 to 4 years) is near to the lifespan of short lived fish species	**Moderate** Active management could be used to enhance flows in near miss events. Demand could be met in the Narran River in conjunction with a purchase (water harvesting pumping opporutnity) to achieve a 25 GL inflow into Narran Lakes
	Culgoa River – fish migration [3,4]	Large in-channel fresh 3 500 ML/day @ Brenda (August - May)	14	4 to 6 in 10 years	Met													<u>Critical</u> A large fresh is required this year to maintain healthy fish populations and provide for dispersal and recruitment. Interval since the last flow - 4+ years - exceeds or approaches the lifespan of short lived fish species.	**Low** Potential for active management requires further investigation. Uncertain if sufficient additional flows could be obtained, and would likely have to target one channel not whole system
Lower Balonne River floodplain	Connectivity with the riparian zone[5-9]	9 200 ML/day Culgoa River @ Brenda	12	Every 2 to 3 years	Not Met													<u>Critical</u> Inundation required this year to maintain ecosystem health and function. 4 years since last flow - exceeds critical interval (3 years) to maintain condition of river red gum forests[F]	**Probably out of scope for active management** Benefit of supplying additional CEW would be negligible.
	Connectivity with the inner floodplain[5-9]	15 000 ML/day Culgoa River @ Brenda	10	Every 3.5 to 4 years	Not Met													<u>High</u> Inundation required this year to maintain ecosystem health and function. Interval since last flow (4+ years) exceeds the critical interval to maintain condition of river red gum forests and within interval to sustain lignum (3 to 5 years) and vigorous growth of blackbox (5 to 7 years)	**Out of scope for active management** Benefit of supplying additional CEW would be negligible

Umbrella environmental asset	Specific site /ecological process	Flow/volume, stream gauge	Duration (Days)	Average required frequency (maximum interval)	Likelihood of being met in the long term[A]	Watering history (from all sources of water)												2017–18	
						2005–06	2006–07	2007–08	2008–09	2009–10	2010-11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	Predominant urgency of environmental demand for water	Potential for <u>active management</u> of environmental water?[B,C]
						Low	Very low	Moderate	Very Low	Very High	Highest on record	Very High	High	Low	Low	Low	Moderate		
	Connectivity with the mid floodplain[5-9]	24 500 Ml/day Culgoa River @ Brenda	7	Every 6 to 8 years	Met													<u>Low</u> Inundation required within the next two years to maintain ecosystem health and function	**Out of scope for active management** Benefit of supplying additional CEW would be negligible
	Connectivity with outer floodplain [5-9]	38 000 ML/day Culgoa River @ Brenda	6	Every 10 to 20 years	May be Met													<u>Very low</u> Critical interval for inundation, since the 2010-11 and 2011-12 floods, will be around 2020	**Out of scope for active management** Benefit of additional CEW would be negligible
Narran Lakes	Waterbird breeding habitat in northern lakes (Ramsar site)[8,10-14]	25 GL @ Narran Park (Narran River) over 60 days	N/A	Every 1 to 1.3 years	Met													<u>High</u> Inflows required this year to sustain core lignum waterbird habitat and abillity to support waterbird breeding. While the interval since last fully successful event (4.5 years) exceeds interval for vigorous growth and maximum without development spell, an inflow of 24 GL occurred during 2016 -17 water year reducing the urgency of this environmental water requirment	**High** Event based mechanisms could be used to augment near miss events Consistent with 2016–17 Basin Environmental Watering Priority: *In moderate conditions, support waterbird populations by watering critical breeding and feeding habitats at important Basin environmental assets for waterbirds*
	Waterbird breeding and foraging habitat northern lakes zone[8,10-14]	50 GL @ Narran Park over 90 days	N/A	Every 1.3 to 1.7 years	Met													<u>Critical</u> Inflows are required this year to sustain lignum shrublands and maintain condition of riparian red gum forests. Interval since last inflow (4.5 years) exceeds the maximum modelled without development spell	
	Trigger and maintain large scale colonial waterbird breeding[8,10-14]	154 GL @ Narran Park over 90 days	N/A	Twice in every 8 to 10 years	Not Met			large scale breeding		minor breeding	minor breeding	large scale breeding						<u>Moderate to High</u> 4+ years since last large scale waterbird breeding event. Event required this year or next to provide ibis populations (with Narran site fidelity) with 2 breeding opportunities in their lifetime. An acute and chronic shortage of waterbird breeding across the Basin and the likelihood of this demand not being met in the long term, increases its urgency.	**High** Additional water from private storage could be provided to support a waterbird breeding event after initiation if required Consistent with 2016–17 Basin Environmental Watering Priority: *In moderate conditions, capitalise on opportunities to support waterbird breeding*
	Water all floodplain and wetland habitat in Narran Lakes complex, initiate waterbird breeding, provide long-term refuge	250 GL over 180 days @ Narran Park	N/A	Every 10 to 12 years	May be Met													<u>Very low</u> Following the 2010-11 and 2011-12 floods, the critical interval for inundation will be from 2020 (if not received before then)	**Out of scope for active management** Benefit of additional CEW would be negligible

Notes to table: Table 4

A. As indicated by hydrological modelling undertaken by the Murray-Darling Basin Authority (northern Basin review and in developing the Basin Plan) testing outcomes for flow indicators under a number of different water recovery scenarios to meet tributary catchment targets and the shared reduction for the Barwon-Darling system

B. Ongoing in-stream use of unregulated Commonwealth entitlements ('passive management') will contribute to all listed demands. Contributions from unregulated entitlements are subject to suitable flow events and are determined by the characteristics of each particular flow (peak, duration, losses) and the access conditions of held entitlements.

C. Potential for active management is based on demand (antecedent conditions, required frequencies of flows) and whether active management is in scope for the particular demand. The larger volume demands are generally out of scope because it is unlikely to be feasible to obtain the additional volume and/or funding required to make a significant contribution to these demands. Potential does not relate to the likelihood of a suitable flow event occurring in 2016-17, which cannot be predicted. Implementation will always be subject to a suitable unregulated trigger flow.

Key - events in previous years

- means demand was met by Commonwealth environmental water or any other source
- means demand was partially met by Commonwealth environmental water or any other source (may be used to indicate infrastructure assisted delivery)
- means water not provided (or not required)

Note that not all demands require water every year; drying phases are important for floodplains and temporary wetlands or streams

Key - potential watering in 2016-17

- means a high priority for Commonwealth environmental watering (full or partial contribution, and subject to seasonal and operational considerations)
- means a secondary priority for Commonwealth environmental watering, likely to be met via other means (other water holders, or natural flows)
- means a low priority for Commonwealth environmental watering

Key - urgency of environmental demands

- means critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage
- means high demand for water i.e. needed in that particular year
- means moderate demand for water i.e. water needed that particular year and/or next
- means low demand for water i.e. water generally not needed that particular year
- means very low demand for water i.e. water generally not needed that particular year or the following year

Note that demand is considered at a generalised scale; there may be specific requirements that are more or less urgent within the flow regime

References for Table 4:

1 Condamine and Balonne Resource Operations Plan (s269); pers comm P. Harding, Consulting Hydrologist Queensland DSTI 20 Feb 2015 .

2 DSITI (Department of Science, Information Technology and Innovation) 2015, *Waterhole refuge mapping and persistence analysis in the Lower Balonne and Barwon-Darling rivers*. Queensland Department of Science, Information Technology and Innovation, Brisbane

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4 Marshall, J, Menke, N, Crook, D, Lobegeiger, J, Balcombe, S, Huey, J, Fawcett, J, Bond, N, Starkey, A and Sternberg, D 2016, 'Go with the flow: the movement behaviour of fish from isolated waterhole refugia during connecting flow events in an intermittent dryland river', Freshwater Biology, 21 January 2016 (date online version prior to inclusion in an issue).

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10 Thomas, RF, Karunaratne, S, Heath, J and Kuo, W 2016, Assessment of site-specific flow indicator inundated areas in vegetation of Narran Lakes, report prepared for MDBA by the NSW Office of Environment and Heritage, Sydney

11 Thoms, M, Capon, S, James, C, Padgham, M and Rayburg, S 2007, Narran Ecosystem Project: the response of a terminal wetland system to variable wetting and drying, report prepared for the MDBC, Canberra

12 ANU (Australian National University) Enterprise 2011, 'Decision Support System for the Narran Lakes', final report to the NSW Department of Environment, Sydney

13 Merritt, W, Spencer, J, Brandis, K, Bino, G, Harding, P and Thomas, R 2016, Review of the science behind the waterbird breeding indicator for Narran Lakes, report prepared for the MDBA, Canberra

14 Brandis, K and Bino, G 2016, A review of the relationships between flow and waterbird ecology in the Condamine-Balonne and Barwon-Darling River Systems, report prepared for the MDBA by Centre for Ecosystem Science, UNSW, Sydney

Table 5: Environmental demands and priorities for active management of Commonwealth environmental water in the Barwon-Darling for 2017–18

Environmental assets	Specific site /ecological process	Flow/volume, stream gauge	Duration (Days)	Average required frequency (maximum interval)	Long term expected outcomes[A]	Watering history (from all sources of water)											2017 -18	
						2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012–13	2013–14	2014–15	2015–16	2016–17	Predominant urgency of environmental demand for water	Potential for <u>active management</u> of environmental water?[B,C]
						Mod	Low	Moderate	Low	High	Very High	Very High	Moderate	Very Low	Very Low	Very Low	High		
Dry spell breaking low flow pulse over extended river reach	Dry period refuge (waterholes), basic fish habitat	10-20 GL tributary inflow Indicative trigger: > 40 days nil flow @ Bourke > 60 days nil flow @ Wilcannia	10 to 20 days (inflow)	As required to offset an unusually long nil flow spell	May be met		Max spell 332 days (Wilcannia)		Max spell 88 days	Max spell 84 days				Max spell 101 days	Max spell 139 days	Max spell 77 days		<u>Moderate</u>	**Moderate** End of system regulated delivery from Gwydir and/or Border Rivers, Namoi if required
		500 ML/day Barwon River @ Walgett	7 – 20	1 - 3 times a year in an average of 8-9 years out of 10	May be Met													<u>Low</u>	End of system regulated delivery and or reduction in unregulated access - Gwydir and/or Border Rivers, Namoi if water availability improves. Flows at this level could potentially be enhanced by additional A/B class access in the Barwon-Darling
		500 ML/day Darling River @ Bourke	7 – 20	1 - 2 times a year in an average of 8-9 years out of 10	May be Met													<u>Low</u>	
		350 ML/day Darling River @ Louth	7 - 14	1 – 2 times a year in an average of 8-9 years out of 10	May be Met													<u>Low</u>	Flows could be enhanced by directing Commonwealth environmental water from entitlements on the NSW Warrego (Toorale) to the Darling. Subject to trigger flows in the Warrego River and use in the Darling being the priority under CEWO's use strategy for the Toorale entitlements. In future additional A/B class access around Bourke could also contribute to meeting this requirement
Small in channel freshes – **Longitudinal connectivity (1)**	Small scale fish movement/ access to habitat (snags, in channel benches Brewarrina to Bourke)	6,000 ML/day Darling River @ Bourke	14	8 to 9 in 10 years	May be Met													**Out of scope for active management** Benefit of supplying additional CEW would be negligible; sources of additional water are too far upstream	**Low (as not ready for implementation)** **High (in future)** Flows near this level could potentially be enhanced by additional B/C class access in the Barwon-Darling, unregulated access in tributaries and/or end of system regulated deliveries. Low immediate priority because trade and operational requirements need further investigation.
		500 ML/d with a minimum peak of 1,500 ML/d Darling River @ Bourke (Sept. to April)	50 with the peak flow for 14	average of 7- 8 out of 10 years	May be Met													<u>Moderate</u>	**Moderate** End of system regulated delivery and or reduction in unregulated access - Gwydir and/or Border Rivers, Namoi if water availability improves 10-20 GL tributary inflow over10 -20 d Flows at this level could potentially be enhanced by additional A/B/C class access in the Barwon-Darling,
	Access to snags and benches, some fish recruitment (Brewarrina to Tilpa)	6,000 ML/day Darling River @ Louth (Aug to May)	20	7 in 10 years	Not met													<u>High</u>	**High** Flows could be enhanced (up to 16 GL @ 600 ML/day) by directing Commonwealth environmental water from entitlements on the NSW Warrego (Toorale) to the Darling. Subject to trigger flows in the Warrego River and use in the Darling being the priority under CEWO's use strategy for the Toorale entitlements. In future additional B/C class access around Bourke could also contribute to meeting this requirement

Environmental assets	Specific site /ecological process	Flow/volume, stream gauge	Duration (Days)	Average required frequency (maximum interval)	Long term expected outcomes[A]	Watering history (from all sources of water)												2017 -18	
						2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012–13	2013–14	2014–15	2015–16	2016–17	Predominant urgency of environmental demand for water	Potential for <u>active management</u> of environmental water?[B,C]
						Mod	Low	Moderate	Low	High	Very High	Very High	Moderate	Very Low	Very Low	Very Low	High		
	Inundation of benches for primary productivity (Tilpa to Wilcannia)	6,000 ML/day Darling River @ Wilcannia twice in a year	7	4.5 to 6 in 10 years	Met													<u>Moderate</u>	**Out of scope for active management** Benefit of supplying additional CEW would be negligible; sources of additional water are too far upstream
Large in channel freshes (1) **Longitudinal connectivity**	Large scale fish migration Walgett to Wilcannia (weir drown out)	10,000 ML/day Darling River @ Bourke (Aug to May)	14	6 to 8 in 10 years	Met													<u>High</u>	**Low** Potential for active management requires further investigation. Uncertain if sufficient additional flows could be obtained - potentially unregulated access in Border, Namoi, Gwydir, Macquarie and B & C access in the Darling.
	Fish recruitment - flow dependent and in-channel specialists eg Murray cod	10,000 ML/day Darling River @ Bourke twice in a year (Aug to May)	20	2.5 to 3.5 in 10 years	May be Met													<u>High</u>	
	Fish recruitment - in-channel specialists eg Murray cod; access to anabranches and wetlands	21,000 ML/day Darling River @ Louth (Aug to May)	20	4 in 10 years	Not Met													<u>Moderate</u>	**Out of scope for active management** Benefit of supplying additional CEW would be negligible
	Inundation of benches for primary productivity (Tilpa to Wilcannia)	20,000 ML/day Darling River @ Wilcannia	7	4.5 to 6 in 10 years	May be Met													<u>High</u>	**Out of scope for active management** Benefit of supplying additional CEW would be negligible
Lateral Connectivity (2-4)	Connectivity with riparian zone including forests	30,000 ML/day Darling @ Bourke	24	Every 2 to 3 years	Not Met													<u>High</u>	**Out of scope for active management** Benefit of supplying additional CEW would be negligible
	Connectivity with inner floodplain including wetlands	45,000 ML/day Darling @ Bourke	22	Every 3.5 to 4 years	Not Met													<u>High</u>	**Out of scope for active management** Benefit of supplying additional CEW would be negligible
	Connectivity with mid floodplain including woodlands	65,000 ML/day Darling @ Bourke	18	Every 6 to 8 years	Not Met													<u>Low</u>	**Out of scope for active management** Benefit of supplying additional CEW would be negligible
	Connectivity with outer floodplain including grasslands, fill Talyawalka Anabranch system	Total volume 2 350 ML Darling @Wilcannia	60	Every 10 to 12 years	May be Met													<u>Very Low</u>	**Out of scope for active management** Benefit of supplying additional CEW would be negligible

Notes to Table 5:

A. As indicated by hydrological modelling undertaken by the MDBA (northern Basin review and in developing the Basin Plan) testing outcomes for flow indicators under a number of different water recovery scenarios to meet tributary catchment targets and the shared reduction for the Barwon-Darling system

B. Ongoing in-stream use of unregulated Commonwealth entitlements ('passive management') will contribute to all listed demands. Contributions from unregulated entitlements are subject to suitable flow events and are determined by the characteristics of each particular flow (peak, duration, losses) and the access conditions of held entitlements.

C. Potential for active management is based on demand (antecedent conditions, required frequencies of flows) and whether active management is in scope for the demand. The larger volume demands are generally out of scope because it is unlkely to be feasible to obtain the additional volume and/or funding to make a significant contribution to these demands. Potential does not relate to the likelihood of a suitable flow event occuring in 2016-17, which cannot be predicted. Implementation will always be subject to a suitable unregulated trigger flow.

References for Table 5

1 NSW DPI (New South Wales Department of Primary Industries) 2015, *Fish and flows in the Northern Basin: responses of fish to changes in flows in the Northern Murray-Darling Basin*, Tamworth, NSW

2 MDBA (Murray-Darling Basin Authority) 2016d,. *Inundation mapping in the Northern Basin review*, Murray-Darling Basin Authority, Canberra (in prep.)

3 Eco Logical Australia 2016 'Vegetation of the Barwon-Darling and Condamine-Balonne floodplain systems of New South Wales: Mapping and survey of plant community types' prepared for the Murray-Darling Basin Authority.

4 Brandis, K and Bino, G 2016, *A review of the relationships between flow and waterbird ecology in the Condamine-Balonne and Barwon-Darling river system Systems*, Murray-Darling Basin Authority, Canberra (in prep)

Key - events in previous years

- means demand was met by Commonwealth environmental water or any other source
- means demand was partially met by Commonwealth environmental water or any other source (may be used to indicate infrastructure assisted delivery)
- means water not provided (or not required)

Note that not all demands require water every year; drying phases are important for floodplains and temporary wetlands or streams

Key - potential watering in 2016-17

- means a high priority for Commonwealth environmental watering (full or partial contribution, and subject to seasonal and operational considerations)
- means a secondary priority for Commonwealth environmental watering, likely to be met via other means (other water holders, or natural flows)
- means a low priority for Commonwealth environmental watering

Key - urgency of environmental demands

- means critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage
- means high demand for water i.e. needed in that particular year
- means moderate demand for water i.e. water needed that particular year and/or next
- means low demand for water i.e. water generally not needed that particular year
- means very low demand for water i.e. water generally not needed that particular year or the following year

Note that demand is considered at a generalised scale; there may be specific requirements that are more or less urgent within the flow regime

2.4. Active management priorities for 2017–18

Based on the assessment in Table 4 and Table 5 and previous sections, the most urgent environmental water requirements for assets in the northern unregulated rivers in 2017 -18 are summarised in Table 6.

Table 6: Priority environmental requirements and active management options in 2017 - 18 in the northern unregulated rivers

Environmental demand	Urgency	Specific actions to be considered in 2017–18
Inundation of core waterbird breeding habitat at Narran Lakes	High	Enhance a flow event to achieve 25 GL inflow to Narran Lakes (action development well advanced)
Fresh in the Culgoa River for fish migration	Critical	Targeted flow enhancement to achieve 3 500 ML/day at Brenda for 14 days
Inundation of waterbird breeding and foraging habitat in northern zone of Narran Lakes	Critical	Enhance a flow event to achieve 50 GL inflow to Narran Lakes (action development well advanced)
Toorale Western Floodplain wetland inundation	High	Enhance overflow from Boera Dam to the Western Floodplain[#]
Fresh in the Narran River for fish migration	High	Enhance flows to achieve 1,000 ML/day for 14 days at Wilby Wilby. (Likely to overlap with 25 GL Narran inflow option, action development well advanced)
Fresh to inundate snags and benches, enable some fish recruitment along the Barwon-Darling	High	Use Toorale Warrego entitlements to help enhance Darling flows to 6 000 ML/day at Louth for 20 days[#]
Lower Balonne channels drought refuge (waterholes)	High	Enhance flows with purchased unregulated/regulated water to achieve flow through in all channels particularly Bokhara and Birrie
Dry spell breaking small pulse along extended reach of Barwon-Darling	Moderate	End of system regulated delivery in a tributary catchment to restart flow in the Barwon-Darling. Take into account the current regulatory / compliance framework in the Barwon-Darling, and the flows at which diversions are permitted under licence.
Large scale waterbird breeding event at Narran Lakes	High	Support breeding event with additional inflows if required (action development well advanced)

active management at Toorale National Park in 2017 - 18 will be in accordance with the approved 5-year strategy for utilisation of the Commonwealth's unregulated entitlements on the NSW Warrego River based on highest environmental demand.

Delivery in 2017–18

In 2017–18 development of new event based mechanisms options in the northern unregulated rivers will focus on options that are feasible to implement within the next 24 months and which address the most urgent environmental demands (Table 6). There will be an emphasis on the Narran Lakes. Small active deliveries to anabranches in the Lower Border Rivers or flow enhancement in the Culgoa River (Lower Balonne) for fish benefits may also be considered if the associated delivery and contractrual arrangements can be progressed sufficiently.

Although a priority order of active management options has been defined based on urgency of the associated environmental requirements (Table 6), each action is appropriate to a specific flow situation, and will only be viable if there is suitable trigger unregulated flow event. For example, a medium flood at St George is needed to trigger Narran Lakes 25 GL inflow action, while the Lower Balonne distributaries action is applicable to a very small flow pulse that otherwise may not reach to the end of the system, and provide longitudinal continuity and replenishment of waterholes.

The likelihood in any given year of there being a suitable trigger for any active management option based on achieving a target river or end of system flows, is low. Consequently, in practice opportunity, in the form of a suitable trigger unregulated flow event, will be a strong driver for implementation of active management in 2017–18 and beyond.

Active management at Toorale National Park, to achieve targeted outcomes in the lower Warrego/Darling Rivers or the Western Floodplain, will continue in 2017–18 in line with the CEWO's existing strategy for utilisation of the unregulated entitlements on the Warrego River at Toorale.

Murray-Darling Basin-wide environmental watering strategy and 2017–18 annual priorities

In contributing to these demands, the Commonwealth Environmental Water Office will also be aiming to contribute to the expected outcomes in the Basin-wide environmental watering strategy (see Attachment A) and the following 2017–18 Basin annual environmental watering priorities relevant to the northern unregulated rivers.

- Improve flow regimes and connectivity to maximise the ecological function of the Barwon-Darling river system for native fish
- Support viable populations of threatened native fish and maximise opportunities for range expansion and the establishment of new populations
- Improve the abundance and diversity of the Basin's waterbird population
- Enable recruitment of trees and support growth of understorey species within river red gum, black box and coolibah communities on floodplains that received overbank flooding during 2016 by inundating the floodplains again

The Commonwealth Environmental Water Holder will not inundate private land without prior approval from land holders while contributing to the Basin annual environmental watering priorities.

2.5. Water availability in 2017–18

Water availability depends on the flow events that occur. Unregulated entitlements provide opportunistic access to unregulated river flows and overland flows when a flow event reaches levels specified in entitlement conditions and/or water resource plan triggers at which a period of access may be announced are met. Each entitlement will make a contribution to restoring in-stream flows reflecting its particular flow access windows, take rates and location. Daily, instantaneous, annual or multi-year limits cap overall diversions in any given year or flow event, and likewise the in-stream contributions that can be attributed to unregulated Commonwealth entitlements.

The outlook for the early season (June to August 2017) suggests a higher likelihood of dry conditions than wet conditions. There is a low chance (25 to 40 per cent) of above average rainfall across the northern unregulated rivers and there is a high likelihood of above average day time temperatures. However, forecasting skill at this time of year is low and winter is typically a low rainfall and streamflow period in the north, so the short term outlook should not be taken as a reliable predictor of significant unregulated flow events in 2017–18. Unregulated flows cannot be predicted with any certainty. Large flows in northern unregulated rivers typically rely on rainfall events in headwater areas of catchments where overall rainfall is much higher than in the semi-arid lowland areas.

At 31 May 2017, Commonwealth unregulated water holdings in the northern Basin comprise around 128 gigalitres expressed as long-term average annual yield. This total includes supplementary water in the Gwydir and Macquarie catchments (about 6 gigalitres long term average annual yield). Commonwealth unregulated environmental water holdings in the northern Basin now exceed those of regulated water. Further detail on sources of environmental water in the northern unregulated catchments is provided in Attachment D.

The total volume of water that is available (with full activation of all unregulated entitlements in the northern unregulated rivers in 2017–18 exceeds 270 gigalitres (excluding supplementary water). However, this upper limit would rarely, if ever be realised and high utilisation is only likely in very wet years. For example, total utilisation of Commonwealth environmental water across all northern unregulated catchments in 2015–16 (to May 2016), a dry year, was only around 20 gigalitres. In the Lower Balonne in a medium flood leading to some low level floodplain inundation, around 100 gigalitres total opportunity for take could be expected from current Commonwealth unregulated holdings in the system; in small to medium flows total opportunity of around 50 gigalitres is likely, with up to about 25 gigalitres in very small flow events.

Around 10 to 20 gigalitres per action of additional environmental water could potentially be used in active management options such as temporary purchase to enhance flow events in the lower Balonne.

Information on volumes accessed for in-stream use or used actively from Commonwealth unregulated environmental water holdings during the water year can be found at http://www.environment.gov.au/water/cewo/portfolio-mgt/holdings-catchment and is updated monthly.

2.6. Stakeholder Feedback

Input on environmental demands and active management options for the northern unregulated rivers have been sought during 2016–17 and in previous years. Event based mechanisms have been discussed with lower Balonne stakeholders and Queensland departments of Natural Resources and Mines (DNRM) over the last few years and will continue in 2017–18.

A joint project between the DNRM, Queensland Department of Environment and Heritage Protection and the CEWO was undertaken to establish a Code of Practice for the release of water from off-river storages in accordance with Queensland environmental protection law. The Code of Practice was finalised in late 2016, and was gazetted in early 2017.

The above agencies, along with the NSW OEH, NSW Department of Primary Industries (Water and Fisheries divisions), Border Rivers Environmental Water Network, Water NSW and the Queensland Murray-Darling Committee Inc. and Eco Logical Australia (consultants) also provided input and feedback on the active management options in Lower Macintyre River in previous years.

Feedback has included:

- There is support and interest in participation in event based mechanisms amongst Lower Balonne water users, community representatives and Queensland agencies.
- Queensland agencies, community organisations and representatives of the fisheries departments in both states support a trial watering action in the lower Macintyre River targeting near channel wetlands and fish outcomes through enhancing an unregulated flow event. The proposal to use additional unregulated water rather than regulated deliveries (by trading or swapping these types of holdings) was considered ecologically sound. Further consultation would be required prior to implementation.
- Whilst most parties would like trial actions to be undertaken as soon as possible, there is a recognition that developing water trading processes, the requirement for a suitable unregulated trigger flow event/conditions and resolution of water quality issues (for options that include a release from private storage) may delay or constrain implementation of active flow augmentation in the short-term.

2.7. Identifying Investment Opportunities

Changes to the *Water Act 2007* in 2016 have increased the flexibility for the Commonwealth Environmental Water Holder (CEWH) to use the proceeds of water allocation sales to invest in environmental activities. Under these amendments environmental activities must improve environmental outcomes and be undertaken for the purpose of protecting and restoring environmental assets in the Basin.

The CEWH will publically release a Discussion Paper seeking feedback on what type of activities stakeholders would like the CEWH to consider when developing a framework for future investment in environmental activities.'

It should be noted that proceeds of past water sales must be managed based on the legislation in place at that time and are not available to be used for such activities.

3. Next steps

3.1. From planning to decision making

It is important to distinguish between planning and operational decision making. As shown in Figure 3, planning allows the CEWO to manage the environmental water portfolio in a holistic manner and is an exercise in developing a broad approach or intention, based on the key drivers (demand and supply).

Decision making throughout each year builds on the intention by considering in more detail the specific prevailing factors and additional factors such as costs, risks, and constraints to water delivery and market conditions. The conditions and arrangements in the northern unregulated rivers will be taken into account by the CEWH at the decision making stage.

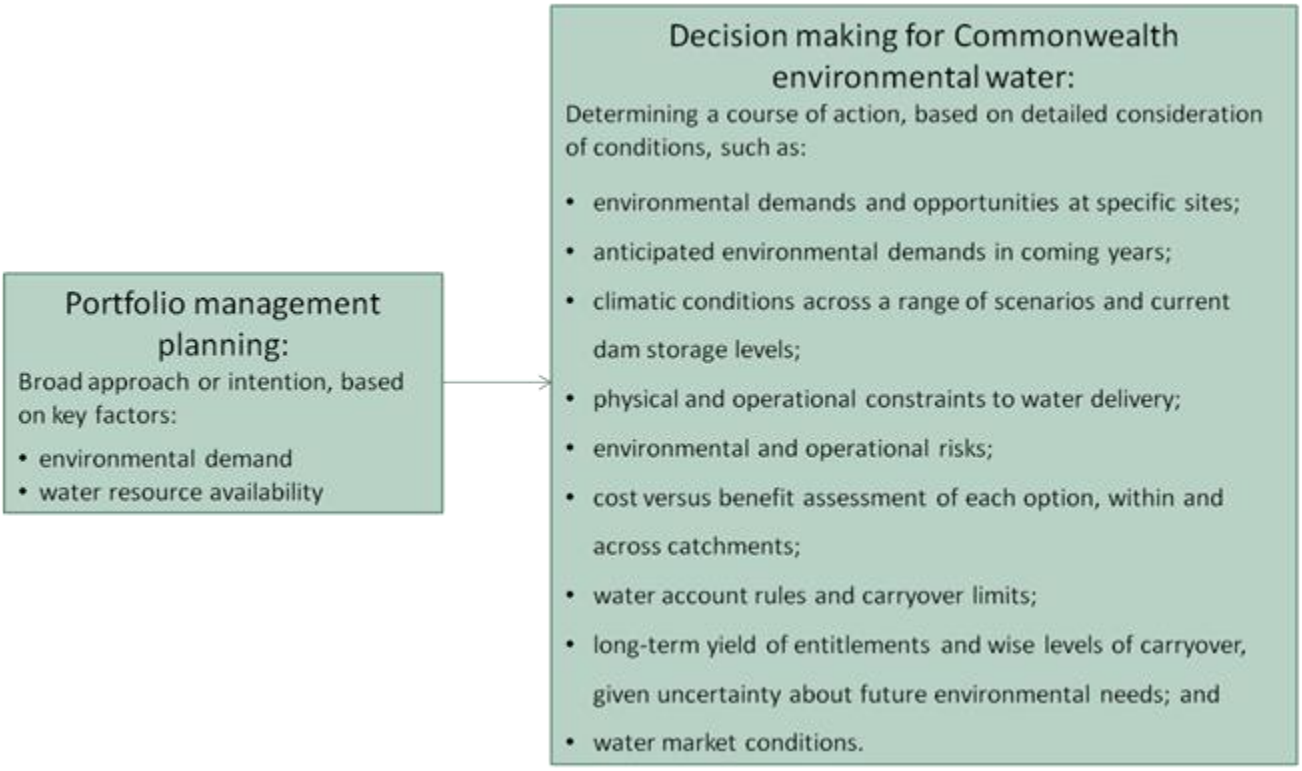

Figure 3: Planning and decision making for Commonwealth environmental water use

3.2. Further information

For further information on how the CEWO plans for water use, carryover and trade, please visit our web site http://www.environment.gov.au/water/cewo

- Water use: www.environment.gov.au/topics/water/commonwealth-environmental-water-office/assessment-framework
- Carryover: http://www.environment.gov.au/topics/water/commonwealth-environmental-water-office/portfolio-management/carryover
- Trade: *Discussion Paper – Trade of Commonwealth environmental water* and *Commonwealth environmental water Trading Framework:* http://www.environment.gov.au/water/cewo/trade/trading-framework

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Attachment A – Further detail on environmental assets of the northern unregulated rivers

Lower Balonne

- Wetlands cover more than 1.4 million hectares of the Condamine-Balonne-Nebine Creek catchment (Nairn and Kingsford 2012), including nationally and internationally important sites:

  - **Balonne River Floodplain** (nationally significant): several hundred hectares of billabongs and swamps within a larger floodplain area below St George in Queensland.

  - **Narran Lakes**: a large system of lakes and floodplain wetlands at the terminus of the Narran River in the Lower Balonne that supports internationally significant waterbird and migratory bird habitat. The northern part of the system is a Ramsar wetland. Narran Lakes is an important breeding site for many species, particularly straw-necked ibis, and also the Australian pelican, great cormorant, pied cormorant, rufous night heron, little egret, intermediate egret and the gull-billed tern (Thoms et al 2008). The lignum shrub lands in the Narran Lake Nature Reserve are some of the largest undisturbed communities of their type in NSW (NSW NPWS 2000).

  - **Culgoa River floodplain**: adjacent national parks in NSW and Queensland protect over 100,000 hectares of the interlinked floodplains of the Culgoa River and Nebine Creek. The Culgoa floodplain is noted for its high plant diversity and low percentage of introduced species (Dick 1993) and large relatively intact expanses of native grassland and coolibah woodland (Hunter 2005), including samples of the threatened ecological community coolibah-blackbox woodland.

Lower Balonne River floodplain: The Lower Balonne River floodplain, covering two million hectares in Queensland and New South Wales, supports the largest area of wetland of any catchment in the Murray-Darling Basin. Native grasslands and coolibah woodlands on the floodplain are some of the most extensive in Australia and are considered to be in near natural condition. The channels of the lower Balonne provide habitat for many aquatic plants and animals, including threatened species such as silver perch and Murray cod. Refugial waterholes that persist in these channels for up to 18 months in the absence of any inflow, are critical to the survival of in-stream fauna (Queensland DSITI 2015).

Warrego

- The Warrego catchment also supports a very large area of wetlands, including lignum swamps, flood channels and waterholes, black box and spike rush swamps, claypans, freshwater lakes and saline lakes (Nairn and Kingsford 2012). Several wetlands are of national importance including the following sites that are dependent on low-medium seasonal flows and large floods in the main river (Holz et al. 2008):

  - **The Warrego River Waterholes**: a string of large, permanent and intermittent waterholes and billabongs covering 500 hectares along the Warrego River channel from Charleville to south of Wyandra. The waterholes support a rich native fish fauna including Murray cod and silver perch. Flows that reconnect the waterholes have been shown to be important for redistributing previously isolated native fish assemblages and for driving recruitment of several species (Balcombe et al. 2006). Significant waterbird populations can also inhabit the waterholes after flooding.

  - **The Warrego River Distributary System** covers 12,000 hectares of open woodlands of coolibah and lignum shrubs in distributary creeks (and their associated floodplain swamps) that break from the Warrego above and below Cunnamulla. They comprise Widgeegoara, Noorama, Thrulgoonia and Tuen Creeks flowing to the south-east and Cuttaburra and Irara Creeks flowing to the south-west.

- **Cuttaburra Basin** includes the nationally significant Yantabulla Swamp, a mosaic of channels, floodways and wetlands covering 37,000 hectares. The swamp consistently supports large numbers and a high diversity of waterbirds and when flooded provides breeding sites for ducks and colonial waterbirds (Kingsford et al. 1994; Kingsford et al. 2013). It is considered the most important breeding site in north-west NSW for the vulnerable freckled duck. The channels of Cuttaburra Creek also support large numbers of waterbirds (Kingsford et al.1997) and a distinctive woodland vegetation comprising river red gum on the banks of the waterholes and floodplains dominated by Yapunyah gum (limited distribution in NSW), coolibah and black box, with cane grass grassland and lignum also present (King et al. 1995).

- The '**Western Floodplain'** at Toorale near the junction of the Warrego and Darling rivers, is a large wetland covering over 10,000 hectares. Key vegetation species include coolibah and black box trees in the upper story, river cooba in the mid-storey and a scattered to dense shrub layer of lignum. The floodplain includes examples of coolibah-black box woodland endangered ecological community listed under Commonwealth legislation (Gowans et al. 2012).

  The Western Floodplain provides habitat for number of international migratory bird species including the rainbow bee-eater, great egret, and glossy ibis; nationally threatened waterbirds including Australian painted snipe and Australasian bittern; and waterbirds listed as threatened in NSW including the brolga, freckled duck and blue-billed duck (Alluvium 2016). Other fauna recorded in the wetland include the desert froglet and the Murray turtle (Capon 2009).

- **Waterholes** along the Warrego River in Queensland, Cuttaburra Creek and other Warrego distributary channels and permanent waterbodies on the Warrego at Toorale provide valuable refuge habitat for fauna including waterbirds, fish, birds and aquatic macroinvertebrates during dry periods. Ten species of native fish have been recorded in waterholes in the lower Warrego in Queensland (Balcombe et al. 2006) including threatened species listed in state or Commonwealth legislation. The storages at Toorale also intermittently support significant numbers and numerous species of waterbirds (Capon 2009). Waterbird breeding activity, in the Australasian darter, black-fronted dotterel, royal spoonbill and freckled duck, has also been observed at Boera Dam and Ross Billabong (Eco Logical Australia 2015).

Moonie

- Over 100 wetlands exceeding one hectare in area have been mapped in the Moonie, many of which are in the lower catchment below Nindigully (CSIRO 2008). Thallon waterholes have been observed to support between 10,000 and 20,000 waterbirds (Kingsford et al. 1997). There is past evidence of black swans, grey teal and little black cormorants breeding at the waterholes (Queensland DNR 1999).

- Threatened waterbirds including the Australian painted snipe and freckled duck and fish including purple spotted gudgeon and eel tailed catfish have been observed in the Moonie (CSIRO 2008).

- The Moonie has relatively long and deep waterholes that have been shown to be critical refugia for sustaining native fish populations in the often long periods between flows in the system. Species including golden perch, bony bream, eel tailed catfish and smelt moved significant distances (up to 70 kilometres) in response to waterhole reconnecting flows, enabling recolonisation of the system and genetic mixing (Queensland DERM 2010; Marshall et al. 2016).

Barwon-Darling

- **The Barwon-Darling river channel** connects all the rivers, lakes and wetlands in the northern Basin, providing a critical dry period refuge and movement corridor for fish and waterbirds. Diverse in-stream habitats including channels, deep pools, riffles, inset and higher floodplain benches, snags and woody debris, gravel beds and aquatic and riparian vegetation (NSW DPI 2007) support a significant native fish community and a healthy community of turtles, mussels, shrimp and other aquatic species. Lakes and wetlands along the floodplain provide water bird breeding sites and staging posts for migratory species.

- **Wetland**s: the Barwon-Darling River supports a high density and wide variety of wetlands that receive flows from the main river prior to overbank inundation. More than 580 wetlands were mapped between Mungindi and Menindee from aerial photographs, including anabranches, flood runners, billabongs, deflation basins, lakes and swamps (Brennan et al. 2002).

- **Talyawalka Anabranch-Teryaweynya Creek** is a nationally important wetland system to the west of the main Darling River channel between Wilcannia and Menindee. The channels and lakes of Talyawalka Anabranch and its distributary Teryaweynya Creek support extensive areas of floodplain vegetation and black box woodland in particular. When inundated the system's lakes provide habitat for large numbers of waterbirds. Poopelloe Lake, Talyawalka Creek and Pelican Lake (in the Teryaweynya system), along with the Darling River floodplain near Louth are known or predicted to support 20,000 or more waterbirds (Kingsford et al. 1997).

Attachment B – Expected outcomes from the Basin-wide environmental watering strategy

Expected outcomes from the Basin-wide environmental watering strategy (MDBA 2014) that are relevant to the northern unregulated rivers are described below.

RIVER FLOWS AND CONNECTIVITY

Connectivity outcome	Barwon-Darling	Condamine-Balonne	Nebine	Border Rivers	Moonie	Warrego & Paroo
Baseflows are at least 60% of natural levels	*	*	*	*	*	*
10 percent overall increase inflows to the Barwon-Darling	*	*		*		
30 to 60% increase in the frequency of freshes, bankfull and lowland floodplain flows		*				
10 to 20% increase of freshes and bank-full events	*			*		
Maintain current levels of connectivity			*		*	*

VEGETATION

Maintain current extent of river red gum, black box, coolibah forest and woodlands; existing large communities of lignum and non-woody vegetation

No decline in the condition of black box, river red gum and coolibah.

Improved recruitment of trees within river red gum, black box and coolibah communities by 2024

Improved condition of lignum shrublands (Lower Balonne including Narran Lakes, Lower Border Rivers) by 2024

Vegetation extent

Catchment	Area of river red gum (ha)*	Area of black box (ha)*	Area of coolibah (ha)*	Shrublands	Non–woody water dependent vegetation
Warrego	7,300	80,400	121,400		Fringing/within the Warrego, Langlo, Ward & Nive rivers
Nebine	200	28,800	15,400		Fringing/within Nebine Creek
Condamine Balonne (lower Balonne)	11,500#	36,100#	62,900#	Lignum in Narran Lakes	Fringing/within the Condamine, Balonne, Birrie, Bokhara, Culgoa, Maranoa, Merivale & Narran rivers
Moonie	2,200	2,500	7,900		Fringing/within Moonie River
Border Rivers	10,700	3,800	35,200	Lignum in the lower Border rivers region	Fringing/within the Barwon, Dumaresq, Macintyre rivers & Macintyre Brook
Barwon Darling	7,800#	11,700#	14,900#		Fringing/within the Barwon and Darling rivers

Area estimates (ha) are from: Cunningham SC, White M, Griffioen P, Newell G and MacNally R 2013, 'Mapping vegetation types across the Murray-Darling Basin', Murray-Darling Basin Authority, Canberra

considered to be an underestimate due to technical limitations in determining the lateral extent of floodplain inundation achieved through Basin Plan implementation

WATERBIRDS

Maintain current species diversity

Increase Basin-wide abundance of waterbirds by 20–25 per cent by 2024

Up to 50 per cent more breeding events (Basin-wide) for colonial nesting waterbird species

A 30–40 per cent increase in nests and broods (Basin-wide) for other waterbirds

Important Basin environmental assets for waterbirds in the northern unregulated rivers

Environmental asset	Total abundance and diversity	Drought refuge	Colonial waterbird breeding	Shorebird abundance	In scope for Commonwealth e-watering
Narran Lakes	*		*	*	Yes
Cuttaburra channels	*		*	*	Minor in-stream contribution
Yantabulla swamp	*				
Upper Darling River	*	*			
Talyawalka system	*				No

NATIVE FISH

No loss of native species

Improved population structure of key species through regular recruitment, including

- Short-lived species with distribution and abundance at pre-2007 levels and breeding success every 1–2 years
- Moderate to long-lived with a spread of age classes and annual recruitment in at least 80 per cent of years

Increased movements of key species

Expanded distribution of key species and populations

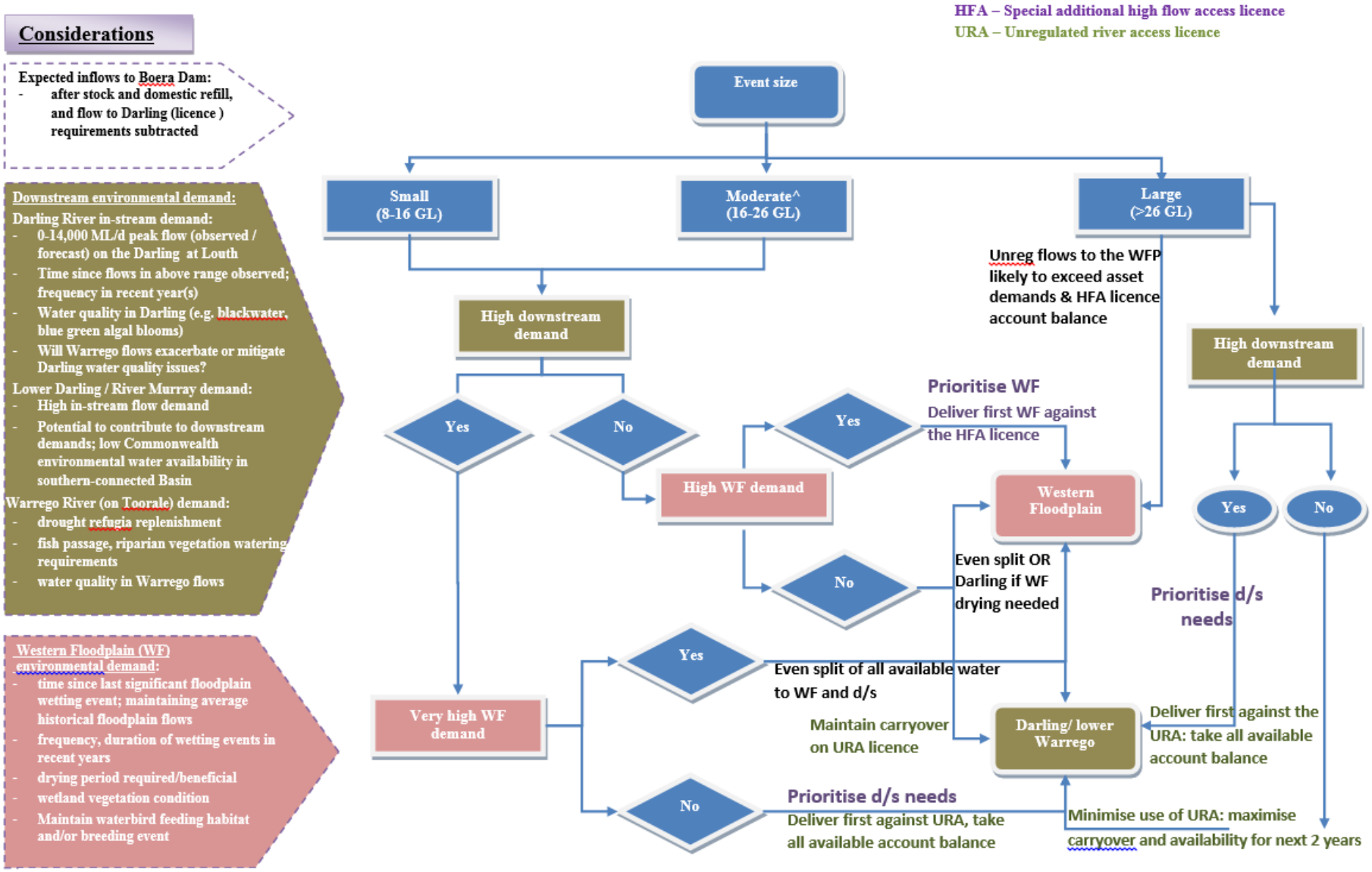
Key native fish species in the northern unregulated rivers:

Species	Specific outcomes	In-scope for Commonwealth water in the northern unregulated rivers?
Silver perch (*Galaxias rostratus*)	Expand the core range of at least 2 existing populations (Barwon–Darling is a candidate site) improve core range (candidate sites are the Warrego, Paroo and Condamine catchment (including Oakey Creek).	Limited, through improved in-stream flows in unregulated flow events
Freshwater catfish (*Tandanus tandanus*)	Expand the core range of at least 3–5 existing populations (Border Rivers, Warrego, Condamine and Paroo Rivers are amongst candidate sites)	
Olive perchlet (*Ambassis agassizii*)	Expand the range of at least 3 existing populations (the Border Rivers and middle Condamine are amongst candidate sites) Establish or improve the core range of 2–4 additional populations (Gowrie and Oakey creeks in the Condamine candidate sites)	
Southern purple-spotted gudgeon (*Mogurnda adspersa*)	Expand the range (or core range) of at least 3 existing populations (the Border Rivers/Gwydir and Condamine are amongst priority sites) Establish or improve the core range of 2–5 additional populations – (the Border Rivers/Gwydir, Barwon– Darling and Oakey Creek are amongst priority sites).	
Murray cod (*Maccullochella peelii*)	A 10–15 per cent increase of mature fish in key populations	
Golden perch (*Macquaria ambigua*)	A 10–15 per cent increase of mature fish in key populations	

Important environmental assets for native fish in the northern unregulated river catchments

Key site/ environmental asset	Key movement corridor	High biodiversity	Site of other significance	Hydrodynamic diversity	Threatened species	Dry period refuge
Warrego River (Ward River to Darling confluence)	*	*		*	*	*
Anabranches connecting Warrego and Paroo Rivers (including Gumholes, Bow, Cuttaburra Ck)	*					
Barwon-Darling River (Mungindi to Menindee)	*	*		*	*	*
Talyawalka anabranch [Darling]	*			*		*
Lower Moonie to Barwon River [Moonie]	*	*		*		*
Macintyre River floodplain lagoons Goondiwindi to Boomi [Border]	*	*	*		*	*
Macintyre River – Mungindi to Severn in NSW [Border]	*	*		*	*	*
Severn River within Sundown National Park (Queensland) [Border]		*		*	*	*
Condamine headwaters and Spring Creek upstream of Killarney				*	*	*
Condamine River - Oakey Ck to Surat, including Lower Oakey Creek	*	*		*	*	*
Charley's Ck and tributaries upstream Chinchilla [Condamine]		*	*	*	*	*
Condamine River – floodplain lagoons between Condamine and Surat	*	*	*		*	*
Balonne River and Culgoa Rivers from St George to Barwon-Darling confluence	*	*			*	*

Attachment C – Decision tree for consideration of use of Toorale Warrego Commonwealth environmental water



^ In moderate events residual volumes in excess of ~16 GL Commonwealth environmental water may be available to the WF during high Darling River demand

Attachment D – Long-term water availability

Commonwealth environmental water holdings

The Commonwealth holds a variety of unregulated entitlements in northern Basin catchments. In Queensland, the main type of unregulated entitlement is called an unsupplemented water allocation. In the Barwon-Darling River and other unregulated streams in northern NSW they are unregulated river access licences. NSW supplementary water access licences in the 'regulated' reaches of the Border Rivers, Gwydir, Namoi and Macquarie valleys also provide access to unregulated flows in the lower reaches of these river systems.

Overland flow licences, specific to the Lower Balonne in Queensland, set rules for the diversion of overland flow. This is the water that breaks out of rivers onto the floodplain or flows over the floodplain during floods. Diversion of overland flow ('floodplain harvesting') is to some extent provided for under most unregulated entitlements. The NSW government is also working towards issuing explicit volumetric 'floodplain harvesting licences' in the Gwydir, Border, Namoi, Macquarie and Barwon-Darling that reflect existing authorised diversion infrastructure.

The full list of Commonwealth environmental water holdings can be found at www.environment.gov.au/topics/water/commonwealth-environmental-water-office/about-commonwealth-environmental-water/how-much and is updated monthly.

Other sources of environmental water

Other than a small entitlement recovered by the NSW Government in the Barwon-Darling (1 448 ML), there are currently no other sources of held environmental water in the northern unregulated rivers. This small entitlement can be used to further a number of environmental outcomes as well as Aboriginal, cultural and heritage outcomes.

Planned environmental water

In addition to water entitlements held by the Commonwealth, environmental demands in the northern unregulated rivers may be met via water provided for the environment under rules in state water plans (referred to as 'planned environmental water').

Rules limiting extraction of unregulated flows by users, such as commence/cease to take flow thresholds and instantaneous, daily, annual and multi-year use limits, form the basis of 'planned environmental water' in the northern unregulated rivers. They are complemented by rules in state water plans in a few areas which defer or reduce extraction during specific types of unregulated flows. Event based rules are triggered by antecedent conditions such as the time since the last flow in a target range or occurrence of a flow that is close to the magnitude required to meet specified ecological outcomes but may not do so unless extraction is limited.

Key flow event protection rules in the region are:

- Lower Balonne – water harvesting may be reduced to assist a low flow to reach the end of all the distributary channels when this has not occurred for more than a year; in the case of a flow likely to fill Narran Lakes and the during the first medium flow (60–100,000 ML/day at St George) after a spell of 2 or 3 years. Inflows into Beardmore Dam up to 730 ML/day outside water harvesting periods are also passed downstream as environmental, stock and domestic (ESD) releases. There are several real time provisions in the resources operations plan to further manage/augment low flow events to achieve flow through if this outcome is looking unlikely.
- Warrego – deferral of water harvesting until after the peak of the flow event has passed, for dry spell (6 months) breaking flows.

- Barwon-Darling – B and C class access in the Barwon-Darling and supplementary access in northern NSW tributaries (Border Rivers, Gwydir, Namoi and Macquarie valleys) may be restricted in response to prolonged dry conditions in order to maintain flows in the Barwon-Darling for algal suppression, fish passage and to meet critical town water supply needs. Application of these provisions is at the discretion of the NSW Water Minister.
- Border Rivers – 25 per cent of unregulated flows in main trunk system and the Macintyre River in NSW protected from point of inflow to the end of system (Mungindi).

While water from entitlements held by the Commonwealth will contribute to environmental demands in the northern unregulated rivers, particularly under low flow and conditions where event based mechanisms are triggered, environmental demands will primarily be met by unregulated flows (portion of natural events that is unallocated/not diverted under state water plans, supplemented by additional flows from episodic flow protection rules in certain conditions.

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