DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT

Lachlan Long Term Water Plan

Part B: Lachlan planning units

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Cover photo: Sunrise over wetland, Mal Carnegie

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Contents

List of tables

List of figures

Acknowledgement of Traditional Owners

The NSW Department of Planning, Industry and Environment pays its respect to the Traditional Owners and their Nations of the Murray-Darling Basin. The contributions of earlier generations, including the Elders, who have fought for their rights in natural resource management are valued and respected.

In relation to the Lachlan catchment, the Department of Planning, Industry and Environment pays its respects to the Traditional Owners – the Nari Nari, Ngiyampaa, Wiradjuri and Yita Yita Nations – past, present and future. We look forward to developing new partnerships and building upon existing relationships to improve the health of our rivers, wetlands and floodplains, including in recognition of their traditional and ongoing cultural and spiritual significance.

Figure 1 **Nardoo at Booligal Wetlands.**
Photo: V. Bucello/Midstate Video.

Abbreviations

AHIMS	Aboriginal Heritage Information Management System
ARI	Annual recurrence interval
ASL	Above Sea Level
Basin Plan	Murray-Darling Basin Plan 2012
BCT	Biodiversity Conservation Trust
BF	Baseflow
BK	Bankfull
BWS	Basin-wide environmental watering strategy
CAG	Customer Advisory Group
CAMBA	China-Australia Migratory Bird Agreement
CEWO	Commonwealth Environmental Water Office
CF	Cease-to-flow
DBH	Diameter at breast height
DO	Dissolved oxygen
DOC	Dissolved organic carbon
DPIE	NSW Department of Planning, Industry and Environment
DPIE–BC	NSW Department of Planning, Industry and Environment – Biodiversity and Conservation Division
DPIE–EES	NSW Department of Planning, Industry and Environment – Environment, Energy and Science
DPIE–Water	NSW Department of Planning, Industry and Environment – Water
DPIF	NSW Department of Primary Industries Fisheries
EEC	Endangered ecological community
EWAG	Environmental Water Advisory Group
EWR	Environmental water requirement
FFDI	Forest Fire Danger Index
GCM	Global Climate Model
GDE	Groundwater dependent ecosystem
GL	gigalitres
ha	hectares
HEW	Held environmental water
JAMBA	Japan-Australia Migratory Bird Agreement
LALC	Local Aboriginal Land Council
LF	Large fresh
LLS	Local Land Services (NSW)
LTWP	Long Term Water Plan
m	metres
m/s	metres per second
MDBA	Murray-Darling Basin Authority

MER	Monitoring, evaluation and reporting
mg/L	milligrams per litre
ML	megalitre
ML/d	megalitres per day
NPWS	NSW National Parks and Wildlife Services
NRAR	Natural Resources Access Regulator
NSW	New South Wales
OB	Overbank
PCT	Plant community type
PEW	Planned environmental water
PU	Planning unit
RAS	Resource availability scenario
RCM	Regional Climate Model
Risk Assessment	Risk assessment for the Lachlan Surface Water Resource Plan Area
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SDL	Sustainable diversion limit
SF	Small fresh
VF	Very low flow
WAL	Water access licence
WL	Wetland inundating flow
WQA	Water quality allowance
WQMP	Water quality management plan
WRP	Water resource plan
WRPA	Water resource plan area
WSP	Water sharing plan

Glossary

Actively managed wetland / floodplain	The area of floodplains and wetlands that can be inundated by managed environmental water deliveries alone or in combination with other flows from regulated river systems (see ‘Regulated river’).
Adaptive management	A procedure for implementing management while learning about which management actions are most effective at achieving specified objectives.
Allocation	The volume of water made available to water access licence or environmental water accounts in a given year by DPIE–Water, which is determined within the context of demand, inflows, rainfall forecasts and stored water.
Allochthonous	Organic material (leaf litter, understory plants, trees) derived from outside rivers, including riparian zones, floodplains and wetlands.
Alluvial	Comprised of material deposited by water.
Autochthonous	Organic material derived from photosynthetic organisms (algal and macrophyte growth) within rivers.
Bankfull flow (BK)	River flows at maximum channel capacity with little overflow to adjacent floodplains. These flows engage the riparian zone, anabranches, flood runners and wetlands located within the meander train. They inundate all in-channel habitats including benches, snags and backwaters.
Baseflow (BF)	Reliable background flow levels within a river channel that are generally maintained by seepage from groundwater storage, but also by surface inflows. They typically inundate geomorphic units such as pools and riffle areas.
Basin Plan	The Basin Plan as developed by the Murray-Darling Basin Authority under the *Water Act 2007*.
Biota	The organisms that occupy a geographic region.
Blackwater	Occurs when water moves across the floodplain and releases organic carbon from the soil and leaf litter. The water takes on a tea colour as tannins and other carbon compounds are released from the decaying leaf litter. The movement of blackwater plays an important role in transferring essential nutrients from wetlands into rivers and vice versa. Blackwater carries carbon which is the basic building block of the aquatic food web and an essential part of a healthy river system.
Carryover	Water allocated to water licences or environmental water accounts that remains allocated but un-used in storage at the end of the water year which, under some circumstances, may be held over and used in the following water year.
Catch per unit effort (CPUE)	An indirect measure of the abundance of a target species.
Cease-to-flow (CF)	The absence of flowing water in a river channel that leads to partial or total drying of the river channel. Streams contract to a series of isolated pools.

Cease-to-pump (access rule in WSP)	Pumping is not permitted: • from in-channel pools when the water level is lower than its full capacity • from natural off-river pools when the water level is lower than its full capacity • from pump sites when there is no visible flow. These rules apply unless there is a commence to pump access rule that specifies a higher flow rate that licence holders can begin pumping.
Cold water pollution	The artificial lowering of water temperature that occurs downstream of dams, particularly during warmer months when stratification is more likely to occur. The impact of cold water pollution can extend for hundreds of kilometres along the river from the point of release.
Constraints	The physical or operational constraints that affect the delivery of water from storages to extraction or diversion points. Constraints may include structures such as bridges that can be affected by higher flows, the volume of water that can be carried through the river channel or scheduling of downstream water deliveries from storage.
Consumptive water	Water that is removed from available supplies without return to a water resource system (such as water removed from a river for agriculture).
Cultural water dependent asset	A place that has social, spiritual and cultural value based on its cultural significance to Aboriginal people. Related to the water resource.
Cultural water dependent value	An object, plant, animal, spiritual connection or use that is dependent on water and has value based on its cultural significance to Aboriginal people.
Discharge	The amount of water moving through a river system, most commonly expressed in megalitres per day (ML/day).
Discretionary water	
Dissolved Organic Carbon (DOC)	A measurement of the amount of carbon from organic matter that is soluble in water. DOC is transported by water from floodplains to river systems and is a basic building block available to bacteria and algae that are food for microscopic animals that are in turn consumed by fish larvae, small bodied fish species, yabbies and shrimp. DOC is essential for building the primary food webs in rivers and ultimately generates a food source for large bodied fish like Murray cod and golden perch and predators such as waterbirds.
Environmental asset	The physical features that make up an ecosystem and meet one or more of the assessment indicators for any of the five criteria specified in Schedule 8 of the Basin Plan.
Ecosystem function	The resources and services that sustain human, plant and animal communities and are provided by the processes and interactions occurring within and between ecosystems. Identified ecosystem functions must also meet one or more of the assessment indicators for any of the four criteria specified in Schedule 9 of the Basin Plan.
Ecological objective	Objective for the protection and/or restoration of an environmental asset or ecosystem function. Objectives are set for all priority environmental assets and priority ecosystem functions and have regard to the outcomes described in the Basin-wide environmental watering strategy.
Ecological target	Level of measured performance that must be met to achieve the defined objective. The targets in this Long Term Water Plan are SMART (Specific/Measurable/Achievable/Realistic/Time-bound) and can demonstrate progress towards the objectives and the outcomes described in the Basin-wide environmental watering strategy.

Ecological value	An object, plant or animal which has value based on its ecological significance.
Ecosystem	A biological community of interacting organisms and their physical environment. It includes all the living things in that community, interacting with their non-living environment (weather, earth, sun, soil, climate and atmosphere) and with each other.
Environmental water	Water for the environment. It serves a multitude of benefits to not only the environment, but communities, industry and society. It includes water held in reservoirs (held environmental water) or protected from extraction from waterways (planned environmental water) for the purpose of meeting the water requirements of water dependent ecosystems.
Environmental water requirement (EWR)	The water required to support the completion of all elements of a lifecycle of an organism or group of organisms (taxonomic or spatial), consistent with the objective/target, measured at the most appropriate gauge.
Flow category	The type of flow in a river defined by its magnitude (e.g. bankfull).
Flow regime	The pattern of flows in a waterway over time that will influence the response and persistence of plants, animals and their ecosystems.
Freshes	Temporary in-channel increased flow in response to rainfall or release from water storages.
Groundwater	Water that is located below the earth's surface in soil pore spaces and in the fractures of rock formations. Groundwater is recharged from, and eventually flows to, the surface naturally.
Held environmental water (HEW)	Water available under a water access right, a water delivery right, or an irrigation right for the purposes of achieving environmental outcomes (including water that is specified in a water access right to be for environmental use).
Hydrograph	A graph showing the rate of flow and/or water level over time past a specific point in a river. The rate of flow is typically expressed in megalitres per day (ML/day).
Hydrological connectivity	The link of natural aquatic environments.
Hydrology	The occurrence, distribution and movement of water.
Hypoxic blackwater	Occurs when dissolved oxygen (DO) levels fall below the level needed to sustain native fish and other water dependent species. Bacteria that feed on dissolved organic carbon use oxygen in the water. When they multiply rapidly their rate of oxygen consumption can exceed the rate at which oxygen can be dissolved in the water. As a result, oxygen levels fall and a hypoxic (low oxygen) condition occurs. Dissolved oxygen is measured in milligrams per litre (mg/L). Generally native fish begin to stress when DO levels fall below 4 mg/L. Fish mortality occurs when DO levels are less than 2 mg/L.
Large fresh (LF)	High-magnitude flow pulse that remains in-channel. These flows may engage flood runners with the main channel and inundate low-lying wetlands. They connect most in-channel habitats and provide partial longitudinal connectivity, as some low-level weirs and other in-channel barriers may be drowned out.
Lateral connectivity	The flow linking rivers channels and the floodplain.
Longitudinal connectivity	The consistent downstream flow along the length of a river.

Long Term Water Plan (LTWP)	A component of the Murray–Darling Basin Plan. Long Term Water Plans give effect to the Basin-wide environmental watering strategy (MDBA 2014) relevant for each river system and will guide the management of water over the longer term. These plans will identify the environmental assets that are dependent on water for their persistence, and match that need to the water available to be managed for or delivered to them. The plan will set objectives, targets and watering requirements for key plants, waterbirds, fish and ecosystem functions. DPIE–BC is responsible for the development of nine plans for river catchments across NSW, with objectives for five, 10 and 20-year timeframes.
Montane	Relating to mountainous country.
Overbank flow (OB)	Flows that spill over the riverbank or extend to floodplain surface flows.
Planned environmental water (PEW)	Water that is committed or preserved by the Basin Plan, a water resource plan or a plan made under state water management law for fundamental ecosystem health or other specified environmental purposes. This water cannot be taken or used for any other purpose.
Planning Unit (PU)	A division of a water resource plan area based on water requirements (in catchment areas in which water is actively managed), or a sub-catchment boundary (all other areas).
Population structure	A healthy population structure has individuals in a range of age and size classes. These populations demonstrate regular recruitment and good numbers of sexually mature individuals.
Priority environmental asset	A place of particular ecological significance that is water dependent, meets one or more of the assessment indicators for any of the 5 criteria specified in Schedule 8 in the Basin Plan, and can be managed with environmental water. This includes planned and held environmental water.
Priority ecosystem function	Ecosystem functions that meets one or more of the assessment indicators for any of the four criteria specified in Schedule 9 of the Basin Plan and can be managed with environmental water.
Ramsar Convention	An international treaty to maintain the ecological character of key wetlands.
Recruitment	Successful development and growth of offspring; such that they can contribute to the next generation.
Refuge pool	Sections of river channel or waterholes that are deep relative to the rest of the channel which retain water for longer periods of time can provide refuge for aquatic biota during periods of no flow. Refugial waterholes and lakes can also be present in floodplain areas. Not only do these features provide refugial habitat & nursery sites for aquatic life, they are important sinks for nutrients & DOC cycling within the riverine environment.
Refugium	An area in which a population of plants or animals can survive through a period of decreased water availability.
Registered cultural asset	A cultural water-dependent asset that is registered in the Aboriginal Heritage Information Management System (AHIMS).
Regulated river	A river that is gazetted under the *NSW Water Management Act 2000.* Flow is largely controlled by major dams, water storages and weirs. River regulation brings more reliability to water supplies but has interrupted the natural flow characteristics and regimes required by native fish and other plant and animal to breed, feed and grow.
Riffle	A rocky or shallow part of a river where river flow is rapid and broken.
Riparian	The part of the landscape adjoining rivers and streams that has a direct influence on the water and aquatic ecosystems within them.

Risk management strategy	A plan of management to overcome risks to achieving environmental outcomes.
Small fresh (SF)	Low-magnitude in-channel flow pulse. Unlikely to drown out any significant barriers but can provide limited connectivity and a biological trigger for animal movement.
Stochastic	Relating to or characterised by random chance.
Substrate	A habitat surface such as a stream bed.
Surface water	Water that exists above the ground in rivers, streams creeks, lakes and reservoirs. Although separate from groundwater, they are interrelated and over extraction of either will impact on the other.
Sustainable diversion limit (SDL)	The grossed-up amount of water that can be extracted from Murray-Darling Basin rivers for human uses while leaving enough water in the system to achieve environmental outcomes.
Unregulated river	A waterway where flow is mostly uncontrolled by dams, weirs or other structures.
Very low flow (VF)	Small flow in the very-low flow class that joins river pools, thus providing partial or complete connectivity in a reach. These flows can improve DO saturation and reduce stratification in pools.
Water quality management plan (WQMP)	A document prepared by state authorities and accredited by the Commonwealth under the Basin Plan. It forms part of a water resource plan and aims to provide a framework to protect, enhance and restore water quality in each water resource plan area.
Water resource plan (WRP)	A document prepared by state authorities and accredited by the Commonwealth under the Basin Plan. The document describes how water will be managed and shared between users in an area.
Water resource plan area (WRPA)	Catchment-based divisions of the Murray–Darling Basin defined by a water resource plan.
Water sharing plan (WSP)	A plan made under the NSW *Water Management Act 2000* that sets out specific rules for sharing and trading water between the various water users and the environment in a specified water management area. It forms part of a water resource plan.
Water dependent	An ecosystem or species that depends on periodic or sustained inundation, waterlogging or significant inputs of water for natural functioning and survival.
Wetland inundation flow (WL)	Flows that fill wetlands below bankfull or via regulating structures over weeks or sometimes months (i.e. longer than a typical fresh/pulse) or flows that are required to inundate wetlands in areas where there are very shallow channels or no discernible channels exist (e.g. terminal wetlands).

Definitions and explanatory text for environmental water requirements

Flow category	Flows in rivers vary over time in response to rainfall, river regulation, extractions and other factors. The sequence of flows over time can be considered as a series of discrete events. These events can be placed into different flow categories (e.g. baseflows, freshes, bankfull, overbank and wetland flows) according to the magnitude of flow discharge or height within a watercourse, and the types of outcomes associated with the events (e.g. inundation of specific features such as channel benches, riparian zones or the floodplain). Flow categories used in LTWPs are illustrated and defined in Figure 13 and Table 7 in Part A of each LTWP.
Environmental water requirement (EWR)	An environmental water requirement (EWR, singular) describes the characteristics of a flow event (e.g. magnitude, duration, timing, frequency, and maximum dry period) within a particular flow category (e.g. small fresh), that are required for that event to achieve a specified ecological objective or set of objectives (e.g. to support fish spawning and in-channel vegetation). There may be multiple EWRs defined within a flow category, and numerous EWRs across multiple flow categories within a planning unit. Achievement of each of the EWRs will be required to achieve the full set of ecological objectives for a planning unit.
EWR code	Each EWR is given a specific code that abbreviates the EWR name (e.g. SF1 for small fresh 1). This code is used to link ecological objectives and EWRs.
Gauge	The flow gauging station that best represents the flow within the planning unit, for the purpose of the respective EWR and associated ecological objective(s). To assess the achievement of the EWR, flow recorded at this gauge should be used.
Flow rate or flow volume	The flow rate (typically ML/day) or flow volume (typically GL over a defined period of time) that is required to achieve the relevant ecological objective(s) for the EWR. Most EWRs are defined using a flow rate, whilst flow volumes are used for EWRs that represent flows into some large wetland systems.
Timing	The required timing (or season, typically expressed as a range of months within the year) for a flow event to achieve the specified ecological objective(s) of the EWR. In some cases, a preferred timing is provided, along with a note that the event may occur at 'anytime'. This indicates that ecological objectives may be achieved outside the preferred timing window, but perhaps with sub-optimal outcomes. In these instances, for the purposes of managing and delivering environmental water, the preferred timing should be used to give greater confidence in achieving ecological objectives. Natural events may occur at other times and still achieve ecological objectives.
Duration	The duration for which flows must be above the specified flow rate for the flow event to achieve the specified ecological objective(s) of the EWR. Typically, this is expressed as a minimum duration. Longer durations will often be desirable and deliver better ecological outcomes. Some species may suffer from extended durations of inundation, and where relevant a maximum duration may also be specified. Flows may persist on floodplains and within wetland systems after a flow event has past. Where relevant a second duration may also be specified, representing the duration for which water should be retained within floodplain and wetland systems.
Frequency	The frequency at which the flow event should occur to achieve the ecological objective(s) associated with the EWR. Frequency is expressed as the number of years that the event should occur within a 10-year period. In most instances, more frequent events will deliver better outcomes & maximum frequencies may also be specified, where relevant.

	Clustering of events over successive years can occur in response to climate patterns. Clustering can be ecologically desirable for the recovery & recruitment of native fish, vegetation & waterbirds populations, however extended dry periods between clustered events can be detrimental. Achieving ecological objectives will require a pattern of events over time that achieves both the frequency & maximum inter-flow period, & the two must be considered together when evaluating outcomes or managing systems. Where a range of frequencies is indicated (e.g. 3–5 years in 10), the range reflects factors including the natural variability in population requirements, uncertainty in the knowledge base, and variability in response during different climate sequences (e.g. maintenance of populations during dry climate sequences at the lower end of the range, and population improvement and recovery during wet climate sequences at the upper end of the range). The lower end of the frequency range (when applied over the long term) may not be sufficient to maintain populations and is unlikely to achieve any recovery or improvement targets. As such, when evaluating EWR achievement over the long-term through statistical analysis of modelled or observed flow records, the LTWP recommends using a minimum long term average (LTA) target frequency that is at least the average of the recommended frequency range but may be higher than the average where required to achieve objectives. For example, for a recommended frequency range of 3–5 years in 10, the minimum LTA frequency should be at least 40% of years but may be up to 50% of years at sites where a higher frequency should be targeted over the long term to ensure recovery in certain species/populations. Whilst these higher frequencies may exceed modelled natural event frequency in some cases, recovery in particularly degraded systems will be unlikely should lower (i.e. average) frequencies be targeted. Minimum LTA target frequencies in this LTWP are reported predominantly as the average of the recommended frequency range, however this may be refined during implementation of the LTWP and in future revisions of the LTWP based on the results of ongoing ecological monitoring.
Maximum inter-flow or inter-event period	The maximum time between flow events before a significant decline in the condition, survival or viability of a particular population is likely to occur, as relevant to the ecological objective(s) associated with the EWR. This period should not be exceeded wherever possible. *Annual planning of environmental water should consider placing priority on EWRs that are approaching (or have exceeded) the maximum inter-event period, for those EWRs that can be achieved or supported by the use of environmental water or management.*
Additional requirements and comments	Other conditions that should occur to assist ecological objectives to be met – for example rates of rise and fall in flows. Also comments regarding limitations on delivering environmental flows and achieving the EWR.

1. Introduction

To manage the complexity of the Lachlan Water Resource Plan Area (WRPA), the Lachlan Long Term Water Plan (LTWP) has been divided into 39 planning units (PUs) (Figure 2). Planning units delineate areas with a unique set of mechanisms for managing water for environmental outcomes. Planning units are classified as either: Zone A, regulated (or which can be affected by regulated water); or Zone B, unregulated.

This document, which forms Part B of the LTWP, provides the following local-scale information for each planning unit:

- the location of priority environmental assets identified as part of LTWP development
- the ecological values, including native fish, frogs and waterbird species, and native vegetation communities that occur within the planning unit's priority environmental assets
- for Zone A planning units that are regulated or that can be affected by regulated water (PUs 1–16), environmental water requirements (EWRs) to support key ecological values and related LTWP objectives and targets that are presented for representative gauge/s in the planning unit
- for Zone B planning units that are unregulated (PUs 17–39), an evaluation of the impact of water resource development on local hydrology and recommended management strategies for mitigating these changes to meet LTWP objectives and targets.

The planning units are presented in two chapters in this document.

- Chapter 2 contains Zone A planning units 1–16, which are regulated or can be affected by regulated water.
- Chapter 3 contains Zone B planning units 17–39, which are unregulated and unable to be influenced by regulated water deliveries.

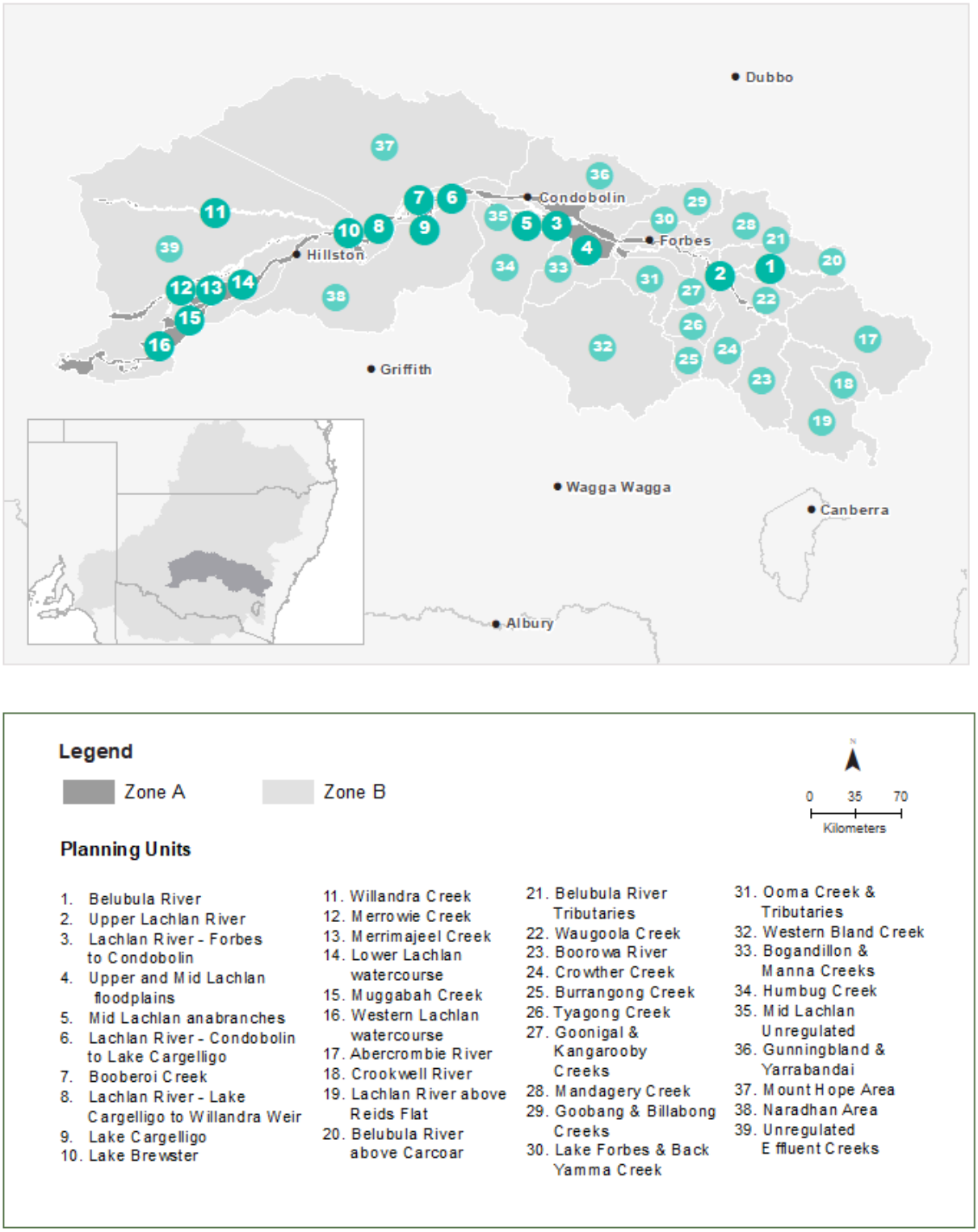


Figure 2 The Lachlan catchment showing the division of planning units into Zone A and Zone B in the Long Term Water Plan

2. Zone A planning units

Zone A planning units (PU1-16) are located downstream of Wyangala and Carcoar dams on either the Lachlan River or its distributary channels. Held environmental water released from Wyangala and Carcoar dams or Lake's Brewster and Cargelligo can be delivered to priority environmental assets in these planning units, together with planned environmental water and water delivered for consumptive use.

Bundaburra Creek, Lake Cowal and the Jemalong Wyldes Plain floodplain (Upper and Mid Lachlan floodplain planning unit) are included in the Zone A planning units. While discretionary delivery HEW and some types of PEW are not possible in this planning unit[1], it is reliant on flows that are delivered through the connected regulated system and other sources of PEW, such as tributary inflows and dam spills. For example, major flood flows down the regulated Lachlan River contribute water to the Upper and Mid Lachlan floodplain PU, which can then also contribute water back into the Mid Lachlan anabranches PU (which is also in Zone A).

Although river regulation has typically had a greater influence on the hydrology of Zone A planning units compared to those in Zone B, the associated storage and diversion infrastructure in Zone A has increased the potential for river flows to be targeted and manipulated to meet the needs of the environment.

Planning units in Zone A have been delineated in this LTWP based on how water can be managed in each unit either directly through regulated water deliveries, or indirectly via the operating rules and protocols of Wyangala and Carcoar dams, and other regulating storages. This is primarily determined by the layout of the main watercourses, the lateral extent of the managed floodplain, the location of weirs and regulators, and groups of priority assets with similar water requirements. Although most floodplains, wetlands and many smaller creeks are located in 'unregulated' water sources, these environmental assets are included in the Zone A planning units in this LTWP because they can be influenced either directly through regulated water deliveries or indirectly via the operating rules and protocols of major regulating storages.

2.1 Environmental water requirements in planning units

EWRs are defined for representative gauges in each Zone A planning unit. These EWRs describe the flow (or inundation regime, in the case of large lake systems) to support ecological objectives and targets for all priority environmental assets in each planning unit. A guide to interpreting EWRs is provided in the Glossary.

EWRs may be met with discretionary environmental water, consumptive deliveries, operational flows (e.g. conveyance flows or bulk water transfers between storages), unregulated flows (i.e. tributary flows and spills from dams), or a combination of these.

In all planning units, most high flow EWRs (bankfull, overbank and, in some cases, also large freshes) cannot currently be met with regulated water deliveries. This is because discretionary PEW and HEW must currently remain within known channel capacity constraints as specified by the Water Sharing Plans, river operations (WaterNSW) and potentially affected community members or landholders. EWRs are included for larger flow rates and volumes even if not currently targeted with discretionary environmental water to highlight how natural or unregulated flows and non-discretionary PEW (e.g. translucent flow rules, and the portion of natural and unregulated flows that are not extracted) must continue to be protected to meet the LTWP ecological objectives and legislative obligations, such as

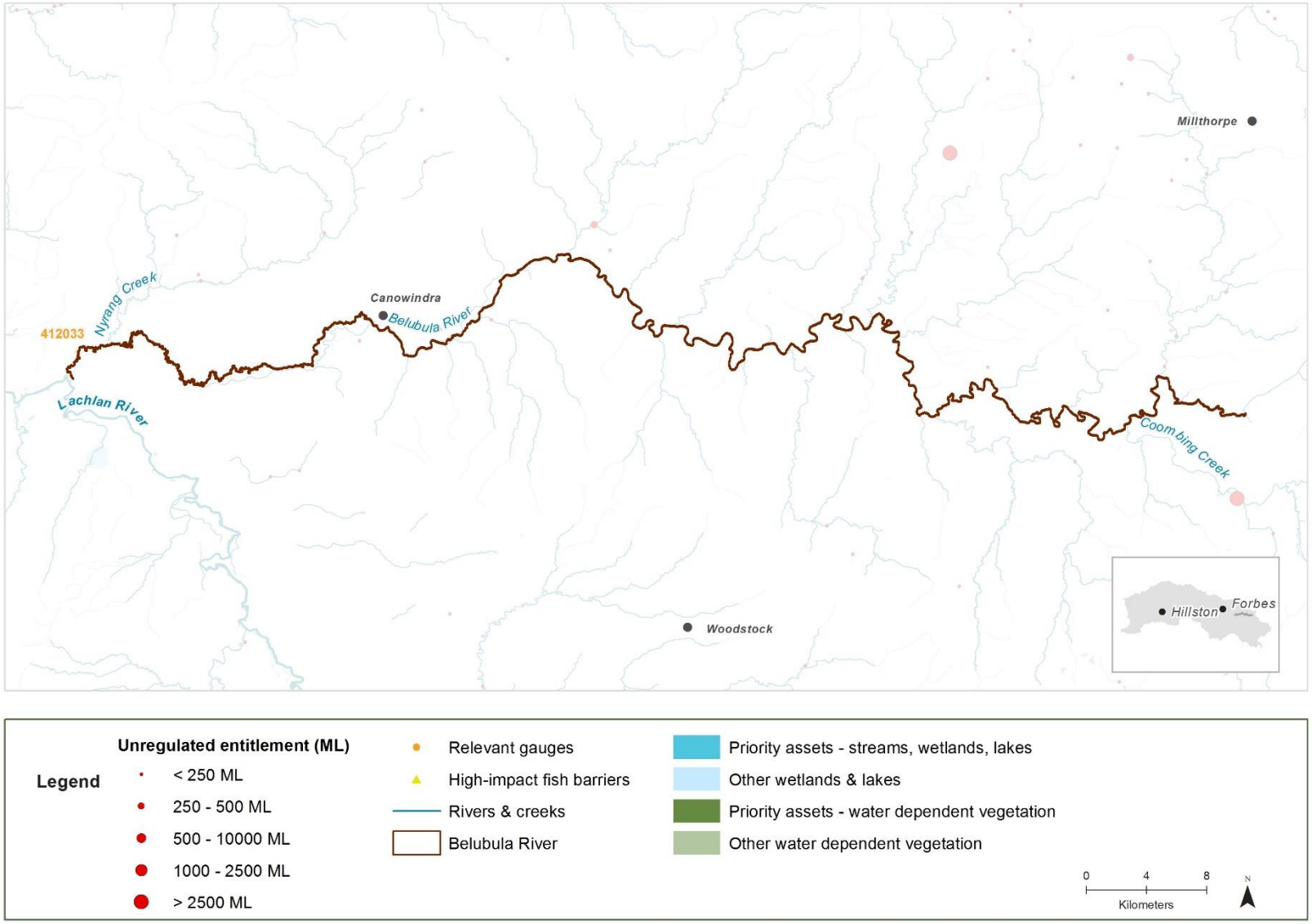
[1] with the current volumes of HEW available, under current constraints or with the amount of PEW available under the current WSP rules.

Basin Plan sustainable diversion limits and WSP long-term average extraction limits. These EWRs are indicated through grey shading. EWR tables for each of the planning units should be interpreted based on the definitions and explanatory text for EWRs found in the glossary.

The information in this section will help guide water management decision-making in the short-term and contribute to long-term objectives at targets at the regional, catchment and basin scale. This information is also subject to updating and review as improved information and knowledge on EWRs for these planning units is developed or becomes available.

Figure 3 **Sunrise over Lake Cowal**
Photo: M Carnegie/Lake Cowal Foundation

PU1: Belubula River



Priority environmental assets and values			
• Belubula River and its in-stream habitat and fringing vegetation communities • Critical fish refuge			
Native fish[2]	• southern purple-spotted gudgeon • freshwater catfish • northern river blackfish • obscure galaxias • Australian smelt	• freshwater shrimp • yabby • alpine crayfish • Suttons crayfish • flathead gudgeon	• freshwater prawn • golden perch • Murray cod • Rieks crayfish • carp gudgeon
Birds	1 water-dependent bird species recorded		
Native vegetation	2 water-dependent plant community types, including river red gum woodland		
Registered cultural assets	None registered		
Other species[3]	• platypus • southern myotis	• little pied bat	• eastern bentwing-bat

[2] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

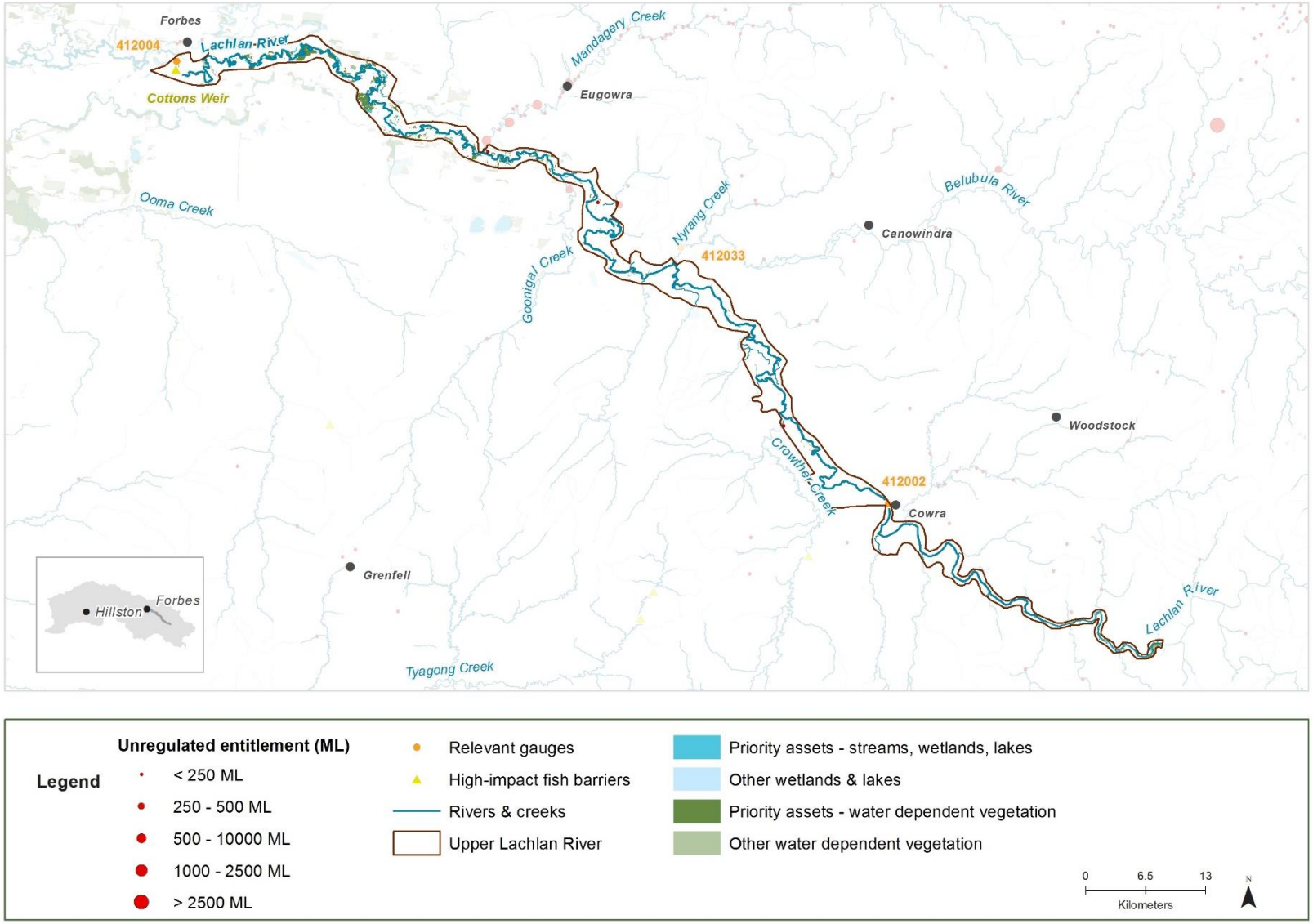
[3] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Flow category[4]		Gauge	Flow rate / volume[4]	Timing[4]	Minimum duration[4]	Frequency (LTA frequency)[4]	Maximum inter-event period[4]	Additional requirements and comments
Cease-to-flow	CF1	Belubula River @ Helenshome (412033)	0 ML/d	In line with historical low flow season, typically December to April	Typical CF events should be around 3 days. CF events should not persist for longer than 100 days.	CF events should occur in no more than 94% of years	N/A	There is no HEW in Carcoar dam, but these EWRs can be met with PEW under the 2012 WSP rules that includes a 10 ML/day end of system flow requirement. When restarting flows ensure a slow rate of rise and fall (in line with natural) to reduce the risks of harmful water-quality impacts, such as de-oxygenated refuge pools. Minimum durations in very dry years represents the 95%ile duration at each flow rate.
Very-low flow	VF1	Belubula River @ Helenshome (412033)	>10 ML/d	Any time	265 days (or 50 days in very dry years)	Annual (100% of years)	1 year	
Baseflow	BF1	Belubula River @ Helenshome (412033)	>30 ML/d	Any time	224 days (or 24 days in very dry years)	Annual (100% of years)	1 year	These EWRs can be partially met by PEW under the current WSP rules for shorter durations. Natural flows from tributaries below Carcoar dam must be protected to meet these flows and contribute to achieving the ecological objectives.
	BF2	Belubula River @ Helenshome (412033)	>30 ML/d	September to March	139 days (or 14 days in very dry years)	5–10 years in 10 (75% of years)	2 years	
Small fresh	SF1	Belubula River @ Helenshome (412033)	>70 ML/d	October to April (but can occur any time)	10 days	Annual (100% of years)	1 year	
	SF2	Belubula River @ Helenshome (412033)	>70 ML/d	October to April	14 days	5–10 years in 10 (75% of years)	2 years	

[4] See Glossary for definitions and explanatory text on how to interpret the EWR table

Flow category[4]		Gauge	Flow rate / volume[4]	Timing[4]	Minimum duration[4]	Frequency (LTA frequency)[4]	Maximum inter-event period[4]	Additional requirements and comments
	SF3	Belubula River @ Helenshome (412033)	>70 ML/d	Any time	10 days	When flows have been <10 ML/day for >50 days	N/A	
Large fresh	LF1	Belubula River @ Helenshome (412033)	>655 ML/d	July to September (but can occur any time)	5 days	5–10 years in 10 (75% of years)	2 years	These EWRs are reliant on natural flows from tributaries below Carcoar dam. These natural flows must be protected to meet these EWRs and contribute to achieving the ecological objectives.
	LF2	Belubula River @ Helenshome (412033)	>655 ML/d	October to April	5 days	3–5 years in 10 (40% of years)	4 years	
Bankfull	BK1	Belubula River @ Helenshome (412033)	5,000-6,000 ML/d	August to February (but can occur any time)	1 day	4 years in 10 (40% of years)	N/A	
Small overbank	OB3	Belubula River @ Helenshome (412033)	>6,000 ML/d	August to February (but can occur any time)	2 days, 2-3 months of habitat inundation	3–5 years in 10 (40% of years)	4 years	
Large overbank	OB4	Belubula River @ Helenshome (412033)	>8,000 ML/d	September to May (but can occur any time)	3 days, 3–8 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	
	OB5	Belubula River @ Helenshome (412033)	>14,000 ML/d	Any time	1 day, 1–6 months of habitat inundation	1 year in 10 (10% of years)	10 years	

PU2: Upper Lachlan River



Priority environmental assets and values			
• Upper Lachlan River and its in-stream habitat, floodplain, floodplain wetlands & water-dependant native vegetation • Critical fish refuge			
Native fish[5]	• southern purple-spotted gudgeon • freshwater catfish • olive perchlet • flathead gudgeon • silver perch • flathead galaxias	• unspecked hardyhead • trout cod (historical) • obscure galaxias • carp gudgeon • bony herring • Australian smelt	• Murray cod • freshwater shrimp • yabby • freshwater prawn • golden perch • northern river blackfish
Birds	64 water-dependent bird species recorded, including the listed[6] waterbird species: • blue-billed duck		
Native vegetation	10 water-dependent plant community types, including:		
	• river red gum woodland	• wetland sedgeland	• canegrass swamp grassland wetland
Registered cultural assets	• burials	• modified trees	• ceremony and dreaming
Other species[7]	• southern myotis	• eastern bentwing-bat • water rat	• platypus

[5] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[6] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

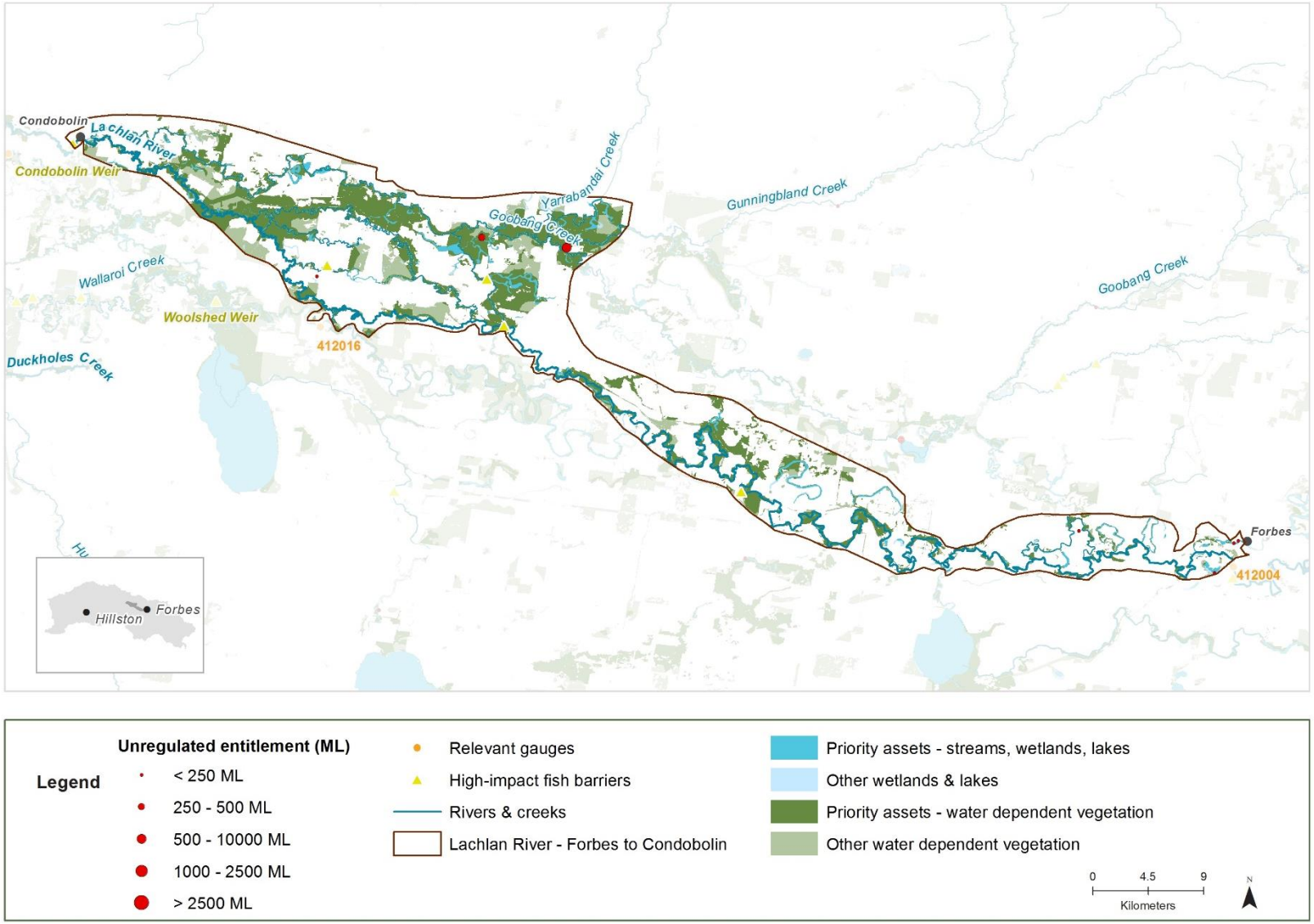
[7] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Flow category[8]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Cease-to-flow	CF1	Lachlan River @ Cowra (412002)	0ML/d	In line with historical low flow season, typically December to May	CF events should not persist longer than 18 days	CF events should occur in no more than 7% of years	N/A	These EWRs can be met with the current volumes of HEW under current constraints or with PEW under the current WSP rules. River operations, irrigation deliveries, and natural flows from tributaries will also contribute to these EWRs. When restarting flows ensure a slow rate of rise and fall (in line with natural) to reduce the risks of harmful water-quality impacts, such as de-oxygenated refuge pools. Minimum durations in very dry years represents the 95%ile duration at each flow rate.
Very-low flow	VF1	Lachlan River @ Cowra (412002)	>50 ML/d	Any time	312 days (or 173 days in very dry years)	Annual (100% of years)	1 year	
Baseflow	BF1	Lachlan River @ Cowra (412002)	>160 ML/d	Any time	246 days (or 110 days in very dry years)	Annual (100% of years)	1 year	
	BF2	Lachlan River @ Cowra (412002)	>160 ML/d	September to March	147 days (or 48 days in very dry years)	5–10 years in 10 (75% of years)	2 years	
Small fresh	SF1	Lachlan River @ Cowra (412002)	>420 ML/d	October to April (but can occur any time)	10 days	Annual (100% of years)	1 year	
	SF2	Lachlan River @ Cowra (412002)	>420 ML/d	October to April	14 days	5–10 years in 10 (75% of years	2 years	
Large fresh	LF1	Lachlan River @ Cowra (412002)	>5,600 ML/d	July to September (but can occur any time)	5 days	5–10 years in 10 (75% of years)	2 years	These EWRs can be met with PEW under the current WSP rules, and may be able to be met with current volumes of HEW under current constraints. The Hydro plant currently

[8] See Glossary for definitions and explanatory text on how to interpret the EWR table

Flow category[8]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
	LF2	Lachlan River @ Cowra (412002)	>5,600 ML/d	October to April	5 days	3–5 years in 10 (40% of years)	4 years	constrains regulated deliveries from Wyangala to approximately 3,000 ML/d, if flows are to be passed through the plant and depends on the water level in Wyangala dam. Translucent releases, dam airspace releases and natural flows from tributaries are mainly responsible for supporting these EWRs.
Bankfull	BK1	Lachlan River @ Cowra (412002)	30,600-47,800 ML/d	August to February (but can occur any time)	2 days	5 years in 10 (50% of years)	N/A	These EWRs cannot be met with current volumes of HEW under current constraints or with discretionary PEW or Translucent releases under the current WSP rules. This section of the Lachlan river is managed to mitigate flooding risks to protect towns and infrastructure. The minor flood level is recorded to be at 47,800 ML/d by BOM. Infrastructure needs to be upgraded (bridges, roads and crossings) and natural flows from dam spills and tributaries need to be protected to meet these EWRs.
Small overbank	OB3	Lachlan River @ Cowra (412002)	>47,800 ML/d	August to February (but can occur any time)	2 days, 2-3 months of habitat inundation	3–5 years in 10 (40% of years)	4 years	
Large overbank	OB4	Lachlan River @ Cowra (412002)	>85,500 ML/d	September to May (but can occur any time)	1 day, 3–8 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	
	OB5	Lachlan River @ Cowra (412002)	>135,000 ML/d	Any time	1 day, 1–6 months of habitat inundation	1 year in 10 (10% of years)	10 years	

PU3: Lachlan River (Forbes to Condobolin)



Priority environmental assets and values			
Rivers, creeks, lakes, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):			
• Lachlan River	• Horseshoe Lagoon	• Bumbuggan Creek	• Critical fish refuge
Native fish[9]	• freshwater catfish • olive perchlet • flathead galaxias • unspecked hardyhead • yabby	• northern river blackfish • carp gudgeon • bony herring • flathead gudgeon • Australian smelt	• freshwater shrimp • freshwater prawn • golden perch • Murray cod • silver perch
Birds	73 water-dependent bird species recorded, including the listed[10] waterbird species:		
	• blue-billed duck	• freckled duck	• magpie goose
Native vegetation	11 water-dependent plant community types, including		
	• river red gum woodland	• wetland sedgeland	• cumbungi rushlands wetland
Registered cultural assets	• modified trees		
Other species[11]	• Peron's tree frog	• eastern sign-bearing froglet	• spotted grass frog
Unregulated WALs	• The total volume of unregulated entitlements in the planning unit is 1243 ML, of which 1232 ML are for production. There are three unregulated WALs for production <250 ML, two between 250-500 ML, and one between 500-1000 ML.		
Unregulated WSP recommendations	Consider introducing cease-to-pump and commence-to-pump rules (and any associated required amendments to WAL conditions) that protect held and planned environmental water reaching floodplain wetlands[12]		
	• Consider protection of water for the environment in this planning unit to protect ecologically important flows in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* within five years		

[9] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[10] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

[11] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

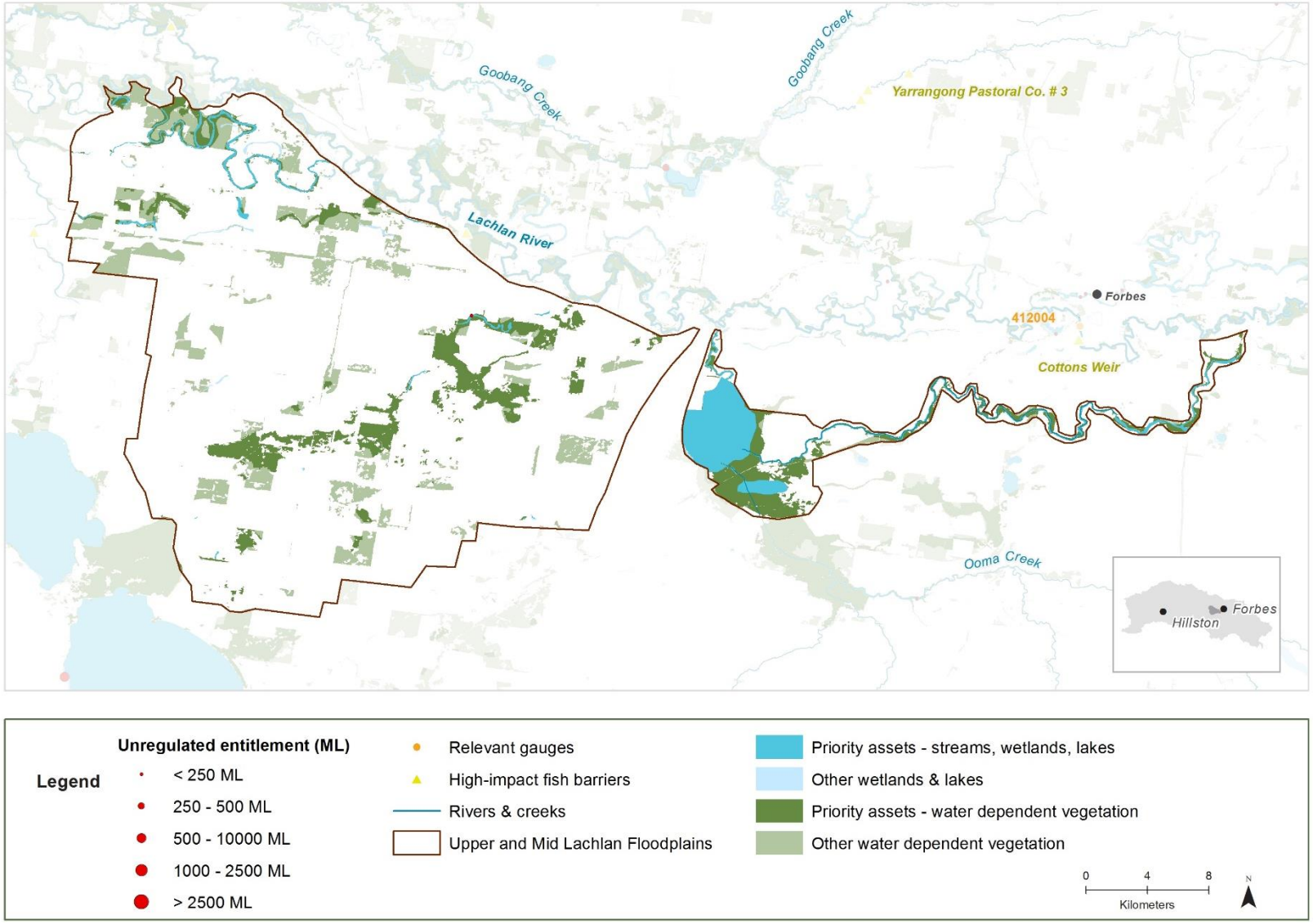
[12] In-line with the Basin Plan requirement for implementation of prerequisite policy measures that provide for delivered environmental water to be protected. It is also recommended by the Matthews reports (2017).

Flow category[13]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Cease-to-flow	CF1	Lachlan River @ Forbes (412004)	0 ML/d	In line with historical low flow season, typically December to May	CF events should not persist longer than 4 days	CF events should occur in no more than 1% of years	N/A	These EWRs can be met with the current volumes of HEW under current constraints or with PEW under the current WSP rules. River operations, irrigation deliveries, and natural flows from tributaries will also contribute to these EWRs. When restarting flows ensure a slow rate of rise and fall (in line with natural) to reduce the risks of harmful water-quality impacts, such as de-oxygenated refuge pools. Minimum durations in very dry years represents the 95%ile duration at each flow rate.
Very-low flow	VF1	Lachlan River @ Forbes (412004)	>50 ML/d	Any time	359 days (or 220 days in very dry years)	Annual (100% of years)	1 year	
Baseflow	BF1	Lachlan River @ Forbes (412004)	>165 ML/d	Any time	289 days (or 146 days in very dry years)	Annual (100% of years)	1 year	
	BF2	Lachlan River @ Forbes (412004)	>165 ML/d	September to March	176 days (or 63 days in very dry years)	5–10 years in 10 (75% of years)	2 years	
Small fresh	SF1	Lachlan River @ Forbes (412004)	>600 ML/d	October to April (but can occur any time)	10 days	Annual (100% of years)	1 year	
	SF2	Lachlan River @ Forbes (412004)	>600 ML/d	October to April	14 days	5–10 years in 10 (75% of years)	2 years	
	SF3	Lachlan River @ Forbes (412004)	>3,000 ML/d	August to February (but can occur any time)	6 days	5-10 years in 10 (75% of years)	2 years	

[13] See Glossary for definitions and explanatory text on how to interpret the EWR table

Flow category[13]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Large fresh	LF1	Lachlan River @ Forbes (412004)	>8,500 ML/d	July to September (but can occur any time)	5 days	5–10 years in 10 (75% of years)	2 years	PEW under current WSP rules and HEW may be able to contribute to this EWR with current volumes and under current constraints if delivered in combination with consumptive water deliveries or natural flows.
	LF2	Lachlan River @ Forbes (412004)	>8,500 ML/d	October to April	5 days	3–5 years in 10 (40% of years)	4 years	
	LF3	Lachlan River @ Forbes (412004)	>9,250 ML/d	August to February (but can occur any time)	7 days	3–5 years in 10 (40% of years)	4 years	
Bankfull	BK1	Lachlan River @ Forbes (412004)	13,000-13,900 ML/d	August to February (but can occur any time)	4 days	5-7 years in 10 (60% of years)	N/A	
Small overbank	OB2	Lachlan River @ Forbes (412004)	>13,900 ML/d	October to April (but can occur any time)	10 days, 2–6 months of habitat inundation	4–7 years in 10 (55% of years)	3 years	These EWRs cannot be met with the current volumes of HEW under current conditions or with discretionary PEW or Translucent releases under current WSP rules. Channel capacity, as defined in the WSP, constrains flows >13,900 ML/d Natural flows need to be protected to meet these EWRs
	OB3	Lachlan River @ Forbes (412004)	>21,600 ML/d	August to February (but can occur any time)	5 days, 2-3 months of habitat inundation	3–5 years in 10 (40% of years)	4 years	
Large overbank	OB4	Lachlan River @ Forbes (412004)	>45,000 ML/d	September to May (but can occur any time)	1 days, 3–8 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	
	OB5	Lachlan River @ Forbes (412004)	>65,000 ML/d	Any time	1 days, 1–6 months of habitat inundation	1 year in 10 (10% of years)	10 years	

PU4: Upper and Mid Lachlan floodplain



Priority environmental assets and values			
Creeks, lakes, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):			
• Thurumbidgee Lagoon • Lake Cowal		• Bundaburra Creek • Jemalong Wyldes Plain floodplain	
Native fish[14]	• olive perchlet • silver perch • bony herring • yabby • Murray cod • golden perch	• flathead galaxias • flathead gudgeon • unspecked hardyhead • dwarf flat-headed gudgeon • Murray-darling rainbowfish	• Australian smelt • freshwater shrimp • freshwater prawn • carp gudgeon • freshwater catfish
Birds	65 water-dependent bird species recorded, including the listed[15] waterbird species:		
	• Latham's snipe • brolga	• blue-billed duck • buff-banded rail • gull-billed tern	• glossy ibis • Australasian bittern
Native vegetation	10 water-dependent plant community types, including		
	• wetland sedgeland	• river red gum woodland	• canegrass swamp grassland wetland
Registered cultural assets	• modified trees	• hearth	
Other species[16]	• Peron's tree frog	• spotted grass frog	• eastern snake-necked turtle

[14] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

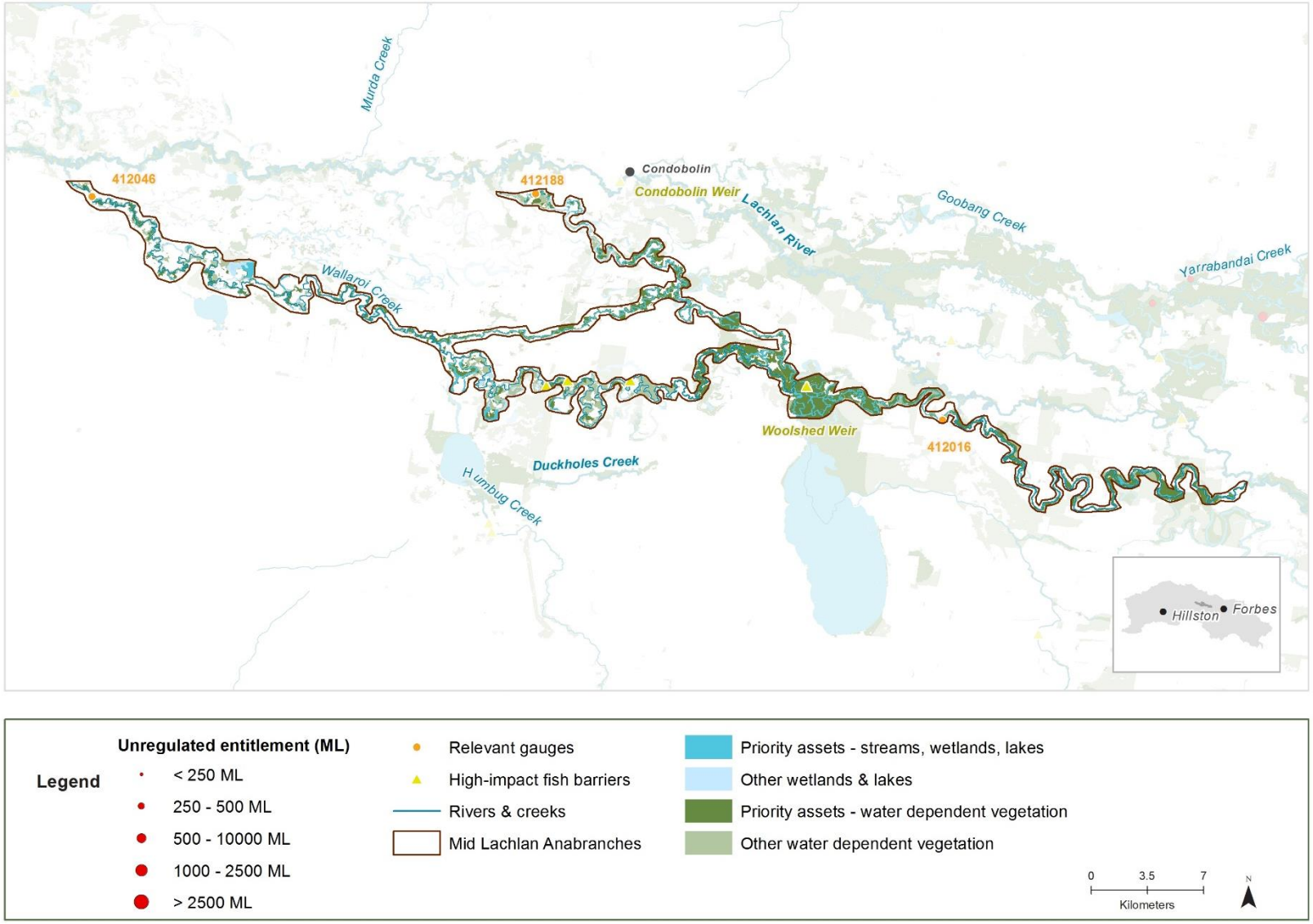
[15] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

[16] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Flow category[17]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Large wetland inundation	WL3	Lachlan River @ Jemalong weir (412036)	>15,000 ML/d	August to February (but can occur any time)	5 days, 2-3 months of habitat inundation	3-5 years in 10 (40% of years)	4 years	These EWRs cannot be met with the current volumes of HEW under current conditions or with discretionary PEW or Translucent releases under current WSP rules. Channel capacity, as defined in the WSP, constrains flows >13,900 ML/d These EWRs can only be met by natural flows or pre-flood airspace releases from Wyangala Dam. Natural flows need to be protected to meet these EWRs.
Small overbank	OB3	Lachlan River @ Forbes (412004)	>21,600 ML/d	August to February (but can occur any time)	5 days, 2-3 months of habitat inundation	3–5 years in 10 (40% of years)	4 years	
Large overbank	OB4	Lachlan River @ Forbes (412004)	>45,000 ML/d	September to May (but can occur any time)	1 days, 3–8 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	
	OB5	Lachlan River @ Forbes (412004)	>65,000 ML/d	Any time	1 days, 1–6 months of habitat inundation	1 year in 10 (10% of years)	10 years	

[17] See Glossary for definitions and explanatory text on how to interpret the EWR table

PU5: Mid Lachlan anabranches



Priority environmental assets and values			
Creeks, lakes, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):			
• Island Creek	• Narrathong Creek	• Wallamundry Creek	• Wallaroi Creek
Native fish[18]	• freshwater catfish • freshwater prawn • freshwater shrimp • unspecked hardyhead	• flathead gudgeon • Australian smelt • yabby • olive perchlet • silver perch	• golden perch • Murray cod • flathead galaxias • carp gudgeon • bony herring
Birds	29 water-dependent bird species recorded, including the listed[19] waterbird species: • brolga		
Native vegetation	9 water-dependent plant community types, including: • river red gum woodland	• wetland sedgeland	• black box - lignum woodland
Registered cultural assets	none registered		
Other species[20]	• Peron's tree frog	• eastern sign-bearing froglet	• spotted grass frog

[18] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[19] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

[20] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Flow category[21]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Cease-to-flow	CF1	Nerathong Creek @ Nerathong (412188)	0 ML/d	In line with historical low flow season, typically December to May	N/A	N/A	N/A	These EWRs can be met with the current volumes of HEW under current constraints or with PEW under the current WSP rules. River operations, irrigation deliveries, and natural flows from tributaries will also contribute to these EWRs.
		Wallamundry Creek @ O/T Island Creek (412016)	0 ML/d		Events should not persist longer than 108 days	CF events should occur in no more than 93% of years		
		Wallaroi Creek US Worrongorra Weir (412046)	0 ML/d		Events should not persist longer than 156 days	CF events should occur in no more than 77% of years		
Baseflow	BF1	Nerathong Creek @ Nerathong (412188)	>10 ML/d	Any time	N/A	N/A	1 year	These EWRs can be met or enhanced with the current volumes of HEW under current constraints or with PEW under the current WSP rules. Current volumes of HEW may not be sufficient to provide flows for the entire duration of these EWRs. River operations, irrigation deliveries, and natural flows from tributaries are also needed to contribute to these EWRs. Can only occur as a component of other environmental flows in
		Wallamundry Creek @ O/T Island Creek (412016)	>40 ML/d		222 days (or 102 days minimum in very dry years)	Annual (100% of years)		
		Wallaroi Creek US Worrongorra Weir (412046)	>10 ML/d		223 days (or 77 days minimum in very dry years)	Annual (100% of years)		
	BF2	Nerathong Creek @ Nerathong (412188)	>10 ML/d	September to March	N/A	5–10 years in 10 (75% of years)	2 years	

[21] See Glossary for definitions and explanatory text on how to interpret the EWR table

Flow category[21]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
		Wallamundry Creek @ O/T Island Creek (412016)	>40 ML/d		135 days (or 37 days minimum in very dry years)			the Lachlan River (SF1-3 in Lachlan River Forbes to Condo).
		Wallaroi Creek US Worrongorra Weir (412046)	>10 ML/d		125 days (or 22 days minimum in very dry years)			
Small fresh	SF1	Nerathong Creek @ Nerathong (412188)	>30 ML/d	October to April (but can occur any time)	10 days	Annual (100% of years)	1 year	
		Wallamundry Creek @ O/T Island Creek (412016)	>70 ML/d					
		Wallaroi Creek US Worrongorra Weir (412046)	>30 ML/d					
	SF2	Nerathong Creek @ Nerathong (412188)	>30 ML/d	October to April	14 days	5–10 years in 10 (75% of years)	2 years	
		Wallamundry Creek @ O/T Island Creek (412016)	>70 ML/d					
		Wallaroi Creek US Worrongorra Weir (412046)	>30 ML/d					

Flow category[21]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Large fresh	LF1	Wallaroi Creek US Worrongorra Weir (412046)	>120 ML/d	July to September (but can occur any time)	5 days	5–10 years in 10 (75% of years)	2 years	
		Wallamundry Creek @ O/T Island Creek (412016)	>200 ML/d					
	LF2	Wallaroi Creek US Worrongorra Weir (412046)	>120 ML/d	October to April	5 days	3–5 years in 10 (40% of years)	4 years	
		Wallamundry Creek @ O/T Island Creek (412016)	>200 ML/d					
Bankfull	BK1	Nerathong Creek @ Nerathong (412188)	80-100 ML/d	August to February (but can occur any time)	N/A	5 years in 10 (50% of years)	N/A	
		Wallaroi Creek US Worrongorra Weir (412046)	200-250 ML/d		7 days			
		Wallamundry Creek @ O/T Island Creek (412016)	300-350 ML/d		9 days	7 years in 10 (70% of years)		
Small overbank	OB2	Lachlan River @ Forbes (412004)	>13,900 ML/d	October to April (but can occur any time)	10 days, 2–6 months of habitat inundation	4–7 years in 10 (55% of years)	3 years	These EWRs cannot be met with the current volumes of HEW under current conditions or with discretionary PEW or Translucent releases under

Flow category[21]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
	OB3	Lachlan River @ Forbes (412004)	>21,600 ML/d	August to February (but can occur any time)	5 days, 2-3 months of habitat inundation	3–5 years in 10 (40% of years)	4 years	current WSP rules. Natural flows must be protected to meet these EWRs.
Large overbank	OB4	Lachlan River @ Forbes (412004)	>45,000 ML/d	September to May (but can occur any time)	1 days, 3–8 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	
	OB5	Lachlan River @ Forbes (412004)	>65,000 ML/d	Any time	1 days, 1–6 months of habitat inundation	1 year in 10 (10% of years)	10 years	

PU6: Lachlan River (Condobolin to Lake Cargelligo)

Priority environmental assets and values				
Rivers, creeks, lakes, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):				
• Lachlan River	• Borapine Creek	• Kiagathur Creek	• Yarnel Lagoon	• Critical fish refuge
Native fish[22]	• freshwater catfish • Murray-Darling rainbowfish • freshwater shrimp • spangled perch • silver perch	• olive perchlet • yabby • bony herring • flathead gudgeon • unspecked hardyhead	• carp gudgeon • freshwater prawn • golden perch • Murray cod • flathead galaxias • Australian smelt	
Birds	65 water-dependent bird species recorded, including the listed[23] waterbird species:			
	• glossy ibis • cattle egret	• brolga	• sharp-tailed sandpiper	
Native vegetation	13 water-dependent plant community types, including			
	• river red gum woodland	• lignum shrubland wetland	• black box – lignum woodland	
Registered cultural assets	• ceremony and dreaming	• hearths • artefacts	• modified trees	
Other species[24]	• Peron's tree frog	• eastern sign-bearing froglet • water rat	• spotted grass frog	

[22] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[23] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

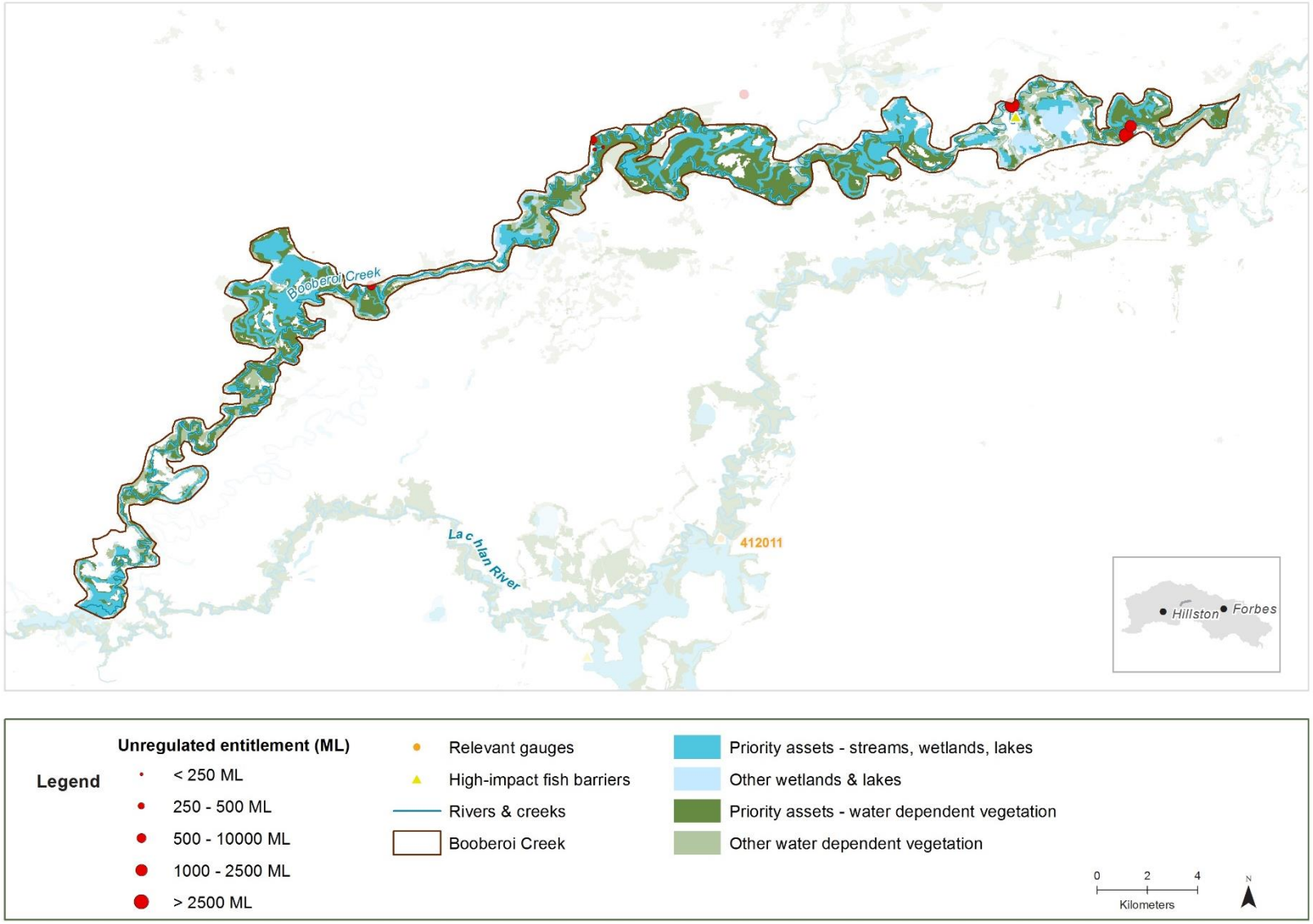
[24] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Flow category[25]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Cease-to-flow	CF1	Lachlan River @ Cargelligo (412011)	0 ML/d	In line with historical low flow season, typically January to May	CF events should not persist longer than 28 days	CF event should occur in no more than 49% of years	N/A	These EWRs can be met with the current volumes of HEW under current constraints or with PEW under the current WSP rules. River operations, irrigation deliveries, and natural flows from tributaries will also contribute to these EWRs. When restarting flows ensure a slow rate of rise and fall (in line with natural) to reduce the risks of harmful water-quality impacts, such as de-oxygenated refuge pools. Minimum durations in very dry years represents the 95%ile duration at each flow rate.
Very-low flow	VF1	Lachlan River @ Cargelligo (412011)	>10 ML/d	Any time	359 days (or 241 days in very dry years)	Annual (100% of years)	1 year	
Baseflow	BF1	Lachlan River @ Cargelligo (412011)	>30 ML/d	Any time	334 days (or 199 days in very dry years)	Annual (100% of years)	1 year	
	BF2	Lachlan River @ Cargelligo (412011)	>30 ML/d	September to March	205 days (or 114 days in very dry years)	5–10 years in 10 (75% of years)	2 years	
Small fresh	SF1	Lachlan River @ Cargelligo (412011)	>165 ML/d	October to April (but can occur any time)	10 days	Annual (100% of years)	1 year	
	SF2	Lachlan River @ Cargelligo (412011)	>165 ML/d	October to April	14 days	5–10 years in 10 (75% of years)	2 years	

[25] See Glossary for definitions and explanatory text on how to interpret the EWR table

Flow category[25]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Large fresh	LF1	Lachlan River @ Cargelligo (412011)	>6,300 ML/d	July to September (but can occur any time)	5 days	5–10 years in 10 (75% of years)	2 years	These EWRs can be met with PEW under current WSP rules but may be constrained after November when the TLF is shut off. These EWRs may be able to be met with current volumes of HEW under current constraints if delivered in combination with other flows. River operations, irrigation deliveries, and natural flows from tributaries are required to contribute to these EWRs.
	LF2	Lachlan River @ Cargelligo (412011)	>6,300 ML/d	October to April	5 days	3–5 years in 10 (40% of years)	4 years	
Bankfull	BK1	Lachlan River @ Cargelligo (412011)	>8,600 ML/d	August to February (but can occur any time)	4 days	5-7 years in 10 (60% of years)	N/A	
Small overbank	OB2	Lachlan River @ Cargelligo (412011)	>8,600 ML/d	October to April (but can occur any time)	11 days, 2–6 months of habitat inundation	4–7 years in 10 (55% of years)	3 years	
	OB3	Lachlan River @ Cargelligo (412011)	>11,000 ML/d	August to February (but can occur any time)	6 days, 2-3 months of habitat inundation	3–5 years in 10 (40% of years)	4 years	These EWRs cannot be met with the current volumes of HEW under current conditions or with discretionary PEW or Translucent releases under current WSP rules. Channel capacity, as defined in the WSP, constrains flows >13,900 ML:/d Natural flows need to be protected to meet these EWRs.
Large overbank	OB4	Lachlan River @ Cargelligo (412011)	>15,000 ML/d	September to May (but can occur any time)	5 days, 3–8 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	
	OB5	Lachlan River @ Cargelligo (412011)	>23,000 ML/d	Any time	5 days, 1–6 months of habitat inundation	1 year in 10 (10% of years)	10 years	

PU7: Booberoi Creek



Priority environmental assets and values			
• Booberoi Creek and its in-stream habitat, floodplain, floodplain wetlands and fringing water-dependant vegetation communities			
Native fish[26]	• freshwater catfish • unspecked hardyhead	• Murray-darling rainbowfish • bony herring	• Australian smelt • freshwater shrimp • carp gudgeon
Birds	25 water-dependent bird species recorded		
Native vegetation	9 water-dependent plant community types, including: • black box woodland	• lignum shrubland wetland	• wetland sedgeland
Registered cultural assets	none registered		
Other species[27]	• Peron's tree frog	• spotted grass frog	• eastern sign-bearing froglet
Unregulated WALs	• The total volume of unregulated entitlements in the planning unit is 11979 ML, of which 11940 ML are for production. There is one unregulated WALs for production <250 ML, one between 500-1000 ML, one between 1000-2500 ML, and two >2500 ML (3198 ML and 5030 ML). The large WALs >1000 ML are all located at the top of Booberoi Creek.		
Unregulated WSP recommendations	Consider introducing cease-to-pump and commence-to-pump rules (and any associated required amendments to WAL conditions) that protect held and planned environmental water reaching floodplain wetlands[28] • Consider protection of water for the environment in this planning unit to protect ecologically important flows in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* within five years		

[26] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[27] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

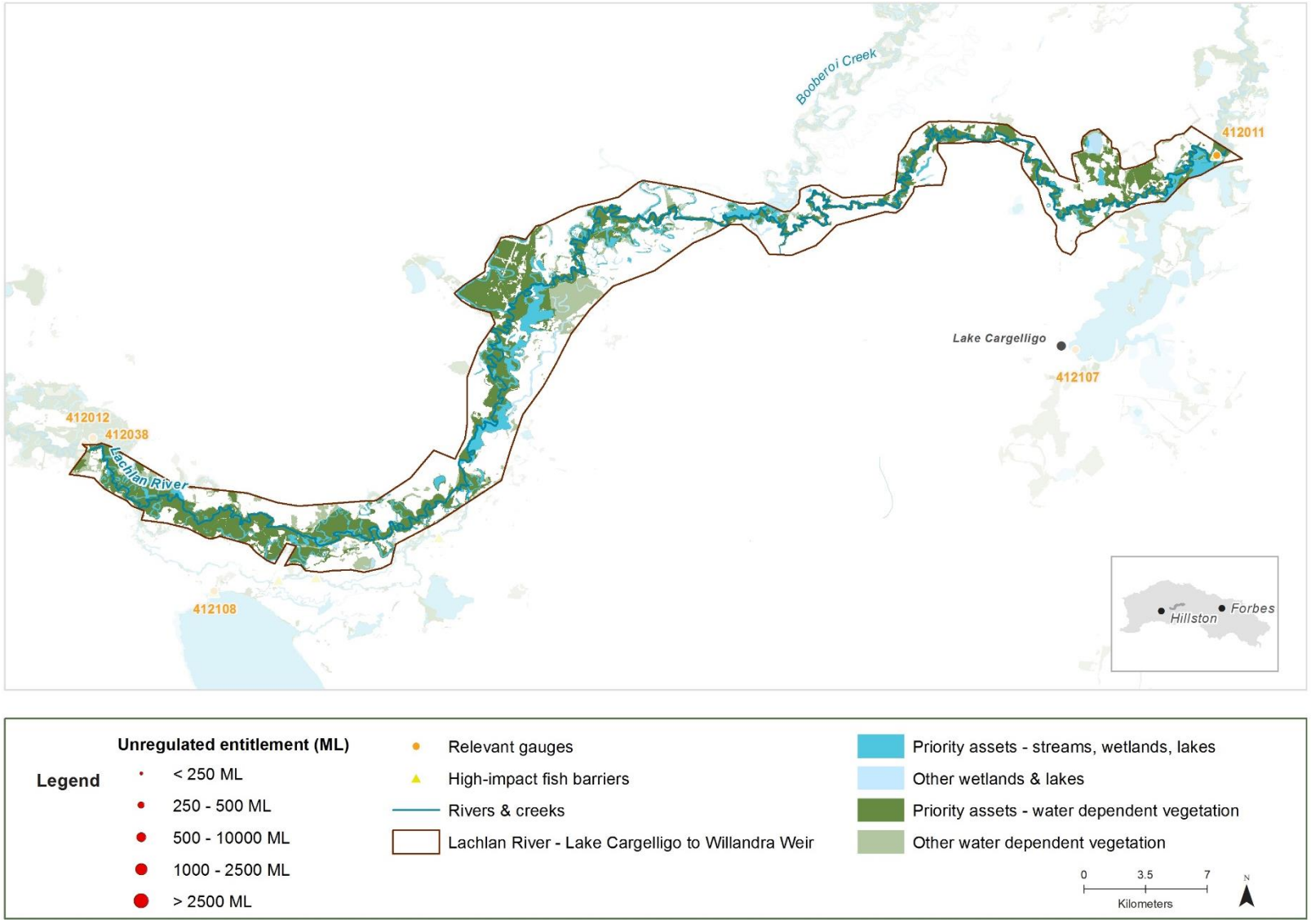
[28] In-line with the Basin Plan requirement for implementation of prerequisite policy measures that provide for delivered environmental water to be protected. It is also recommended by the Matthews reports (2017).

Flow category[29]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Baseflow	BF1	Booberoi Creek @ Offtake (412189)	>30 ML/d	Any time	365 days (or 173 days in very dry years)	Annual (100% of years)	1 year	These EWRs are currently met through operational water deliveries under current WSP rules. They cannot be met with the current volumes of HEW or PEW under the current WSP rules alone for the entire ideal duration of flows required. When restarting flows ensure a slow rate of rise and fall (in line with natural) to reduce the risks of harmful water-quality impacts, such as de-oxygenated refuge pools. Minimum durations in very dry years represents the 95%ile duration at each flow rate.
Small fresh	SF1	Booberoi Creek @ Offtake (412189)	>60 ML/d	October to April (but can occur any time)	10 days	Annual (100% of years)	1 year	These EWRs are currently met through operational water deliveries under current WSP rules. They can be met with current volumes of HEW under current constraints or with PEW under current WSP rules.
	SF2	Booberoi Creek @ Offtake (412189)	>60 ML/day	October to April	14 days	5–10 years in 10 (75% of years)	2 years	
Large fresh	LF1	Booberoi Creek @ Offtake (412189)	>120 ML/d	July to September (but can occur any time)	5 days	5–10 years in 10 (75% of years)	2 years	These EWRs may be partially met through operational water deliveries under current WSP rules. They can be met with current volumes of HEW under current constraints or with PEW under current WSP rules if delivered in combination with operational water or natural flows.
	LF2	Booberoi Creek @ Offtake (412189)	>120 ML/d	October to April	5 days	3–5 years in 10 (40% of years)	4 years	

[29] See Glossary for definitions and explanatory text on how to interpret the EWR table

Flow category[29]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Bankfull	BK1	Booberoi Creek @ Offtake (412189)	175-200 ML/day	August to February (but can occur any time)	In line with natural	5-7 years in 10 (60% of years)	N/A	This EWR is predominantly met when there are higher flows in the Lachlan River. This EWR can be met by PEW under current WSP rules. It can be met by current volumes of HEW under current constraints but involves greater flows in river than is cost-effective except under bigger flow objectives for elsewhere.
		Lachlan River @ Cargelligo (412011)	8,000-9,000 ML/d		10 days			These EWRs cannot be met with current volumes of HEW under current constraints, or with discretionary PEW or Translucent releases under current WSP rules. They are reliant on the protection of natural flows through this system.
Small overbank	OB3	Booberoi Creek @ Offtake (412189)	>200 ML/d	August to February (but can occur any time)	5 days, 2-3 months of habitat inundation	3–5 years in 10 (40% of years)	4 years	
		Lachlan River @ Cargelligo (412011)	>11,000 ML/d					
Large overbank	OB4	Lachlan River @ Cargelligo (412011)	>15,000 ML/d	September to May (but can occur any time)	5 days, 3–8 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	
	OB5	Lachlan River @ Cargelligo (412011)	>23,000 ML/d	Any time	5 days, 1–6 months of habitat inundation	1 year in 10 (10% of years)	10 years	

PU8: Lachlan River (Lake Cargelligo to Willandra Weir)



Priority environmental assets and values			
Rivers, creeks, lakes, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):			
• **Lachlan River**	• Box Creek	• Critical fish refuge	
Native fish[30]	• freshwater catfish • freshwater prawn • flathead gudgeon • unspecked hardyhead	• olive perchlet • silver perch • Australian smelt • freshwater shrimp • yabby	• golden perch • Murray cod • flathead galaxias • bony herring • carp gudgeon
Birds	48 water-dependent bird species recorded, including the listed[31] waterbird species:		
	• Caspian tern	• Australasian bittern	
Native vegetation	9 water-dependent plant community types, including		
	• river red gum woodland	• lignum shrubland wetland	• cumbungi rushlands wetland
Registered cultural assets	• ceremony and dreaming	• hearths • artefacts	• modified trees
Other species[32]	• eastern snake necked turtle	• Macquarie turtle	

[30] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[31] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

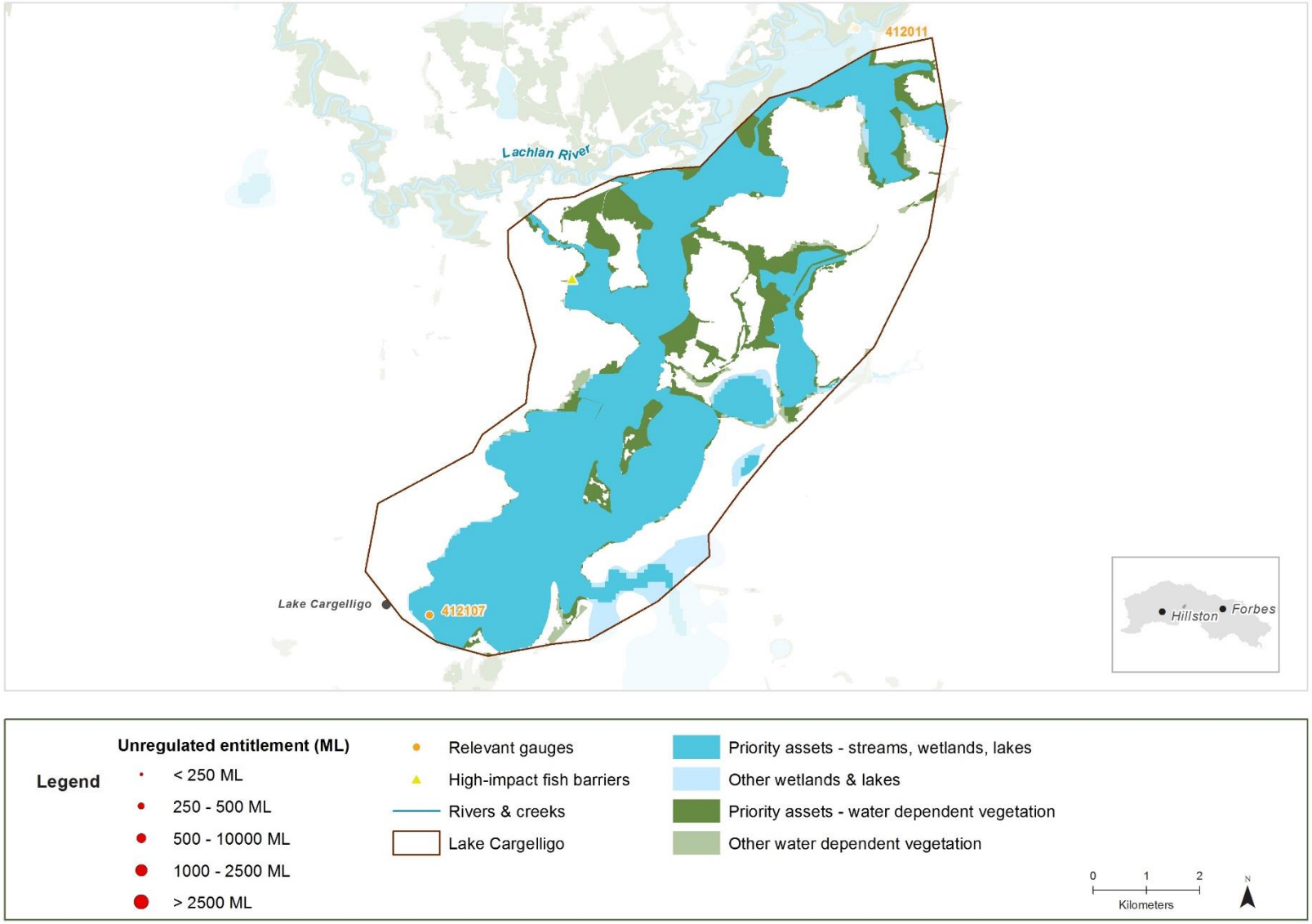
[32] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Flow category[33]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Cease-to-flow	CF1	Lachlan River @ Willandra (412038)	0 ML/d	In line with historical low flow season, typically January to May	Events should not persist longer than 15 days	CF events should occur in no more than 4% of years	N/A	These EWRs can be met with the current volumes of HEW under current constraints or with PEW under the current WSP rules. River operations, irrigation deliveries, and natural flows from tributaries will also contribute to these EWRs. When restarting flows ensure a slow rate of rise and fall (in line with natural) to reduce the risks of harmful water-quality impacts, such as de-oxygenated refuge pools. Minimum durations in very dry years represents the 95%ile duration at each flow rate.
Very-low flow	VF1	Lachlan River @ Willandra (412038)	>30 ML/d	Any time	340 days (or 211 days in very dry years)	Annual (100% of years)	1 year	
Baseflow	BF1	Lachlan River @ Willandra (412038)	>115 ML/d	Any time	279 days (or 148 days in very dry years)	Annual (100% of years)	1 year	
	BF2	Lachlan River @ Willandra (412038)	>115 ML/d	September to March	173 days (or 67 days in very dry years)	5–10 years in 10 (75% of years)	2 years	
Small fresh	SF1	Lachlan River @ Willandra (412038)	>280 ML/d	October to April (but can occur any time)	10 days	Annual (100% of years)	1 year	
	SF2	Lachlan River @ Willandra (412038)	>280 ML/d	October to April	14 days	5–10 years in 10 (75% of years)	2 years	
Large fresh	LF1	Lachlan River @ Willandra (412038)	>2,200 ML/d	July to September (but can occur any time)	5 days	5–10 years in 10 (75% of years)	2 years	
	LF2	Lachlan River @ Willandra (412038)	>2,200 ML/d	October to April	5 days	3–5 years in 10 (40% of years)	4 years	

[33] See Glossary for definitions and explanatory text on how to interpret the EWR table

Flow category[33]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Bankfull	BK1	Lachlan River @ Willandra (412038)	>3,500 ML/d	August to February (but can occur any time)	8 days	7 years in 10 (70% of years)	N/A	
Small overbank	OB1	Lachlan River @ Willandra (412038)	>3,500 ML/d	September to March (but can occur any time)	8 days, 2–8 months of habitat inundation	7-8 years in 10 (75% of years)	2 years	
	OB2	Lachlan River @ Willandra (412038)	>5,200 ML/d	October to April	10 days, 2–6 months of habitat inundation	4–7 years in 10 (55% of years)	3 years	This EWR is unlikely to be met with current volumes of HEW under current constraints. PEW can meet this EWR but is constrained by the November cut-off date for TLF in the WSP. At flow rates >2,800 ML/d, a component of flows in the Lachlan (approx. 10%) will enter Willandra Creek.
	OB3	Lachlan River @ Willandra (412038)	>8,000 ML/d	August to February (but can occur any time)	5 days, 2-3 months of habitat inundation	3–5 years in 10 (40% of years)	4 years	This EWR cannot be met with current volumes of HEW under current constraints and discretionary PEW or Translucent releases are only able to contribute to flows up to 8,000 ML in this PU. Natural flows must be protected to meet this EWR.
Large overbank	OB4	Lachlan River @ Willandra (412038)	>11,300 ML/d	September to May (but can occur any time)	5 days, 3–8 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	These EWRs cannot be met with the current volumes of HEW under current conditions or with discretionary PEW or Translucent releases under current WSP rules. Natural flows need to be protected to meet these EWRs.
	OB5	Lachlan River @ Willandra (412038)	>20,000 ML/d	Any time	1 day, 1–6 months of habitat inundation	1 year in 10 (10% of years)	10 years	

PU9: Lake Cargelligo



Priority environmental assets and values			
• Lake Cargelligo and associated floodplain & water-dependant native vegetation			
Native fish[34]	• carp-gudgeon species	• bony herring • Murray cod	• golden perch • Australian smelt
Birds	91 water-dependent bird species recorded, including the listed[35] waterbird species:		
	• sharp-tailed sandpiper • eastern great egret • glossy ibis • brolga	• freckled duck • marsh sandpiper • gull-billed tern	• red-necked stint • blue-billed duck • common greenshank
Native vegetation	8 water-dependent plant community types, including:		
	• black box - lignum woodland	• river red gum woodland	• canegrass swamp grassland wetland
Registered cultural assets	• resources, gathering	• artefacts	• shell
Other species[36]	-		

[34] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[35] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

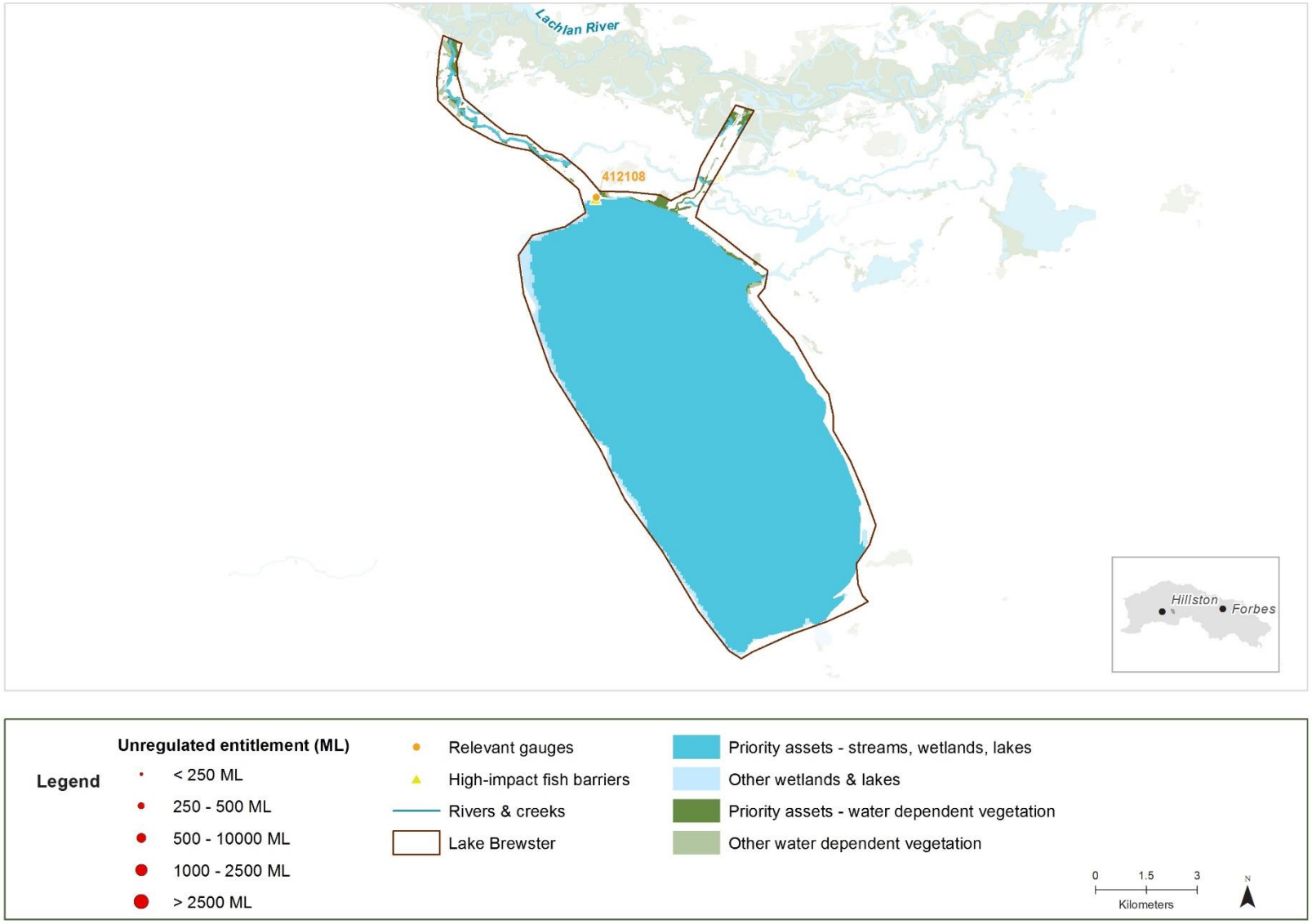
[36] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Flow category[37]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Large wetland inundation	WL3	Lake Cargelligo @ Storage (412107)	>65% full	September to March (can occur anytime)	2–6 months of habitat inundation	5–7 years in 10 (60% of years)	3 years	If colonial waterbirds are nesting and water levels are >65%, then the following must be supported until successful completion of the breeding event[38] • Water levels should be maintained above 65% if possible • Rapid rises in water level should be avoided • Water levels should not drop more than natural rates of evaporation

[37] See Glossary for definitions and explanatory text on how to interpret the EWR table

[38] Successful breeding relates to completion of nests where fledglings and juvenile birds are observed at the end of each breeding event.

PU10: Lake Brewster



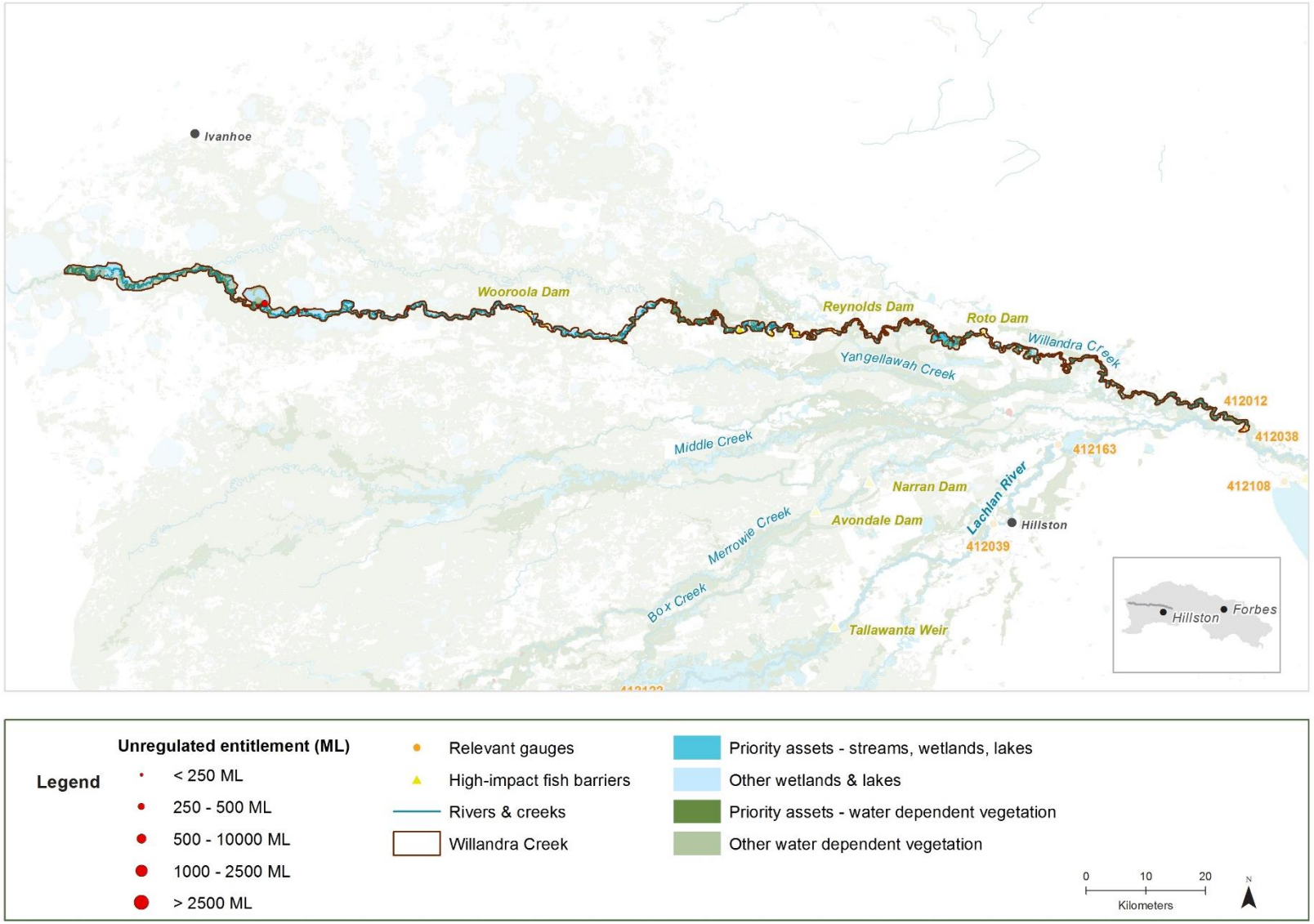
Priority environmental assets and values			
• Lake Brewster and inlet channels (including lake-bed & fringing water-dependant vegetation)			
Native fish[39]	• olive perchlet • silver perch • unspecked hardyhead • carp gudgeon • flathead gudgeon	• Australian smelt • yabby • freshwater prawn • freshwater catfish	• golden perch • Murray cod • freshwater shrimp • bony herring
Birds	75 water-dependent bird species recorded, including the listed[40] waterbird species: • glossy ibis • blue-billed duck • brolga	• common sandpiper • common greenshank	• marsh sandpiper • freckled duck
Native vegetation	7 water-dependent plant community types, including • lignum shrubland wetland	• wetland sedgeland	• black box - lignum woodland
Registered cultural assets	• resources, gathering • artefacts	• hearths	• modified trees
Other species[41]	• spotted grass frog		• eastern snake-necked turtle

[39] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[40] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

[41] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

PU11: Willandra Creek



Priority environmental assets and values			
• Willandra Creek and its in-stream habitat and fringing vegetation communities			
Native fish[42]	• olive perchlet • silver perch • flathead galaxias • carp gudgeon • Murray-Darling rainbowfish	• bony herring • flathead gudgeon • yabby • dwarf flat-headed gudgeon • Australian smelt	• freshwater shrimp • freshwater prawn • golden perch • Murray cod • unspecked hardyhead
Birds	71 water-dependent bird species recorded, including the listed[43] waterbird species: • blue-billed duck	• glossy ibis	
Native vegetation	9 water-dependent plant community types, including • black box - lignum woodland	• lignum shrubland wetland	• river red gum woodland
Registered cultural assets	• artefacts	• hearth	• modified trees
Other species[44]	• spotted grass frog • giant banjo frog • water rat	• eastern sign-bearing froglet • eastern snake-necked turtle	• Peron's tree frog • little pied bat
Unregulated WALs	• The total volume of unregulated entitlements in the planning unit is 1069 ML, of which 726 ML are for production. There are six unregulated WALs for production <250 ML.		
Unregulated WSP recommendations	Consider introducing cease-to-pump and commence-to-pump rules (and any associated required amendments to WAL conditions) that protect held and planned environmental water reaching floodplain wetlands[45] • Consider protection of water for the environment in this planning unit to protect ecologically important flows in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* within five years		

[42] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[43] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

[44] Other species list includes flow-dependent frog species, platypus, and other State or Commonwealth listed water-dependent species where they have been recorded

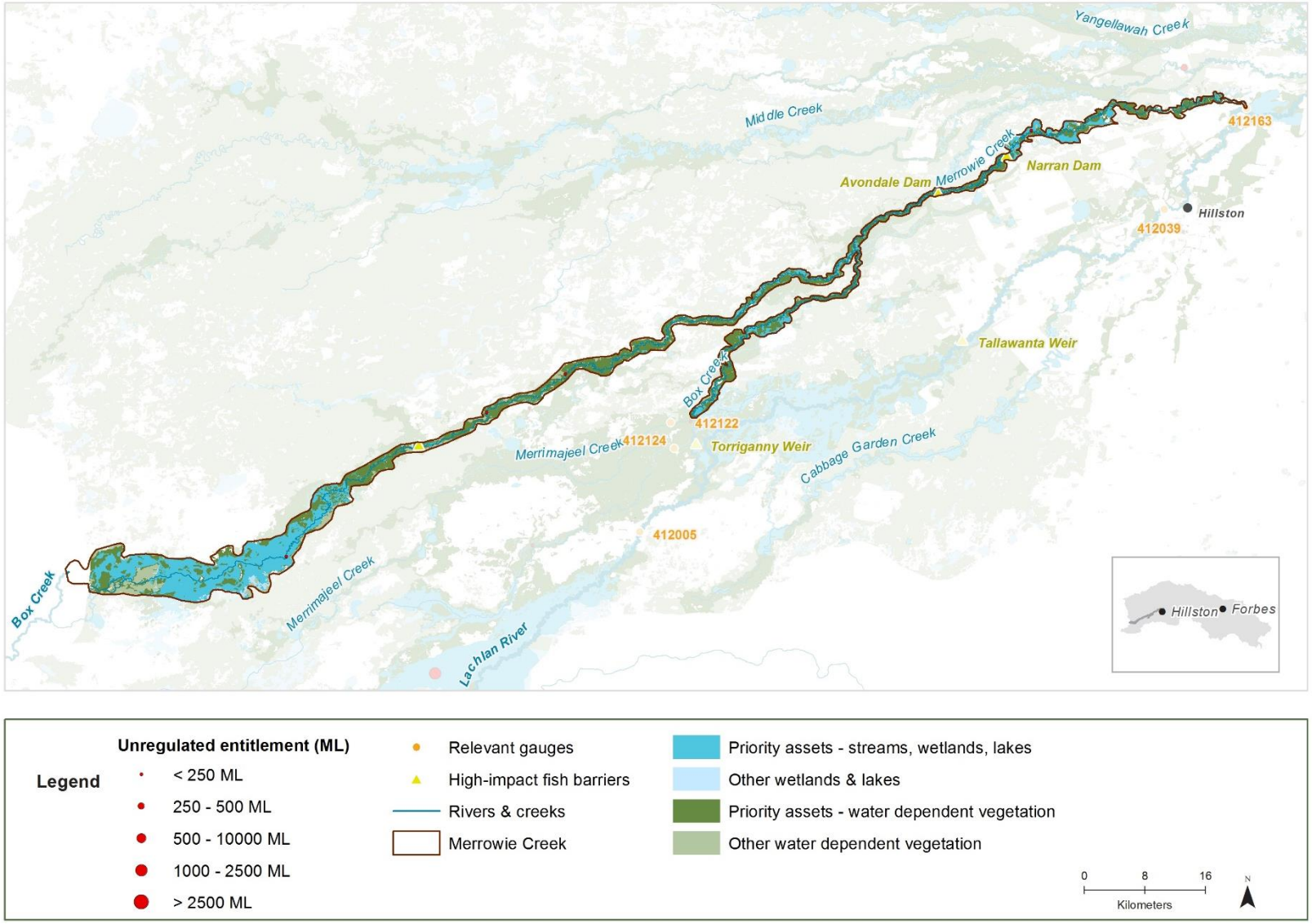
[45] In-line with the Basin Plan requirement for implementation of prerequisite policy measures that provide for delivered environmental water to be protected. It is also recommended by the Matthews reports (2017).

Flow category[46]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Cease-to-flow	CF1	Willandra @ Road Bridge (412012)	0 ML/d	In line with historical low flow season, typically January to May	Events should not persist longer than 53 days	CF events should occur in no more than 78% of years	N/A	These EWRs are currently met through operational and consumptive water deliveries under current WSP rules. They can be met with current volumes of HEW under current constraints or with PEW under current WSP rules. When restarting flows ensure a slow rate of rise and fall (in line with natural) to reduce the risks of harmful water-quality impacts, such as de-oxygenated refuge pools. Minimum durations in very dry years represents the 95%ile duration at each flow rate.
Baseflow	BF2	Willandra @ Road Bridge (412012)	>50 ML/d	September to March	107 days (or 24 days in very dry years)	5–10 years in 10 (75% of years)	2 years	
Small fresh	SF1	Willandra @ Road Bridge (412012)	>70 ML/d	October to April (but can occur any time)	10 days	Annual (100% of years)	1 year	
	SF2	Willandra @ Road Bridge (412012)	>70 ML/d	October to April	14 days	5–10 years in 10 (75% of years)	2 years	
Large fresh	LF1	Willandra @ Road Bridge (412012)	>250 ML/d	July to September (but can occur any time)	5 days	5–10 years in 10 (75% of years)	2 years	This EWR can be met with PEW under current WSP rules and HEW may be able to contribute to flows with current volumes and under current constraints if delivered in combination with consumptive water deliveries or natural flows. Natural flows must be protected to consistently meet this EWR.
	LF2	Willandra @ Road Bridge (412012)	>250 ML/d	October to April	5 days	3–5 years in 10 (40% of years)	4 years	
Bankfull	BK1	Willandra @ Road Bridge (412012)	>300-500 ML/d	August to February (but can occur any time)	10 days	5-7 years in 10 (60% of years)	N/A	

[46] See Glossary for definitions and explanatory text on how to interpret the EWR table

Flow category[46]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Small wetland inundation	WL2	Willandra Creek @ Willandra Homestead (412042)	>150 ML/d	September to March (but can occur any time)	30 days	7-8 years in 10 (75% of years)	2 years	These EWRs are currently mostly met through operational and consumptive water deliveries under current WSP rules. HEW may be able to contribute to flows with current volumes and under current constraints if delivered in combination with consumptive water deliveries or natural flows. This EWR may also be partially met with PEW under current WSP rules.
Large wetland inundation	WL4	Willandra Creek @ Willandra Homestead (412042)	>150 ML/d	Any time	50 days, 2-3 months of habitat inundation	2-3 years in 10 (25% of years)	5 years	
Small overbank	OB2	Willandra @ Road Bridge (412012)	>500 ML/d	October to April (but can occur any time)	14 days, 2–6 months of habitat inundation	4–7 years in 10 (55% of years)	3 years	This EWR can be met with PEW under current WSP rules but cannot be met with current volumes of HEW under current constraints. Natural flows must be protected to consistently meet this EWR.
	OB3	Willandra @ Road Bridge (412012)	>1000 ML/d	August to February (but can occur any time)	16 days, 2-3 months of habitat inundation	3–5 years in 10 (40% of years)	4 years	These EWRs cannot be met with current volumes of HEW under current constraints and is only rarely partially met with PEW under current WSP rules. These EWRs are reliant on the protection of natural flows through this system.
Large overbank	OB4	Willandra @ Road Bridge (412012)	>1,500 ML/d	September to May (but can occur any time)	9 days, 3–8 months of habitat inundation	2–3 years in 10 (25% years)	5 years	
	OB5	Willandra @ Road Bridge (412012)	>2,500 ML/d	Any time	6 days, 1–6 months of habitat inundation	1 year in 10 (10% of years)	10 years	

PU12: Merrowie Creek



Priority environmental assets and values				
Creeks, lakes, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):				
• Merrowie Creek	• Merrowie Creek wetlands	• Box Creek	• Chillichil swamp	• Cuba Dam
Native fish[47]	• olive perchlet • Australian smelt • Murray-darling rainbowfish • dwarf flat-headed gudgeon • unspecked hardyhead	• carp gudgeon • bony herring • flathead gudgeon • flathead galaxias • freshwater shrimp	• freshwater prawn • golden perch • yabby • Murray cod • silver perch	
Birds	64 water-dependent bird species recorded, including the listed[48] waterbird species			
	• glossy ibis • Australasian bittern	• gull-billed tern • eastern great egret	• blue-billed duck • freckled duck	
Native vegetation	10 water-dependent plant community types, including			
	• black box - lignum woodland • black box woodland	• canegrass swamp grassland wetland	• lignum shrubland wetland	
Registered cultural assets	• modified tree			
Other species[49]	• spotted grass frog			
Unregulated WALs	• The total volume of unregulated entitlements in the planning unit is 410.5 ML, of which 326 ML are for production. There are two unregulated WALs for production <250 ML.			
Unregulated WSP recommendations	Consider introducing cease-to-pump and commence-to-pump rules (and any associated required amendments to WAL conditions) that protect held and planned environmental water reaching floodplain wetlands[50]			
	• Consider protection of water for the environment in this planning unit to protect ecologically important flows in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* within five years			

[47] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)
[48] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)
[49] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded
[50] In-line with the Basin Plan requirement for implementation of prerequisite policy measures that provide for delivered environmental water to be protected. It is also recommended by the Matthews reports (2017).

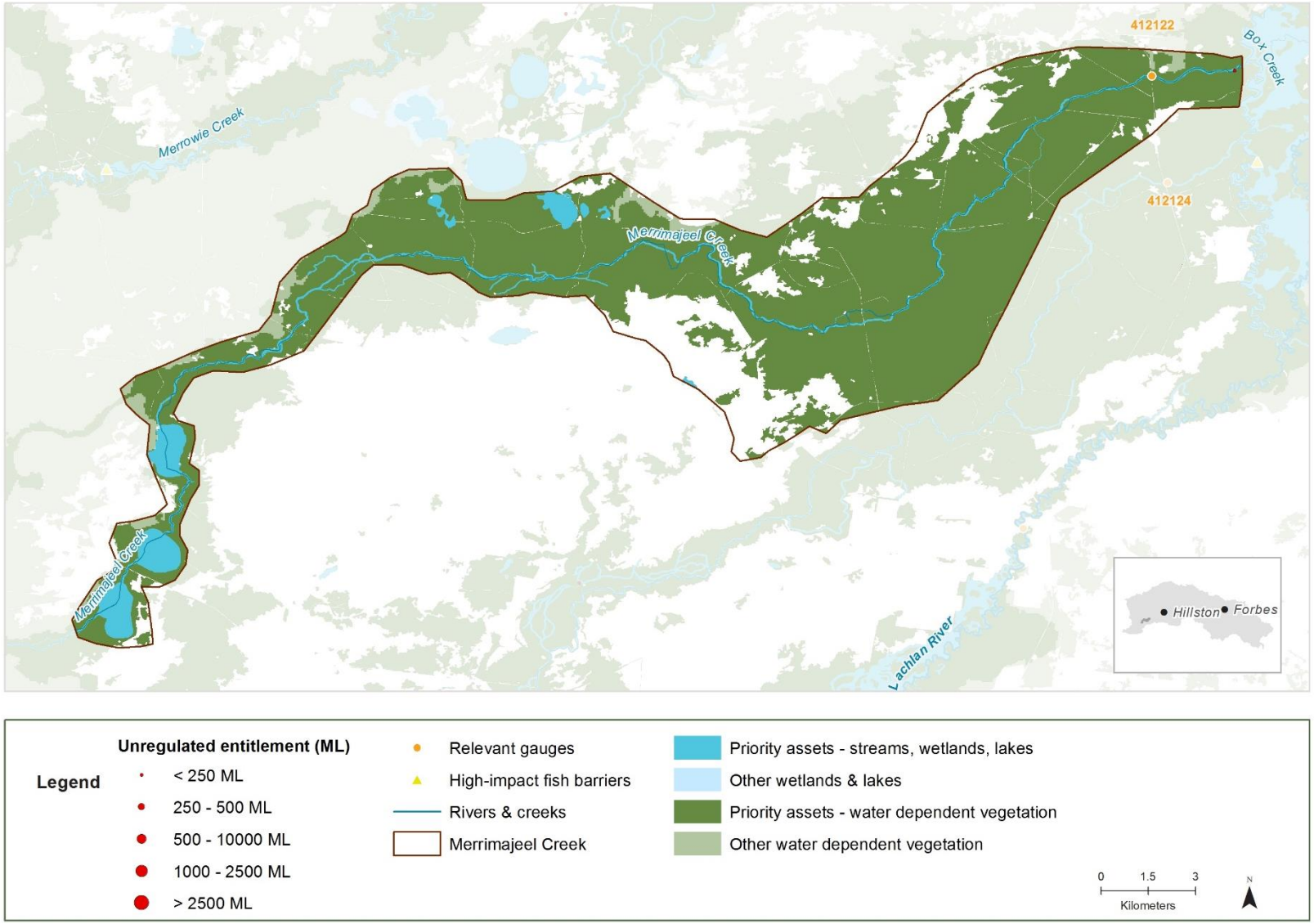
Flow category[51]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Cease-to-flow	CF1	Merrowie Ck @ Offtake (412163)	0 ML/d	In line with historical low flow season, typically January to May	Events should not persist longer than 181 days	CF events should occur in no more than 87% of years	N/A	These EWRs can currently be met through operational and consumptive water deliveries under current WSP rules. They can also be met with current volumes of HEW under current constraints or with PEW under current WSP rules. When restarting flows ensure a slow rate of rise and fall (in line with natural) to reduce the risks of harmful water-quality impacts, such as de-oxygenated refuge pools. Minimum durations in very dry years represents the 95%ile duration at each flow rate.
Small fresh	SF1	Merrowie Ck @ Offtake (412163)	>120 ML/d	October to April (can occur any time)	10 days	Annual (100% of years)	1 year	
	SF2	Merrowie Ck @ Offtake (412163)	>120 ML/d	October to April	14 days	5–10 years in 10 (75% of years)	2 years	
	SF3	Merrowie Ck @ Offtake (412163)	>160 ML/d	July to December (but can occur any time)	30 days	5-7 years in 10 (60% of years)	3 years	These EWRs can currently be met through operational and consumptive water deliveries under current WSP rules. Because of the longer duration, they may be partially met with current volumes of HEW under current constraints or with PEW under current WSP rules if they occur in combination with natural flows or consumptive water deliveries.
Large fresh	LF1	Merrowie Ck @ Offtake (412163)	>200 ML/d	July to September (but can occur any time)	5 days	5–10 years in 10 (75% of years)	2 years	These EWRs can currently be met through operational and consumptive water deliveries under current WSP rules.

[51] See Glossary for definitions and explanatory text on how to interpret the EWR table

Flow category[51]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
	LF2	Merrowie Ck @ Offtake (412163)	>200 ML/d	October to April	5 days	3–5 years in 10 (40% of years)	4 years	They can also be met with current volumes of HEW under current constraints or with PEW under current WSP rules.
Bankfull	BK1	Merrowie Ck @ Offtake (412163)	250-400 ML/d	August to February (but can occur any time)	In line with natural	5-7 years in 10 (60% of years)	N/A	This EWR may be met with PEW under current WSP. HEW may be able to contribute to this EWR with current volumes and under current constraints if delivered in combination with consumptive water deliveries or natural flows.
Small wetland inundation	WL1	Merrowie Ck @ Offtake (412163)	>150 ML/d	September to March (but can occur any time)	30 days, 2–8 months of habitat inundation	7-8 years in 10 (75% of years)	2 years	These EWRs can currently be met through operational and consumptive water deliveries under current WSP rules. They can also be met or enhanced with current volumes of HEW under current constraints or with PEW under current WSP rules.
	WL2	Merrowie Ck @ Offtake (412163)	>150 ML/d	October to April (but can occur any time)	45 days, 2–6 months of habitat inundation	5-7 years in 10 (60% of years)	3 years	
Large wetland inundation	WL3	Merrowie Ck @ Offtake (412163)	>150 ML/d	September to June (but can occur any time)	60 days, 2-3 months of habitat inundation	3-5 years in 10 (40% of years)	4 years	
Small overbank	OB1	Lachlan US Willandra Weir (412038)	>3,000 ML/d	September to March (but can occur any time)	4 days, 2–8 months of habitat inundation	7-8 years in 10 (75% of years)	2 years	If the Merrowie Creek regulator is open, this EWR can be met by PEW under current WSP rules. It can be partially met with current volumes of HEW under current constraints, if delivered in combination with consumptive water deliveries or natural flows. Natural flows need to be protected to consistently meet this EWR.

Flow category[51]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
	OB2	Lachlan US Willandra Weir (412038)	>5,000 ML/d	September to April	8 days, 2–6 months of habitat inundation	4–7 years in 10 (55% of years)	3 years	These EWRs cannot be met with current volumes of HEW under current constraints and can be met with discretionary PEW or Translucent releases under current WSP rules, depending on the time of year. These EWRs are mainly reliant on the protection of natural flows through this system.
	OB3	Lachlan US Willandra Weir (412038)	>6,000 ML/d	August to February (but can occur any time)	10 days, 2-3 months of habitat inundation	3–5 years in 10 (40% of years)	4 years	
Large overbank	OB4	Lachlan US Willandra Weir (412038)	>8,000 ML/d	September to May (but can occur any time)	8 days, 3–8 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	This EWR cannot be met with current volumes of HEW under current constraints or with discretionary PEW or Translucent releases under current WSP rules. These EWRs are reliant on the protection of natural flows through this system.
	OB5	Lachlan US Willandra Weir (412038)	>10,000 ML/d	Any time	16 days, 1–6 months of habitat inundation	1 year in 10 (10% of years)	10 years	

PU13: Merrimajeel Creek



Priority environmental assets and values			
Creeks, lakes, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):			
• Booligal Wetlands • Lake Merrimajeel	• Merrimajeel Creek • Murrumbidgil Swamp		
Native fish[52]	• olive perchlet • silver perch • unspecked hardyhead • carp gudgeon	• flathead gudgeon • Australian smelt • freshwater shrimp • yabby • bony herring	• freshwater prawn • golden perch • Murray cod • flathead galaxias
Birds	68 water-dependent bird species recorded, including the listed[53] waterbird species:		
	• glossy ibis • blue-billed duck	• freckled duck • eastern great egret	• Australasian bittern • gull-billed tern
Native vegetation	9 water-dependent plant community types, including		
	• lignum shrubland wetland	• black box - lignum woodland	• black box woodland
Registered cultural assets	• habitation structure	• modified tree	
Other species[54]	• eastern sign-bearing froglet	• giant banjo frog • Peron's tree frog	• spotted grass frog • southern bell frog

[52] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[53] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

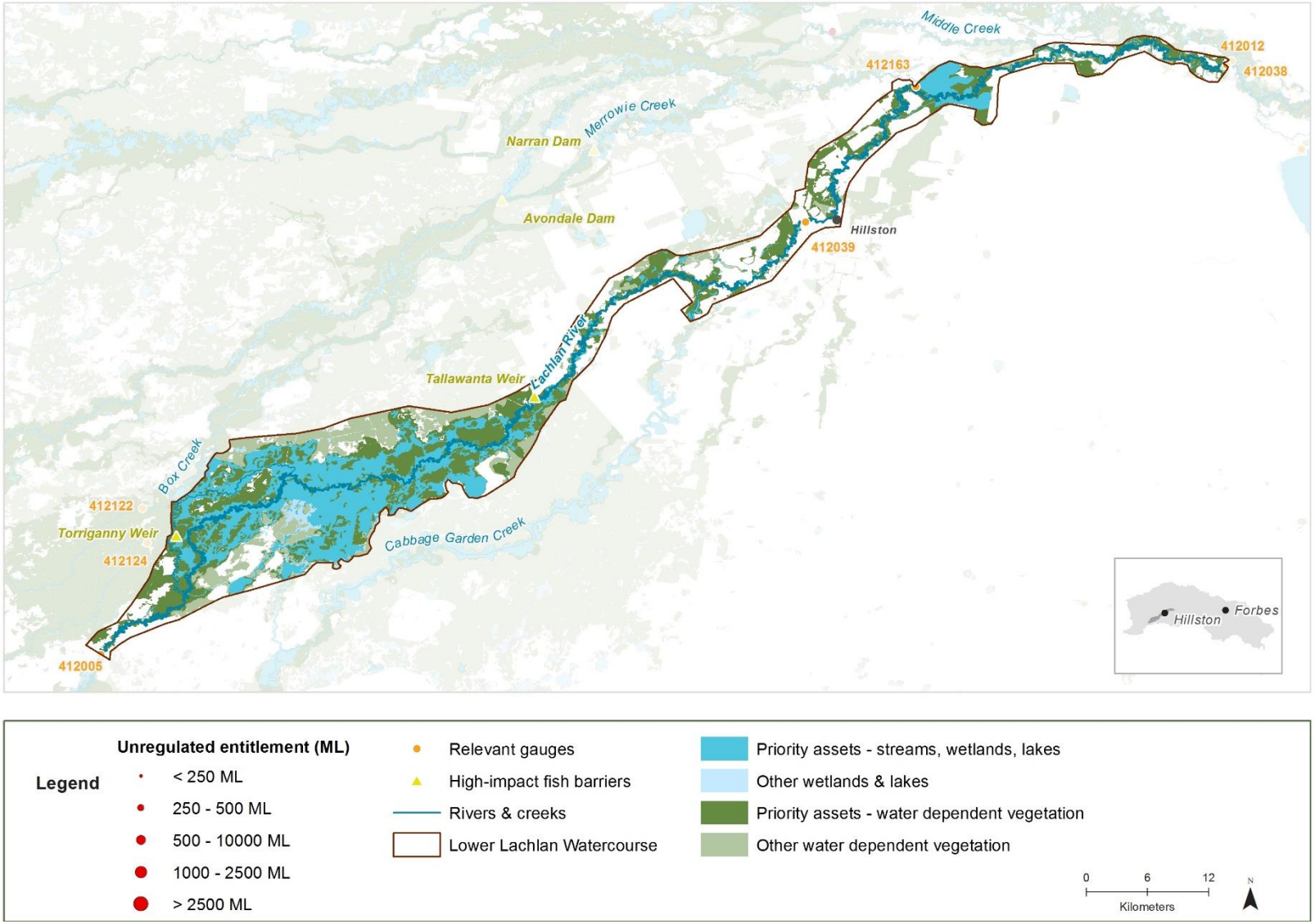
[54] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Flow category[55]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Cease-to-flow	CF1	Merrimajeel Creek @ Cobb Hwy (412122)	0 ML/d	In line with historical low flow season, typically January to May	Events should not persist longer than 565 days	Should occur in no more than 100% of years	N/A	These EWRs can be met with the current volumes of HEW under current constraints or with PEW under the current WSP rules. When restarting flows ensure a slow rate of rise and fall (in line with natural) to reduce the risks of harmful water-quality impacts, such as de-oxygenated refuge pools. Minimum durations in very dry years represents the 95%ile duration at each flow rate.
Small wetland inundation	WL1	Lachlan River @ Booligal (412005)	>300 ML/d	September to March (but can occur any time)	30 days	7-8 years in 10 (75% of years)	2 years	
	WL2	Lachlan River @ Booligal (412005)	>650 ML/d	October to April (but can occur any time)	30 days, 2–8 months of habitat inundation	5-7 years in 10 (60% of years)	3 years	
Large wetland inundation	WL3	Lachlan River @ Booligal (412005)	>850 ML/d	August to February (but can occur any time)	60 days, 2–6 months of habitat inundation	3-5 years in 10 (40% of years)	4 years	PEW under the current WSP rules or HEW can partially contribute to this EWR with current volumes and under current constraints if delivered in combination with consumptive water deliveries or natural flows. Natural flows should be protected to ensure these EWRs are being met.
	WL4	Lachlan River @ Booligal (412005)	>1,200 ML/d	any time	60 days, 2-3 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	
Small overbank	OB2	Lachlan River @ Booligal (412005)	>2,500 ML/d	October to April	5 days, 2–6 months of habitat inundation	4–7 years in 10 (55% of years)	3 years	These EWRs cannot be met with current volumes of HEW under current constraints. Flows >1,800 ML/d are reliant on a wet system or natural events. Translucent releases may be able to meet these EWRs, depending on the time of year.
	OB3	Lachlan River @ Booligal (412005)	>3,500 ML/d	August to February (but can occur any time)	6 days, 2-3 months of habitat inundation	3–5 years in 10 (40% of years)	4 years	

[55] See Glossary for definitions and explanatory text on how to interpret the EWR table

Flow category[55]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Large overbank	OB4	Lachlan River @ Booligal (412005)	>4,000 ML/d	September to May (but can occur any time)	2 days, 3–8 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	These EWRs are mainly reliant on the protection of natural flows through this system. Natural flows should be protected to ensure these EWRs are being met.
	OB5	Lachlan River @ Booligal (412005)	>5,000 ML/d	Any time	1 days, 1–6 months of habitat inundation	1 year in 10 (10% of years)	10 years	This EWR cannot be met with current volumes of HEW under current constraints, or with discretionary PEW or Translucent releases under current WSP rules. This EWR is reliant on the protection of natural flood flows through this system.

PU14: Lower Lachlan watercourse



Priority environmental assets and values			
Rivers, creeks, lakes, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):			
• Lachlan River	• Torriganny Creek	• Moon Moon Lake	• fish refuge
Native fish[56]	• unspecked hardyhead • dwarf flat-headed gudgeon • Murray-Darling rainbowfish • olive perchlet • freshwater catfish	• Australian smelt • flathead gudgeon • bony herring • flathead galaxias • freshwater shrimp	• yabby • freshwater prawn • golden perch • Murray cod • silver perch • carp gudgeon
Birds	69 water-dependent bird species recorded, including the listed[57] waterbird species:		
	• glossy ibis • blue-billed duck	• gull-billed tern • brolga	• marsh sandpiper
Native vegetation	11 water-dependent plant community types, including		
	• black box - lignum woodland	• black box woodland	• canegrass swamp grassland wetland
Registered cultural assets	• artefacts • hearth	• modified trees	• burials
Other species[58]	• eastern sign-bearing froglet	• giant banjo frog • Peron's tree frog	• spotted grass frog • platypus

[56] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[57] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

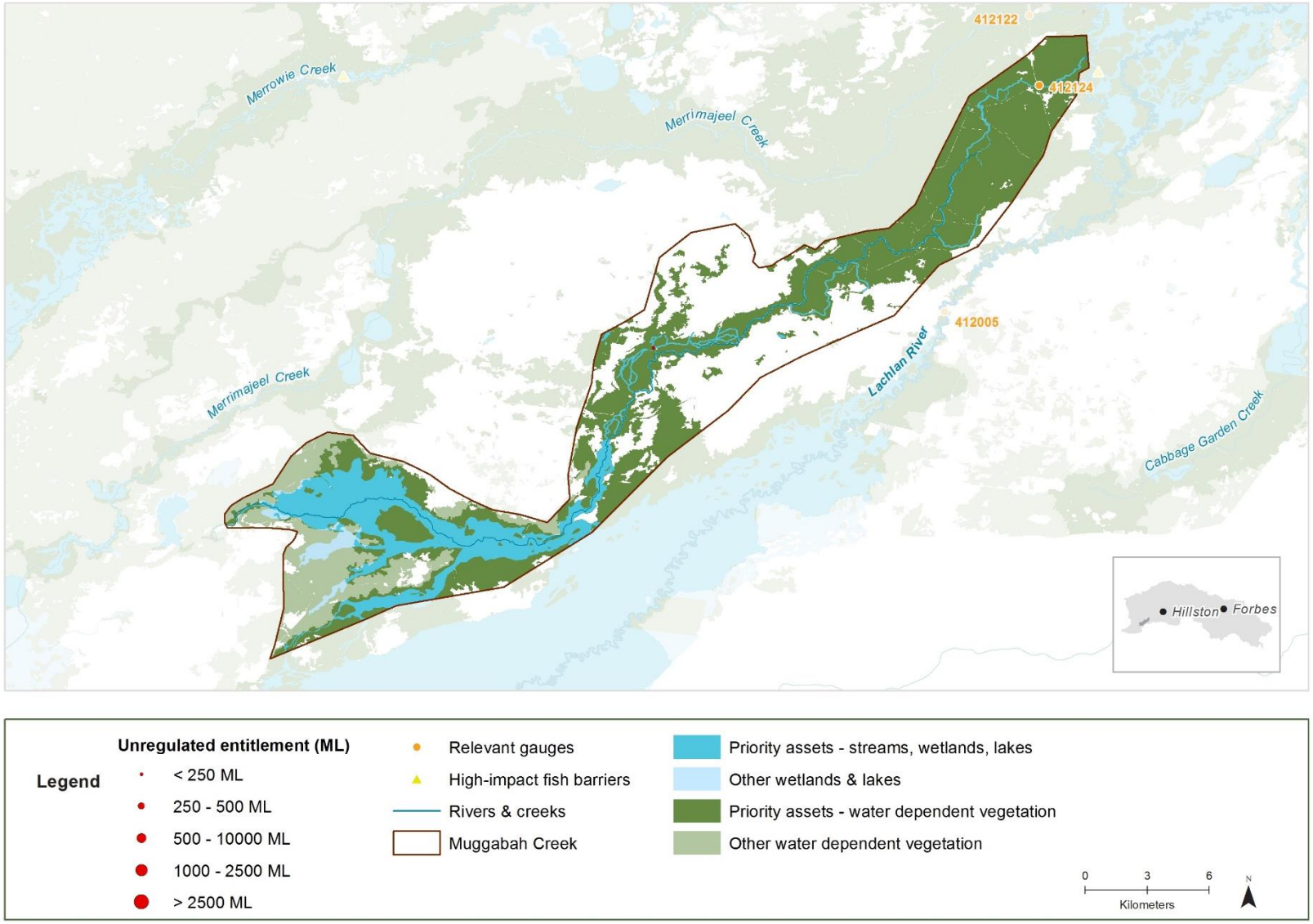
[58] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Flow category[59]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Cease-to-flow	CF1	Lachlan River @ Hillston Weir (412039)	0 ML/d	In line with historical low flow season, typically January to May	Events should not persist longer than 77 days	CF event should occur in no more than 73% of years	N/A	These EWRs are currently mostly met through operational and consumptive water deliveries under current WSP rules. These EWRs can be enhanced with the current volumes of HEW under current constraints or with PEW under the current WSP rules, depending on the time of year. When restarting flows ensure a slow rate of rise and fall (in line with natural) to reduce the risks of harmful water-quality impacts, such as de-oxygenated refuge pools. Minimum durations in very dry years represents the 95%ile duration at each flow rate.
Very-low flow	VF1	Lachlan River @ Hillston Weir (412039)	>20 ML/d	Any time	312 days (or 179 days in very dry years)	Annual (100% of years)	1 year	
Baseflow	BF1	Lachlan River @ Hillston Weir (412039)	>100 ML/d	Any time	260 days (or 136 days in very dry years)	Annual (100% of years)	1 year	
	BF2	Lachlan River @ Hillston Weir (412039)	>100 ML/d	September to March	168 days (or 61 days in very dry years)	5–10 years in 10 (75% of years)	2 years	
Small fresh	SF1	Lachlan River @ Hillston Weir (412039)	>280 ML/d	October to April (but can occur any time)	10 days	Annual (100% of years)	1 year	
	SF2	Lachlan River @ Hillston Weir (412039)	>280 ML/d	October to April	14 days	5–10 years in 10 (75% of years)	2 years	
Large fresh	LF1	Lachlan River @ Hillston Weir (412039)	>1,600 ML/d	July to September (but can occur any time)	15 days	5–10 years in 10 (75% of years)	2 years	These EWRs can be met with PEW under the current WSP rules and may be able to be met with the current volumes of HEW under current

[59] See Glossary for definitions and explanatory text on how to interpret the EWR table

Flow category[59]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
	LF2	Lachlan River @ Hillston Weir (412039)	>1,600 ML/d	October to April	15 days	3–5 years in 10 (40% of years)	4 years	constraints if delivered in combination with river operations, irrigation deliveries, and natural flows from tributaries.
Bankfull	BK1	Lachlan River @ Hillston Weir (412039)	4,000-5,000 ML/d	May to December	10 days	5-7 years in 10 (60% of years)	N/A	These EWRs may be able to be met with PEW under the current WSP rules (depending on the time of year). HEW may be able to contribute to this EWR with the current volumes available and under current constraints, if delivered in combination with river operations, irrigation deliveries, and natural flows from tributaries. Natural flows need to be protected and a regulator at Willandra Creek is required to prevent unwanted flows down Willandra Creek and ensure these EWRs are met.
Small wetland inundation	WL1	Lachlan River @ Hillston Weir (412039)	>2,800 ML/d	September to March (but can occur any time)	10 days, 2–8 months of habitat inundation	7-8 years in 10 (75% of years)	2 years	
Large wetland inundation	WL2	Lachlan River @ Hillston Weir (412039)	>2,800 ML/D	October to April (but can occur any time)	15 days, 2–6 months of habitat inundation	5-7 years in 10 (60% of years)	3 years	
	WL3	Lachlan River @ Hillston Weir (412039)	>2,800 ML/d	August to February (but can occur any time)	30 days, 2-3 months of habitat inundation	3-5 years in 10 (40% of years)	4 years	
Small overbank	OB2	Lachlan River @ Hillston Weir (412039)	>5,000 ML/d	October to April	10 days, 2–6 months of habitat inundation	4–7 years in 10 (55% of years)	3 years	HEW is unlikely to be able to contribute to these EWRs. Translucent releases may be able to contribute to these EWRs, depending on the time of year. These EWRs are mainly reliant on the protection of natural flows through this system.
	OB3	Lachlan River @ Hillston Weir (412039)	>6,000 ML/d	August to February (but can occur any time)	5 days, 2-3 months of habitat inundation	3–5 years in 10 (40% of years)	4 years	
Large overbank	OB4	Lachlan River @ Hillston Weir (412039)	>7,000 ML/d	September to May (but can occur any time)	1 day, 3–8 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	These EWRs cannot be met with current volumes of HEW under current constraints, or with discretionary PEW or Translucent releases under current WSP rules. These EWRs are reliant on the protection of natural flows through this system.
	OB5	Lachlan River @ Hillston Weir (412039)	>8000 ML/d	Any time	1 day, 1–6 months of habitat inundation	1 year in 10 (10% of years)	10 years	

PU15: Muggabah Creek



Priority environmental assets and values			
• Muggabah Creek and its in-stream habitat and fringing vegetation communities			
Native fish[60]	• olive perchlet • silver perch • unspecked hardyhead • yabby • bony herring	• carp gudgeon • Australian smelt • freshwater shrimp • freshwater prawn	• flathead gudgeon • golden perch • Murray cod • flathead galaxias
Birds	51 water-dependent bird species recorded, including the listed[61] waterbird species:		
	• cattle egret	• glossy ibis	• blue-billed duck
Native vegetation	8 water-dependent plant community types, including		
	• lignum shrubland wetland	• river red gum woodland	• black box - lignum woodland
Registered cultural assets	• modified trees		
Other species[62]	• giant banjo frog	• spotted grass frog	

[60] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

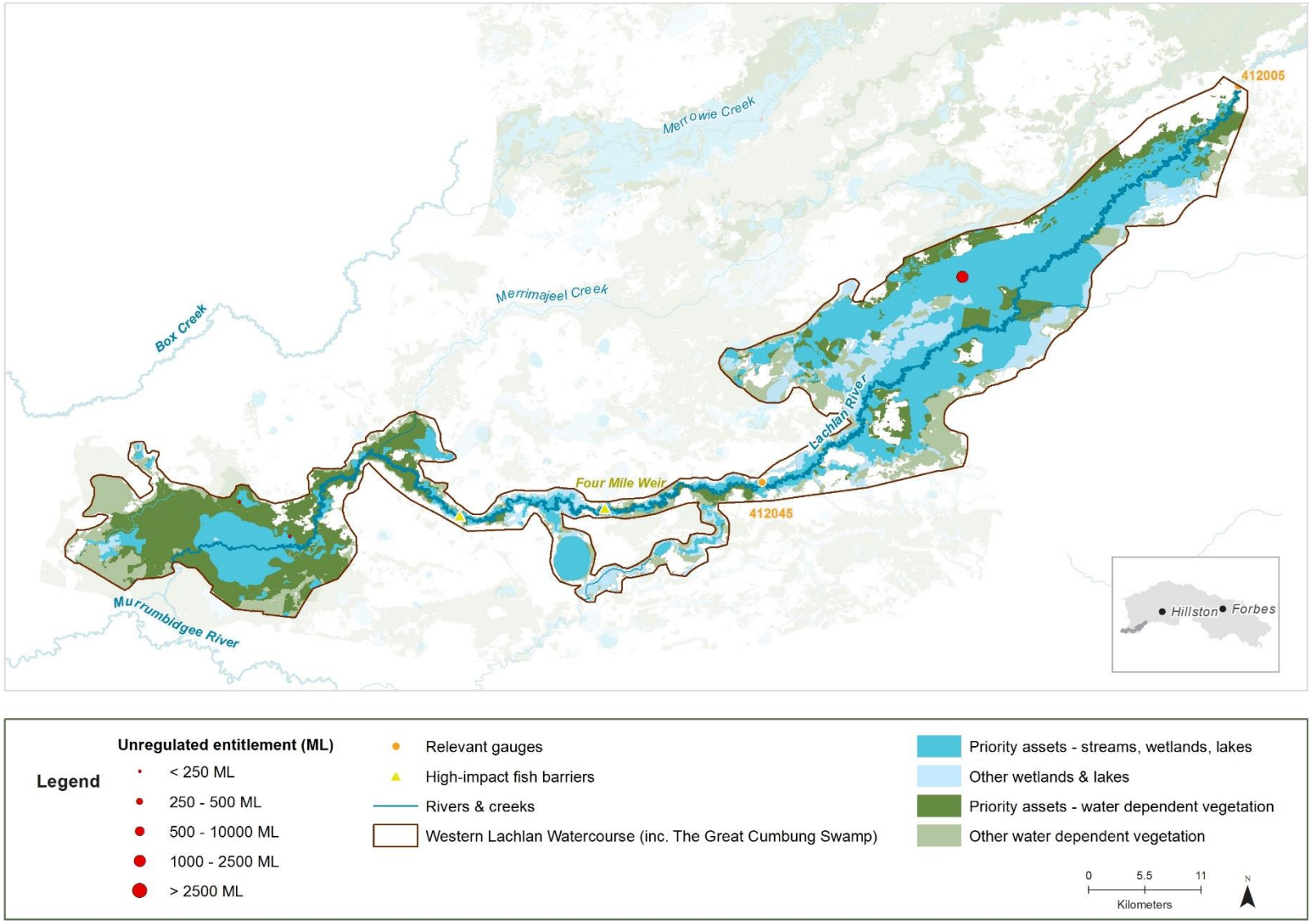
[61] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

[62] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Flow component		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Cease-to-flow	CF1	Muggabah Creek @ Cobb Hwy (412124)		In line with historical low flow season, typically January to May	Events should not persist longer than 365 days	CF events should occur in up to 100% of years	N/A	These EWRs can be met with the current volumes of HEW under current constraints or with PEW under the current WSP rules. When restarting flows ensure a slow rate of rise and fall (in line with natural) to reduce the risks of harmful water-quality impacts, such as de-oxygenated refuge pools. Minimum durations in very dry years represents the 95%ile duration at each flow rate.
Small wetland inundation	WL1	Lachlan River @ Booligal (412005)	>300 ML/d	September to March (but can occur any time)	30 days	7-8 years in 10 (75% of years)	2 years	
Large wetland inundation	WL2	Lachlan River @ Booligal (412005)	>650 ML/d	October to April (but can occur any time)	30 days, 2–8 months of habitat inundation	5-7 years in 10 (60% of years)	3 years	
	WL3	Lachlan River @ Booligal (412005)	>850 ML/d	August to February (but can occur any time)	60 days, 2–6 months of habitat inundation	3-5 years in 10 (40% of years)	4 years	PEW under the current WSP rules or HEW can partially contribute to this EWR with current volumes and under current constraints if delivered in combination with consumptive water deliveries or natural flows. Natural flows should be protected to ensure these EWRs are being met.
	WL4	Lachlan River @ Booligal (412005)	>1,200 ML/d	Any time	60 days, 2-3 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	
Small overbank	OB2	Lachlan River @ Booligal (412005)	>2,500 ML/d	October to April	5 days, 2–6 months of habitat inundation	4–7 years in 10 (55% of years)	3 years	These EWRs cannot be met with current volumes of HEW under current constraints. Flows >1,800 ML/d are reliant on a wet system or natural events. PEW may be able to meet these EWRs, depending on the time of year. These EWRs are mainly reliant on the protection of natural flows through this system.
	OB3	Lachlan River @ Booligal (412005)	>3,500 ML/d	August to February (but can occur any time)	6 days, 2-3 months of habitat inundation	3–5 years in 10 (40% of years)	4 years	
Large overbank	OB4	Lachlan River @ Booligal (412005)	>4,000 ML/d	September to May (but can occur any time)	2 days, 3–8 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	

Flow component	Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
OB5	Lachlan River @ Booligal (412005)	>5,000 ML/d	Any time	1 days, 1–6 months of habitat inundation	1 year in 10 (10% of years)	10 years	This EWR cannot be met with current volumes of HEW under current constraints, or with discretionary PEW or Translucent releases under current WSP rules. This EWR is reliant on the protection of natural flows through this system.

PU16: Western Lachlan watercourse (inc. The Great Cumbung Swamp)



Priority environmental assets and values	
Rivers, creeks, lakes, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):	• Lachlan River • Great Cumbung Swamp • Lachlan swamp • Lake Waljeers • Pimpara Creek • Baconian swamp • Fish refuge • Like Ita
Native fish[63]	• unspecked hardyhead • freshwater shrimp • Murray-Darling rainbowfish • dwarf flat-headed gudgeon • flathead gudgeon • olive perchlet • Australian smelt • yabby • carp gudgeon • Murray cod • silver perch • freshwater prawn • golden perch • flathead galaxias • bony herring
Birds	79 water-dependent bird species recorded, including the listed[64] waterbird species • glossy ibis • blue-billed duck • cattle egret • magpie goose • freckled duck • Australasian bittern • sharp-tailed sandpiper • eastern great egret • Latham's snipe
Native vegetation	14 water-dependent plant community types, including • river red gum woodland • black box - lignum woodland wetland • black box open woodland
Registered cultural assets	• ceremony and Dreaming • burials • resources, gathering • earth mound • hearth • modified tree • shell • artefacts
Other species[65]	• spotted grass frog • water rat • Peron's tree frog • Macquarie turtle • giant banjo frog
Unregulated WALs	The total volume of unregulated entitlements in the planning unit is 1245 ML, of which 1230 ML are for production. There is one unregulated WALs for production that is 1230 ML. It is located in the floodway of the Lachlan River.
Unregulated WSP recommendations	Consider introducing cease-to-pump and commence-to-pump rules (and any associated required amendments to WAL conditions) that protect held and planned environmental water reaching floodplain wetlands[66] • Consider protection of water for the environment in this planning unit to protect ecologically important flows in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* within five years

[63] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)
[64] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)
[65] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded
[66] In-line with the Basin Plan requirement for implementation of prerequisite policy measures that provide for delivered environmental water to be protected. It is also recommended by the Matthews reports (2017).

Flow category[67]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
Cease-to-flow	CF1	Lachlan River @ Booligal (412005)	0 ML/d	In line with historical low flow season, typically January to May	Events should not persist longer than 15 days	CF events should occur in no more than 44% of years	N/A	These EWRs are currently mostly met through operational and consumptive water deliveries under current WSP rules. These EWRs can enhanced with the current volumes of HEW under current constraints or with PEW under the current WSP rules, depending on the time of year. When restarting flows ensure a slow rate of rise and fall (in line with natural) to reduce the risks of harmful water-quality impacts, such as de-oxygenated refuge pools. Minimum durations in very dry years represents the 95%ile duration at each flow rate.
Very-low flow	VF1	Lachlan River @ Booligal (412005)	>10 ML/d	Any time	322 days (or 194 days in very dry years)	Annual (100% of years)	1 year	
Baseflow	BF1	Lachlan River @ Booligal (412005)	>50 ML/d	Any time	275 days (or 140 days in very dry years)	Annual (100% of years)	1 year	
	BF2	Lachlan River @ Booligal (412005)	>50 ML/d	September to March	177 days (or 74 days in very dry years)	5–10 years in 10 (75% of years)	2 years	
Small fresh	SF1	Lachlan River @ Booligal (412005)	>200 ML/d	October to April (but can occur any time)	10 days	Annual (100% of years)	1 year	These EWRs are currently partially met through operational and consumptive water deliveries under current WSP rules. These EWRs can potentially be enhanced with the current volumes of HEW under current constraints, or with PEW under the current WSP rules, depending on the time of year.
	SF2	Lachlan River @ Booligal (412005)	>200 ML/d	October to April	14 days	5–10 years in 10 (75% of years)	2 years	
Large fresh	LF1	Lachlan River @ Booligal (412005)	>650 ML/d	July to September (but can occur any time)	5 days	5–10 years in 10 (75% of years)	2 years	These EWRs can be met with the current volumes of HEW under current constraints or with PEW under the current WSP rules.

[67] See Glossary for definitions and explanatory text on how to interpret the EWR table

Flow category[67]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
	LF2	Lachlan River @ Booligal (412005)	>650 ML/d	October to April	5 days	3–5 years in 10 (40% of years)	4 years	
Bankfull	BK1	Lachlan River @ Booligal (412005)	2,000-2,500 ML/d	August to February (but can occur any time)	15 days	5-7 years in 10 (60% of years)	N/A	These EWRs can be met with PEW under the current WSP rules but may not be met with HEW due to current constraints. Flows >1,800 ML/d are reliant on a wet system or natural events. Natural flows need to be protected and constraints need to be relaxed to reliably meet these EWRs.
Small wetland inundation	WL1	Lachlan River @ Booligal (412005)	>650 ML/d	September to March (but can occur any time)	30 days, 2–8 months of habitat inundation	7-8 years in 10 (75% of years)	2 years	These EWRs can be met with the current volumes of HEW under current constraints or with PEW under the current WSP rules.
	WL2	Lachlan River @ Booligal (412005)	>850 ML/d	October to April (but can occur any time)	60 days, 2–6 months of habitat inundation	5-7 years in 10 (60% of years)	3 years	
Large wetland inundation	WL3	Lachlan River @ Booligal (412005)	>1,200 ML/d	August to February (but can occur any time)	60 days, 2-3 months of habitat inundation	3-5 years in 10 (40% of years)	4 years	Discretionary PEW or Translucent releases under the current WSP rules, or HEW can partially contribute to this EWR with current volumes and under current constraints if delivered in combination with consumptive water deliveries or natural flows. Natural flows should be protected to ensure these EWRs are being met.
	WL4	Lachlan River @ Booligal (412005)	>1,200 ML/d	Any time	60 days, 2-3 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	
Small overbank	OB2	Lachlan River @ Booligal (412005)	>2,500 ML/d	October to April	30 days, 2–6 months of habitat inundation	4–7 years in 10 (55% of years)	3 years	These EWRs cannot be met with current volumes of HEW under current constraints. Flows >1,800 ML/d are reliant on a wet system or

Flow category[67]		Gauge	Flow rate / volume	Timing	Minimum duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements and comments
	OB3	Lachlan River @ Booligal (412005)	>3,500 ML/d	August to February (but can occur any time)	6 days, 2-3 months of habitat inundation	3–5 years in 10 (40% of years)	4 years	natural events. Discretionary PEW or Translucent releases may be able to contribute to these EWRs, depending on the time of year. These EWRs are mainly reliant on the protection of natural flows through this system.
Large overbank	OB4	Lachlan River @ Booligal (412005)	>4,000 ML/d	September to May (but can occur any time)	2 days, 3–8 months of habitat inundation	2–3 years in 10 (25% of years)	5 years	
	OB5	Lachlan River @ Booligal (412005)	>5,000 ML/d	Any time	1 days, 1–6 months of habitat inundation	1 year in 10 (10% of years)	10 years	This EWR cannot be met with current volumes of HEW under current constraints, or with discretionary PEW or Translucent releases under current WSP rules. This EWR is reliant on the protection of natural flows through this system.

3. Zone B planning units

Zone B planning units (PU 20–49) represent areas that cannot be managed with discretionary environmental water delivered from storages or other types of regulated water delivery. They rely on natural inflows, rules and conditions that provide PEW in the planning unit (including the unextracted portion of natural flows protected for the environment) and flows from upstream planning units to meet the water needs of the priority assets and functions they support.

Rules in the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources* (Lachlan unregulated WSP) that govern access to water for consumptive use are the primary mode of environmental water management in Zone B planning units. This means that the water requirements of priority assets and functions in Zone B can be more easily managed through the policy mechanisms that govern PEW in these areas. To accommodate for this policy-based approach to environmental water management, Zone B planning unit boundaries are based on the water source boundaries described in the Lachlan unregulated WSP.

3.1 Quantifying hydrological alteration and strategies for protecting ecologically significant flows

For each Zone B PU, information is presented on the hydrology[68] and the degree of alteration, as determined by DPIE–Water in their *Risk assessment for the Lachlan water resource plan area*, by comparing flows under near natural conditions (with no dams or water extractions) and flows under current conditions[69]. Table 1 describes how the hydrology changes are presented for each planning unit.

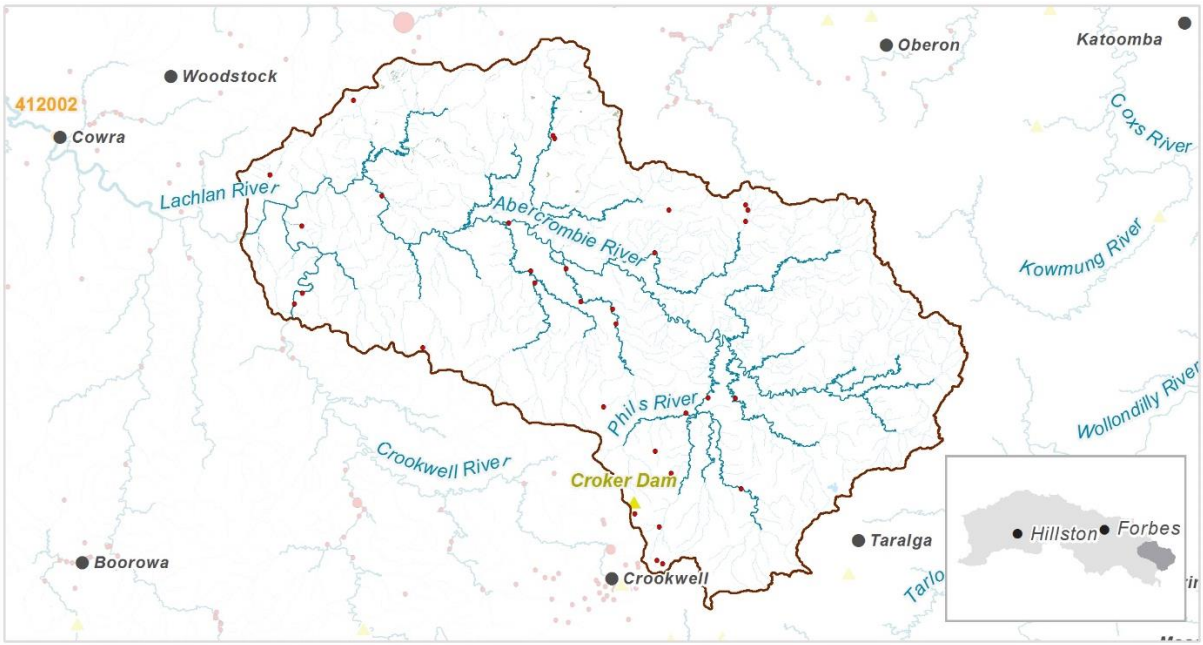
Recommendations have been suggested for each planning unit[70] to ensure important ecological flows are protected to maintain or improve priority assets and functions.[71]

Table 1 Key to hydrological alteration used in this document

Key to hydrological alteration from *Risk assessment for the Lachlan water resource plan area* (NSW DPIE-Water 2019)
L= Low: less than 20% departure (+/-) from the base case for each hydrologic metric
M = Medium: 20-50% departure (+/-); from the base case for each hydrologic metric
H = High: greater than 50% departure (+/-) from the base case for each hydrologic metric
N/A = no risk outcome or modelling available due to no hydrological data available
$^{+}$ increase near-natural condition
$^{-}$ decrease near-natural condition
^{0} no change from near-natural condition

[68] The hydrology is presented as percentiles and ARIs as determined by pre-development modelling.
[69] There are limitations to the flow data available in the unregulated water sources of the Lachlan catchment. The flow statistics used were mainly generated from measured data and vary in duration and cover different climatic periods. In addition, some flow sequences have gaps that were filled using correlations with nearby gauges.
[70] Recommendations are based on the local hydrology, the degree of hydrological change, the water-dependent values and assets present (e.g. especially threatened native fish species), the relevant LTWP objectives, and the number, size and location of water access licenses (WALs) in the water source.
[71] To improve the specificity of rule change recommendations, a better understanding of the actual total amount of take and the individual water access licence conditions is often required.

PU17: Abercrombie River water source



Priority environmental assets and values

Rivers, creeks, lakes, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):

- Abercrombie River
- Bald Ridge Creek
- Bolong River
- Burra Burra Creek
- Lake Wyangala
- Copperhannia Creek
- Grove Creek
- Isabella River
- Meglo Creek
- Mulgunnia Creek
- Peelwood Creek
- Thompsons Creek
- Tuena Creek

Native fish[72]

- southern purple spotted gudgeon
- dwarf flat-headed gudgeon
- Macquarie perch
- southern pygmy perch
- northern river blackfish
- yabby
- obscure galaxias
- golden perch
- carp gudgeon
- flathead gudgeon
- Australian smelt
- freshwater shrimp
- freshwater catfish
- Euastacus claytoni
- Alpine crayfish
- rieks crayfish
- suttons crayfish
- freshwater prawn
- silver perch
- trout cod (historical)
- Murray cod

[72] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

Birds	65 water-dependent bird species recorded, including the listed[73] waterbird species • glossy ibis • Latham's snipe • freckled duck • blue-billed duck • common sandpiper • red-necked stint
Native vegetation	Four water-dependent plant community types, including river red gum woodland
Registered cultural assets	• artefacts, hearth • modified trees
Other species[74]	• Booroolong frog • Sloane's froglet • yellow-spotted tree frog • stuttering frog • spotted grass frog • greater broad-nosed bat • platypus • southern bell frog • eastern snake-necked turtle • eastern bentwing-bat • water rat • Macquarie turtle • Peron's tree frog

Hydrology

Gauge: 412028 *Abercrombie River at Abercrombie*	**80th percentile**: 49.53 ML/d	**50th percentile**: 234.31 ML/d	**20th percentile**: 1,061.82 ML/d
	1.5 ARI: 19,246 ML/d	**2.5 ARI**: 27,417 ML/d	**5 ARI**: 55,011 ML/d

Flows do not seem to be altered by more than 20% compared to the 'without development' model scenario as assessed by the Lachlan WRPA Risk Assessment.

The total volume of unregulated entitlements in the planning unit is 1003 ML, of which 969 ML are for production. There are 29 unregulated WALs for production <250 ML. They are all distributed throughout the water source.

This planning unit has relatively high flows and although there are many unregulated WALs, they are also all quite small. The cease-to-pump rule currently seems adequate to mitigate extraction impacts on cease-to-flow and low flows and baseflows.

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L	L^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment Cease to pump at 7 ML/day at gauge 412028					

Recommended management strategies

Ensure compliance with water access licence conditions including through metering of all licensed extraction

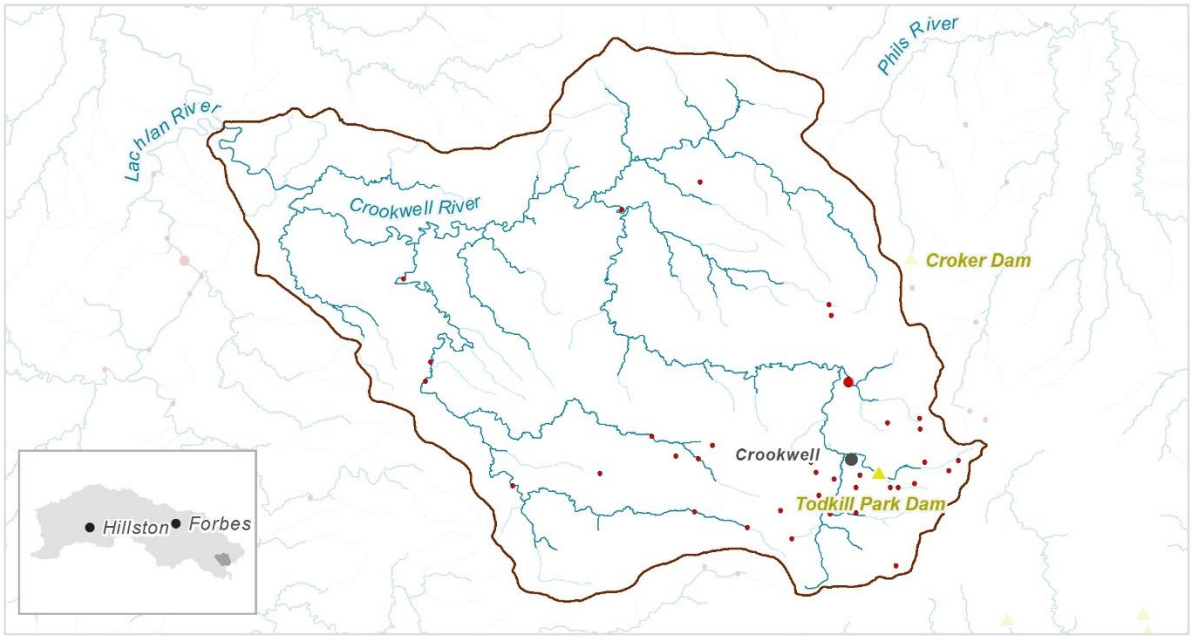
As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

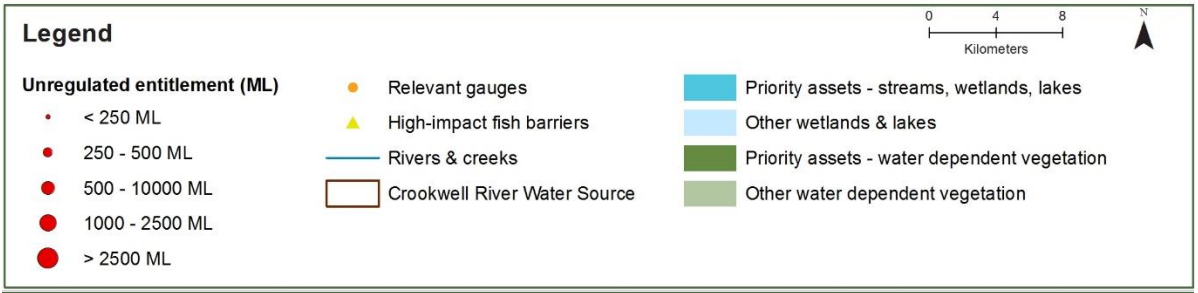
Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[73] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

[74] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

PU18: Crookwell River water source





Priority environmental assets and values

- Crookwell River, its tributaries, in-channel habitat and fringing vegetation communities

Native fish[75]	• Macquarie perch • Rieks crayfish • northern river blackfish	• obscure galaxias • yabby • flathead gudgeon • carp gudgeon	• Australian smelt • alpine crayfish • southern pygmy perch
Birds	61 water-dependent bird species recorded.		
Native vegetation	Two water-dependent plant community types, including river red gum woodland		
Registered cultural assets	None registered		

[75] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

Other species[76]	• platypus • Sloane's froglet	• Eastern snake-necked turtle • Booroolong frog	• Eastern sign-bearing froglet

Hydrology

Gauge: 412050 *Crookwell River at Narrawa North*	**80th percentile**: 11.39 ML/d	**50th percentile**: 43.50 ML/d	**20th percentile**: 199.87 ML/d
	1.5 ARI: 4,603 ML/d	**2.5 ARI**: 7,765 ML/d	**5 ARI**: 14,833 ML/d

Low flows are highly altered (>50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Low flows currently occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 1695 ML, of which 1289 ML are for production. There are 37 unregulated WALs for production <250 ML. The WALs are mainly distributed across the upper part of the PU and concentrated around Crookwell.

This planning unit has relatively high flows but there are also quite a few unregulated WALs for production present in the planning unit. The cease-to-pump threshold is adequate for protecting cease-to-flow periods. However, if all WALs were to extract water around the same time, low flows and baseflows may be substantially impacted (as confirmed by the *Risk assessment for the Lachlan Surface Water Resource Plan Area*).

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L	H^-	L^-	L^-	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment Cease to pump at 2 ML/day at gauge 412050 (Crookwell River at Narrawa North)					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years

- Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
- Consider reviewing the cease-to-pump threshold
  - Consider increasing the cease-to-pump rule to 10 ML/day
  - Consider implementing a commence-to-pump rule to 30 ML/day to provide connectivity opportunities and enable floodplain specialist native fish species to move into new areas (within historical range)
- Consider rostering landholder water access during low flow months
- Consider installing water level gauges at or near extraction sites
- Consider implementing total and/or individual daily extraction limits

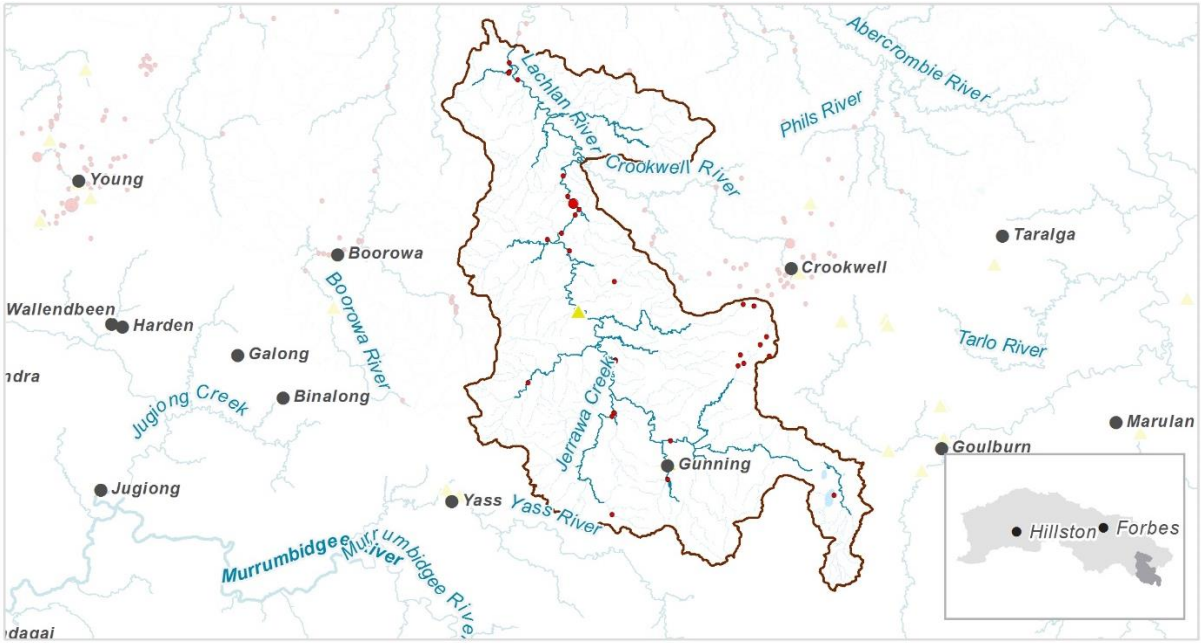
Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[76] Other species list includes flow-dependent frog species, platypus, and other State or Commonwealth listed water-dependent species where they have been recorded

PU19: Lachlan River above Reids Flat water source



Priority environmental assets and values

Rivers, creeks, lakes, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):

- Lachlan River
- Blakney Creek
- Jarrawa Creek
- other tributaries to the Lachlan River

Native fish[77]	• Macquarie perch • southern pygmy perch • northern river blackfish	• Rieks crayfish • Australian smelt • yabby alpine crayfish • carp gudgeon • flathead gudgeon	• freshwater prawn • silver perch • golden perch • Murray cod • obscure galaxias
Birds	66 water-dependent bird species recorded, including the listed[78] waterbird species: • Australian painted snipe	• common sandpiper • glossy ibis	• Latham's snipe

[77] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[78] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Native vegetation	Two water-dependent plant community types, including river red gum woodland
Registered cultural assets	• modified trees
Other species[79]	• Booroolong frog • eastern sign-bearing froglet • spotted grass frog • Peron's tree frog • eastern snake-necked turtle • Sloane's froglet • giant banjo frog

Hydrology

Gauge: 412027 *Lachlan River at Reids Flat*	**80th percentile**: 22.62 ML/d	**50th percentile**: 144.05 ML/d	**20th percentile**: 1,030.56 ML/d
	1.5 ARI: 21,680 ML/d	**2.5 ARI**: 43,693 ML/d	**5 ARI**: 53,437 ML/d

Cease-to-flow periods are highly altered (>50% departure from base case) and low flows are moderately altered (20-50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Cease-to-flow periods currently occur more frequently, and low flows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 2014 ML, of which 1872 ML are for production. There are 27 unregulated WALs for production <250 ML, and 1 between 250-500 ML. Many are distributed along the Lachlan River, but over half of the WALs are located on tributaries throughout the water source.

This planning unit has relatively high flows but there are also quite a few unregulated WALs for production present in the planning unit. If all WALs were to extract water around the same time, cease-to-flow and low flows may be substantially impacted (as confirmed by the *Risk assessment for the Lachlan Surface Water Resource Plan Area*).

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H^+	M^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years

- Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
- Consider rostering landholder water access
- Consider reviewing cease-to-pump rules to better protect low flows
  - Consider increasing the cease-to-pump rule to 45 ML/day
- Consider installing water level gauges at or near extraction sites
- Consider implementing total and/or individual daily extraction limits

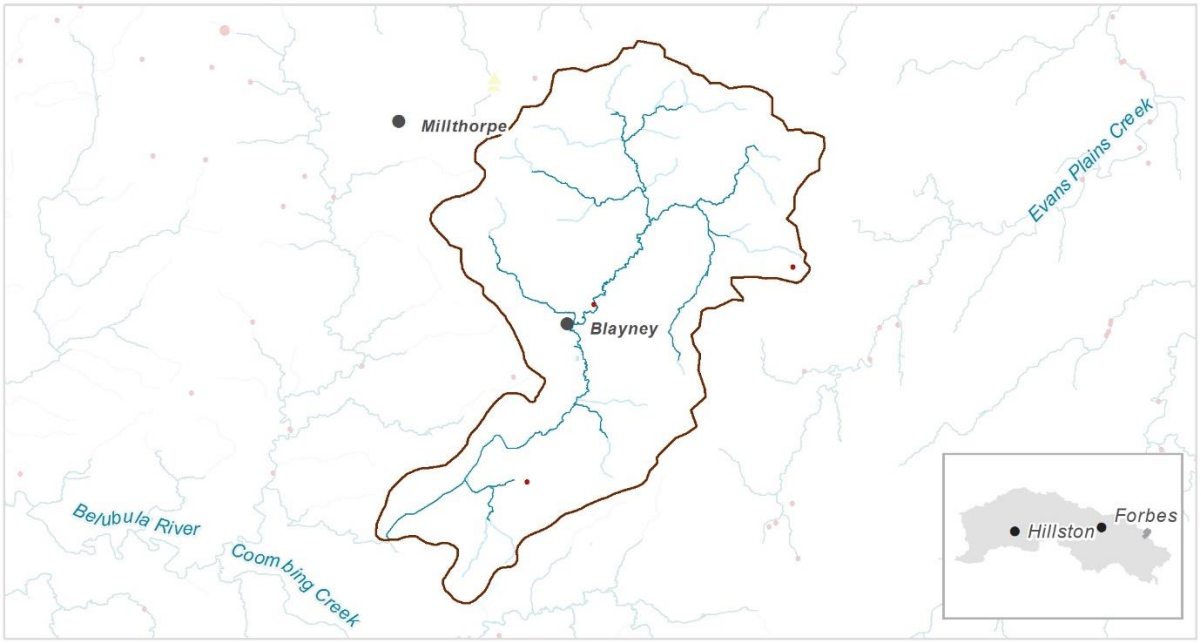
Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

[79] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

PU20: Belubula River above Carcoar Dam water source



Priority environmental assets and values

- Belubula River, its tributaries and in-channel habitat

Native fish[80]	• obscure galaxias	• yabby	• alpine crayfish
Birds	67 water-dependent bird species recorded, including the listed[81] waterbird species:		
	• blue-billed duck	• Latham's snipe	• common greenshank
	• buff-banded rail	• glossy ibis	• sharp-tailed sandpiper
Native vegetation	-		

[80] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)
[81] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Registered cultural assets	None registered		
Other species[82]	• Booroolong frog	• platypus	• eastern snake-necked turtle

Hydrology

Gauge: 412092 *Coombing Creek at Near Neville*	**80th percentile**: 0.63 ML/d	**50th percentile**: 10.48 ML/d	**20th percentile**: 81.45 ML/d
	1.5 ARI: 1,833 ML/d	**2.5 ARI**: 2,769 ML/d	**5 ARI**: 3,796 ML/d

Cease-to-flow periods and low flows are highly altered (>50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Cease-to-flow periods currently occur more frequently and low flows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 268 ML, of which 264 ML are for production. There are three unregulated WALs for production <250 ML. They are distributed throughout the planning unit.

This planning unit has relatively low flows and water is mainly diverted when the rainfall has been inadequate. This means that cease-to-flows and low flows may be impacted by extraction (as confirmed by the *Risk assessment for the Lachlan Surface Water Resource Plan Area*).

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

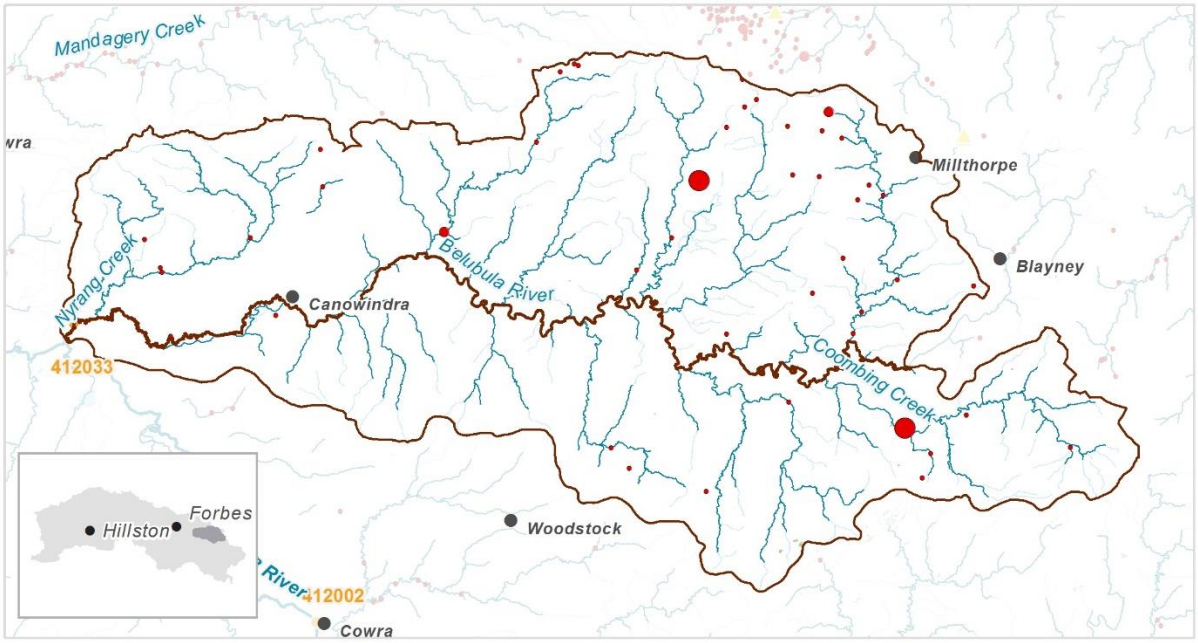
Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[82] Other species list includes flow-dependent frog species, platypus, and other State or Commonwealth listed water-dependent species where they have been recorded

PU21: Belubula Tributaries below Carcoar Dam water source



Priority environmental assets and values

Tributaries to the Belubula River and their in-channel habitat and fringing vegetation communities including, but not limited to:

- Coombing Creek
- Nyrang Creek
- Cadiangullong Creek

Native fish[83]	• southern purple spotted gudgeon • freshwater catfish • obscure galaxias • flathead gudgeon • northern river blackfish	• Australian smelt • yabby • alpine crayfish • carp gudgeon • Murray cod	• freshwater prawn • golden perch • Rieks crayfish • freshwater shrimp • Suttons crayfish
Birds	78 water-dependent bird species recorded, including the listed[84] waterbird species: • Latham's snipe • marsh sandpiper	• common greenshank • red-necked stint	• sharp-tailed sandpiper • curlew sandpiper

[83] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)
[84] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Native vegetation	2 water-dependent plant community types, including river red gum woodland		
Registered cultural assets	None registered		
Other species[85]	• yellow-bellied sheathtail-bat • eastern bentwing-bat • Corben's long-eared bat • eastern snake-necked turtle	• stuttering frog • platypus • water rat	• Sloane's froglet • Booroolong frog • southern myotis • little pied bat

Hydrology

Cease-to-flow periods and low flows are highly altered (>50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Cease-to-flow periods currently occur more frequently and low flows occur less frequently compared to the 'without development' model scenario.

There is a high degree of groundwater – surface water interaction in this system. Groundwater extraction is therefore most likely negatively impacting on surface water flows, in particular, cease-to-flow periods and low flows and baseflows.

The total volume of unregulated entitlements in the planning unit is 9586 ML, of which 6380 ML are for production. There are 39 unregulated WALs for production <250 ML, two WALs between 250-500 ML, and one WAL >2500 ML (4200 ML). They are distributed throughout the water source although the majority are found in the upper half. The largest unregulated WAL for production is found on Cadiangullong Creek.

Water is mainly diverted when the rainfall has been inadequate. However, if all WALs were to extract water around the same time, cease-to-flow and low flows may be substantially impacted (as confirmed by the *Risk assessment for the Lachlan Surface Water Resource Plan Area*).

It is important to protect flows in this water source because EWRs in the Belubula PU (Zone A PU1) are reliant on water contributions from this planning unit to meet the LTWP objectives.

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years

- Consider rostering landholder water access during low flow months
- Consider reviewing cease-to-pump rules to better protect low flows
  - Investigate increasing cease-to-pump to 30 ML/d at Belubula River at Helenshome gauge (412033) or 40 ML/d at Belubula River at Lyndon gauge (412195) to protect baseflows in this planning unit and the Belubula River PU (Zone A)
- Consider implementing a commence-to-pump threshold that is higher than cease-to-pump threshold

[85] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

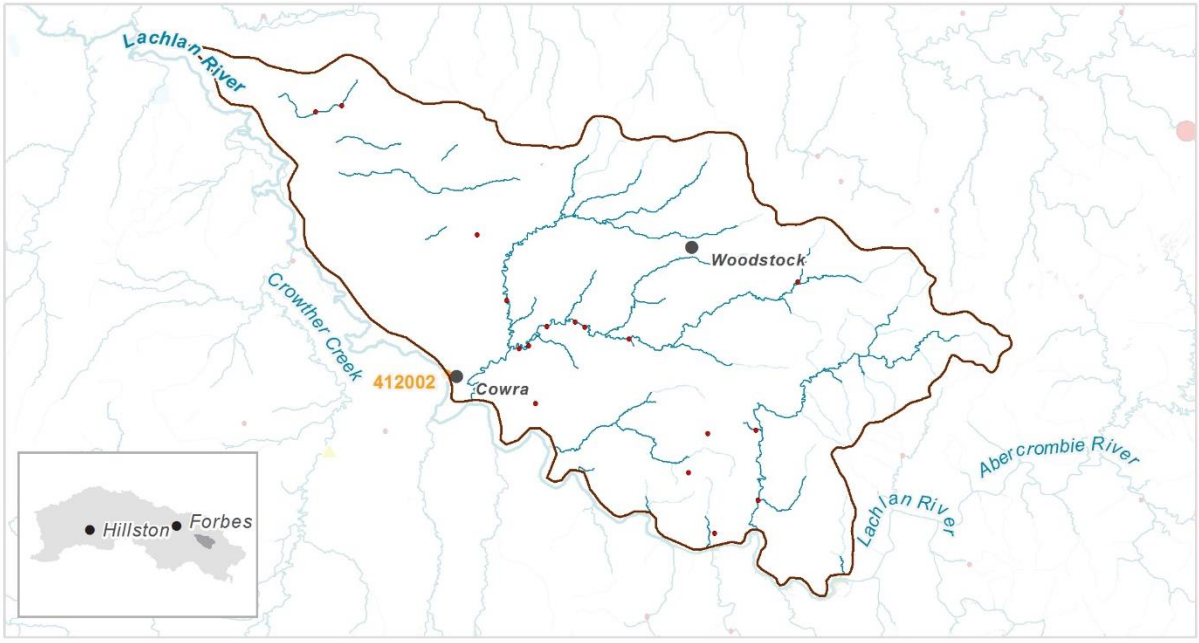
- Investigate implementing a commence-to-pump rule to protect freshes above 70 ML/d at Belubula River at Helenshome gauge (412033) or 130 ML/d at Belubula River at Lyndon gauge (412195)
- Consider implementing total and/or individual daily extraction limits

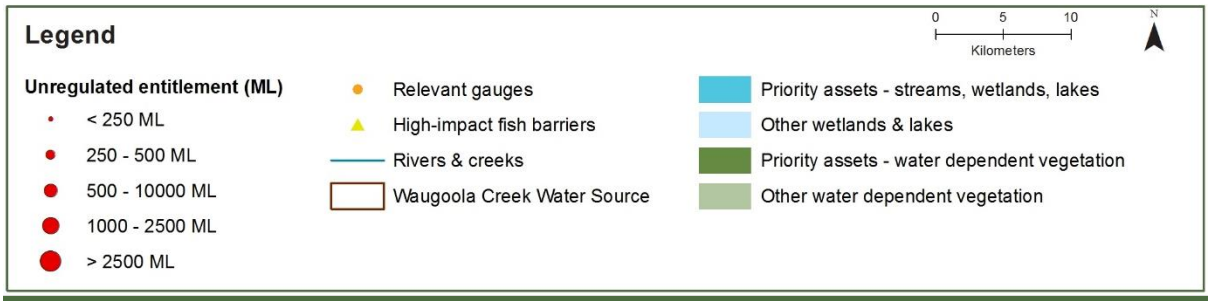
Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

PU22: Waugoola Creek water source





Priority environmental assets and values

- Waugoola Creek, its tributaries, in-channel habitat and fringing vegetation communities

Native fish[86]	• southern purple spotted gudgeon • northern river blackfish	• Australian smelt • yabby • carp gudgeon	• alpine crayfish • obscure galaxias • flathead gudgeon
Birds	69 water-dependent bird species recorded, including the listed[87] waterbird species: • cattle egret • sharp-tailed sandpiper	• marsh sandpiper • Australasian bittern	• freckled duck • Latham's snipe
Native vegetation	Two water-dependent plant community types, including river red gum woodland		

[86] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)
[87] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Registered cultural assets	• modified trees		
Other species[88]	• Sloane's froglet • Peron's tree frog	• eastern sign-bearing froglet • water rat	• spotted grass frog • eastern snake-necked turtle

Hydrology

Gauge – 412091 *Waugoola Creek U/S Cowra*	**80th percentile**: 0.37 ML/d	**50th percentile**: 7.03 ML/d	**20th percentile**: 26.50 ML/d
	1.5 ARI: 857 ML/d	**2.5 ARI**: 1,259 ML/d	**5 ARI**: 1,552 ML/d

Cease-to-flow periods and low flows are highly altered (>50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Cease-to-flow periods currently occur more frequently and low flows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 359 ML, of which 341 ML are for production. There are 15 unregulated WALs for production <250 ML. The majority of WALs is on Waugoola Creek, but approximately half of the unregulated WALs for production are distributed throughout the water source.

This planning unit has relatively low flows and water is mainly diverted when the rainfall has been inadequate. This means that cease-to-flows and low flows and baseflows may be impacted by extraction (as confirmed by the *Risk assessment for the Lachlan Surface Water Resource Plan Area*).

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years

- Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
- Consider rostering landholder water access during low flow months
- Consider reviewing cease-to-pump rules to better protect low flows
- Consider installing water level gauges at or near extraction sites
- Consider implementing total and/or individual daily extraction limits

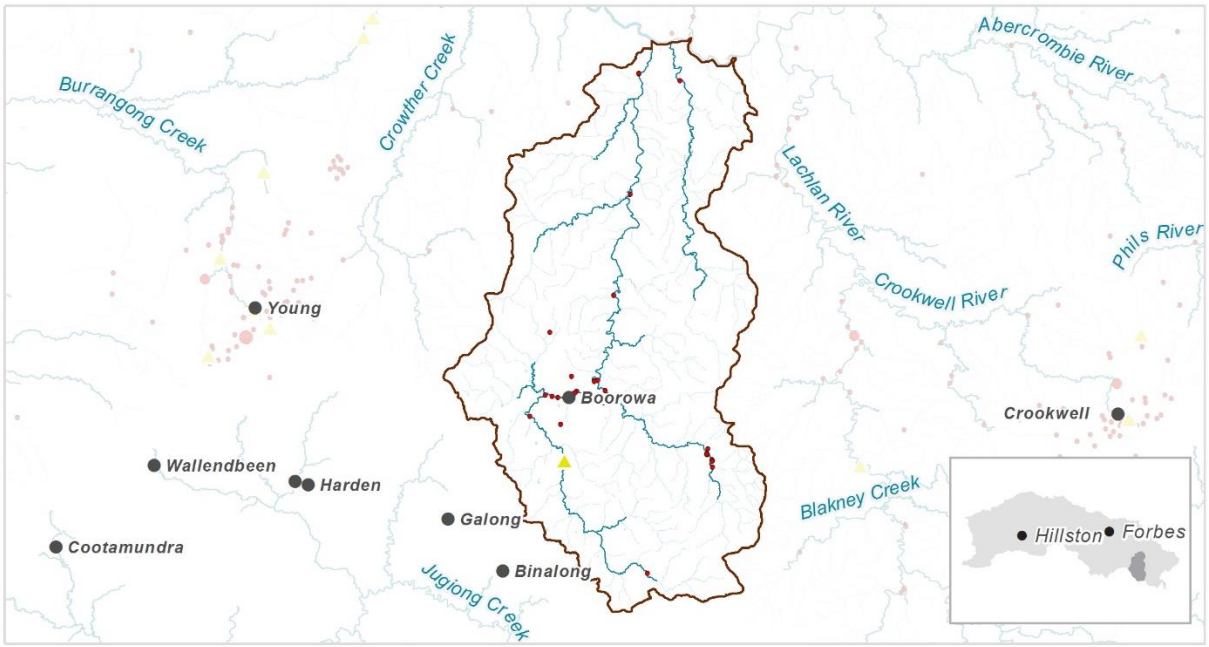
Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[88] Other species list includes flow-dependent frog species, platypus, and other State or Commonwealth listed water-dependent species where they have been recorded

PU23: Boorowa River water source



Priority environmental assets and values

- Boorowa River and its tributaries, in-channel habitat, and fringing vegetation communities

Native fish[89]	• northern river blackfish • obscure galaxias • carp gudgeon • flathead gudgeon	• Australian smelt • alpine crayfish • freshwater prawn • yabby	• Murray cod • golden perch • southern pygmy perch
Birds	61 water-dependent bird species recorded, including the listed[90] waterbird species: cattle egret.		
Native vegetation	Three water-dependent plant community types, including river red gum woodland		
Registered cultural assets	• modified tree		

[89] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[90] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Other species[91]	• eastern sign-bearing froglet • yellow-bellied sheathtail-bat	• Sloane's froglet • spotted grass frog • platypus	• Peron's tree frog • Booroolong frog • eastern bentwing-bat

Hydrology

Gauge: 412029 *Boorowa River at Prossers Crossing*	**80th percentile**: 4.13 ML/d	**50th percentile**: 40.13 ML/d	**20th percentile**: 211.97 ML/d
	1.5 ARI: 6,763 ML/d	**2.5 ARI**: 13,961 ML/d	**5 ARI**: 19,098 ML/d

Cease-to-flow periods and low flows are highly altered (>50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Cease-to-flow periods currently occur more frequently and low flows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 1187 ML, of which 1128 ML are for production. There are 27 unregulated WALs for production <250 ML. The majority of unregulated WALs for production are found on Boorowa River, there are nine located on Pudman Creek, and the rest are distributed throughout the planning unit.

This planning unit has relatively high flows but there are also quite a few unregulated WALs for production present in the planning unit. If all WALs were to extract water around the same time, cease-to-flow and low flows may be substantially impacted (as confirmed by the *Risk assessment for the Lachlan Surface Water Resource Plan Area*).

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment Cease to pump when there is no flow at Boorowa River at Prossers Crossing gauge 412029					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years

- Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
- Consider rostering landholder water access during low flow months
- Consider reviewing cease-to-pump rules to better protect low flows
- Consider implementing a commence-to-pump threshold that is higher than cease-to-pump threshold
- Consider implementing total and/or individual daily extraction limits
- Consider installing water level gauges at or near extraction sites

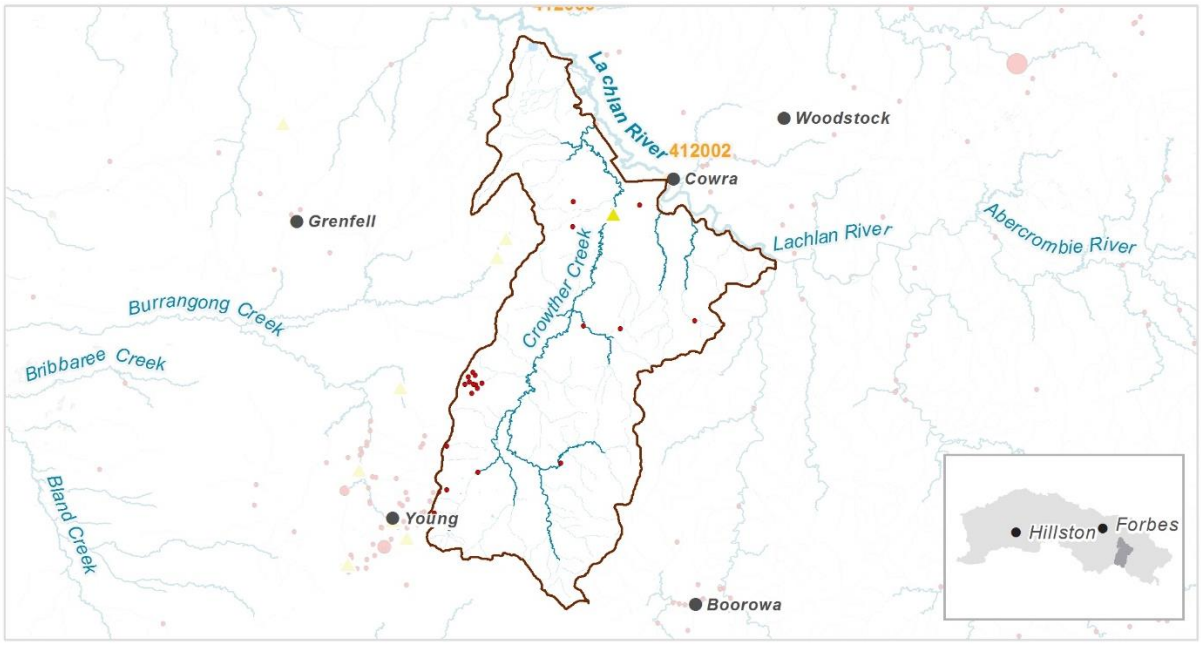
Ensure compliance with water access licence conditions including through metering of all licensed extraction

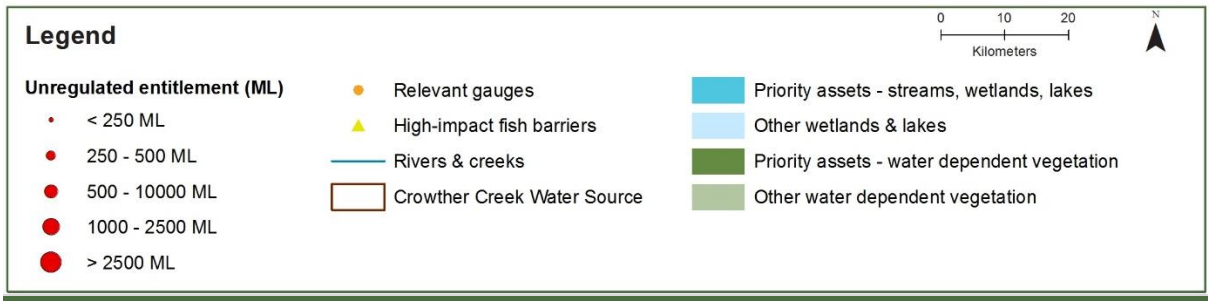
As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[91] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

PU24: Crowther Creek water source





Priority environmental assets and values

- Crowther Creek and its tributaries, in-channel habitat, and fringing vegetation communities

Native fish[92]	• southern purple spotted gudgeon • northern river blackfish • golden perch	• flathead gudgeon • Australian smelt • freshwater shrimp • yabby	• alpine crayfish • freshwater prawn • carp gudgeon • obscure galaxias
Birds	73 water-dependent bird species recorded, including the listed[93] waterbird species:		
	• cattle egret • brolga	• Latham's snipe • Australasian bittern	• sharp-tailed sandpipe • wood sandpiper
Native vegetation	Three water-dependent plant community types, including river red gum woodland		
Registered cultural assets	• modified trees	• artefacts	

[92] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)
[93] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Other species[94]	• Sloane's froglet • Peron's tree frog • southern myotis • spotted grass frog	• giant banjo frog • platypus • little pied bat	• eastern sign-bearing froglet • yellow-bellied sheathtail-bat • eastern snake-necked turtle

Hydrology

Gauge: 412072 *Back Creek at Koorawatha*	**80th percentile**: 0 ML/d	**50th percentile**: 3.12 ML/d	**20th percentile**: 73.87 ML/d
	1.5 ARI: 2,691 ML/d	**2.5 ARI**: 5,935 ML/d	**5 ARI**: 12,413 ML/d

Low flows are highly altered (>50% departure from base case) and cease-to-flow periods are moderately altered (20-50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Cease-to-flow periods currently occur more frequently and low flows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 1404 ML, of which 1363 ML are for production. There are 21 unregulated WALs for production <250 ML. There are a number of unregulated WALs for production on Back Creek, and the rest are distributed throughout the planning unit.

This planning unit has relatively low flows and water is mainly diverted when the rainfall has been inadequate. This means that cease-to-flows and low flows may be impacted by extraction (as confirmed by the Risk assessment for the Lachlan Surface Water Resource Plan Area).

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	M^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years

- Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
- Consider rostering landholder water access during low flow months.
- Consider reviewing cease-to-pump rules to better protect low flows
- Consider implementing total and/or individual daily extraction limits
- Consider installing water level gauges at or near extraction sites

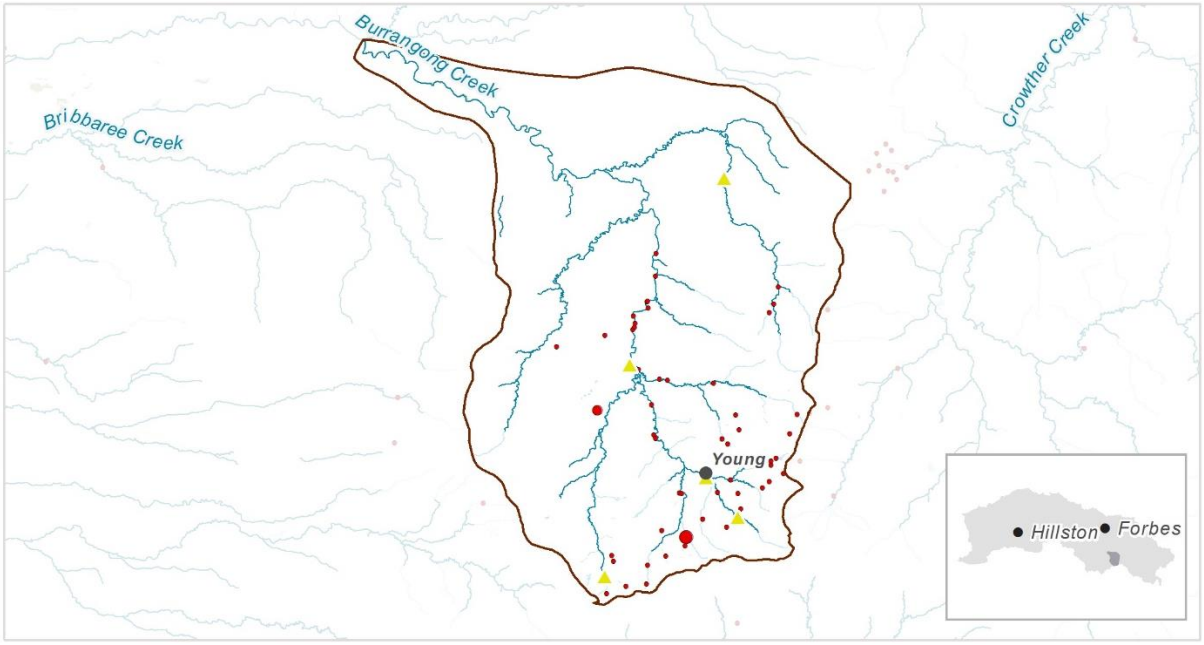
Ensure compliance with water access licence conditions including through metering of all licensed extraction

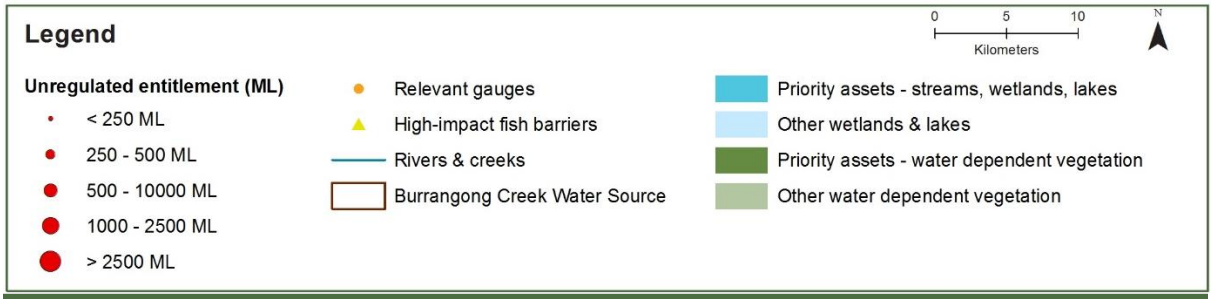
As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[94] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

PU25: Burrangong Creek water source





Priority environmental assets and values

- Burrangong Creek and its tributaries, in-channel habitat, and fringing vegetation communities

Native fish[95]	• northern river blackfish • obscure galaxias	• flathead gudgeon • Australian smelt • carp gudgeon	• yabby • freshwater prawn
Birds	39 water-dependent bird species recorded		
Native vegetation	Two water-dependent plant community types, including river red gum woodland		
Registered cultural assets	• modified tree		
Other species[96]	• eastern snake-necked turtle	• Peron's tree frog • Sloane's froglet	• spotted grass frog

Hydrology

[95] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[96] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Gauge: 412072 *Back Creek at Koorawatha*	**80th percentile**: 0 ML/d	**50th percentile**: 1.14 ML/d	**20th percentile**: 26.91 ML/d
	1.5 ARI: 980 ML/d	**2.5 ARI**: 2,162 ML/d	**5 ARI**: 4,522 ML/d

Cease-to-flow periods and low flows are highly altered (>50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Cease-to-flow periods currently occur more frequently and low flows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 2554 ML, of which 2501 ML are for production. There are 50 unregulated WALs for production <250 ML, one WAL between 250-500 ML, and one WAL between 550-1000 ML. The majority of unregulated WALs for production are found at the top of the planning unit and along Burrangong Creek.

This planning unit has relatively low flows and water is mainly diverted when the rainfall has been inadequate. There are also many WALs. This means that cease-to-flows and low flows may be impacted by extraction (as confirmed by the *Risk assessment for the Lachlan Surface Water Resource Plan Area*).

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years

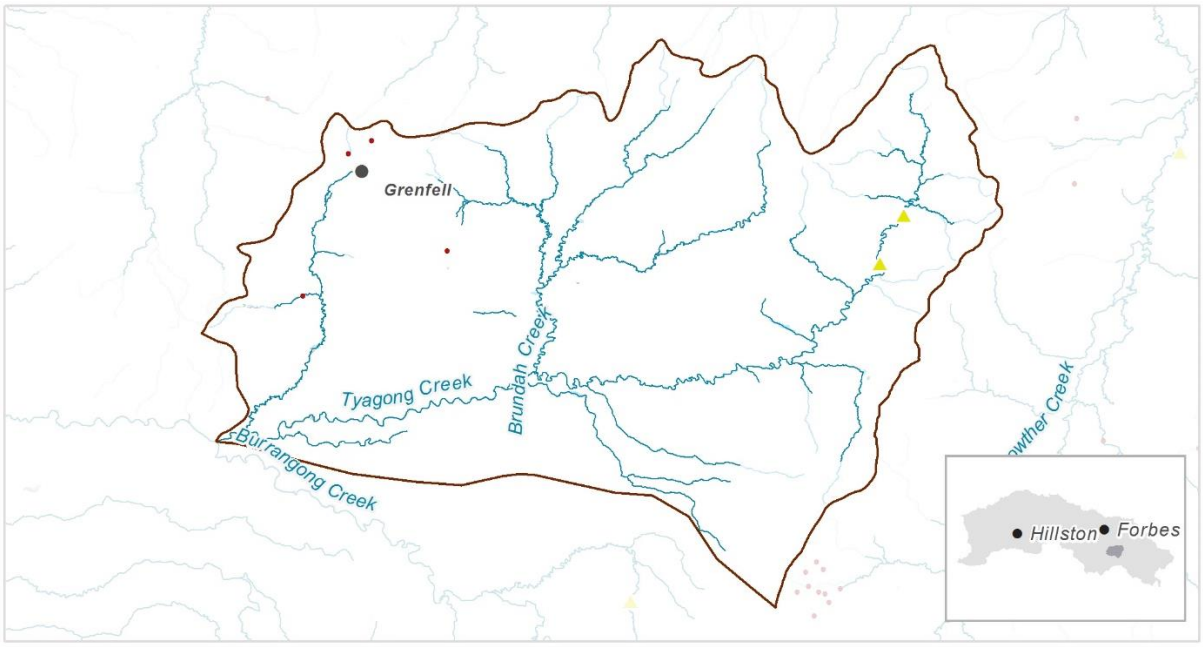
- Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
- Consider rostering landholder water access
- Consider reviewing cease-to-pump rules
- Consider installing water level gauges at or near extraction sites

Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

PU26: Tyagong Creek water source



Priority environmental assets and values

- Tyagong Creek and its tributaries, in-channel habitat, and fringing vegetation communities

Native fish[97]	• southern purple spotted gudgeon • carp gudgeon • obscure galaxias	• golden perch • Australian smelt • freshwater shrimp • flathead gudgeon	• yabby • freshwater prawn • northern river blackfish
Birds	55 water-dependent bird species recorded, including the listed[98] waterbird species: Latham's snipe		
Native vegetation	Four water-dependent plant community types, including • river red gum woodland	• wetland sedgeland	

[97] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[98] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Registered cultural assets	• modified trees		
Other species[99]	• Booroolong frog • Peron's tree frog	• giant banjo frog • spotted grass frog	• Sloane's froglet

Hydrology

Gauge: 412072 *Back Creek at Koorawatha*	**80th percentile**: 0 ML/d	**50th percentile**: 1.49 ML/d	**20th percentile**: 35.42 ML/d
	1.5 ARI: 1,290 ML/d	**2.5 ARI**: 2,845 ML/d	**5 ARI**: 5,951 ML/d

Low flows are highly altered (>50% departure from base case) and cease-to-flow periods are moderately altered (20-50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Cease-to-flow periods currently occur more frequently, and low flows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 184 ML, which is made up of four unregulated WALs for production <250 ML. They are distributed throughout the planning unit.

This planning unit has relatively low flows and water is mainly diverted when the rainfall has been inadequate. This means that cease-to-flows and low flows may be impacted by extraction (as confirmed by the *Risk assessment for the Lachlan Surface Water Resource Plan Area*).

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	M^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years

- Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points

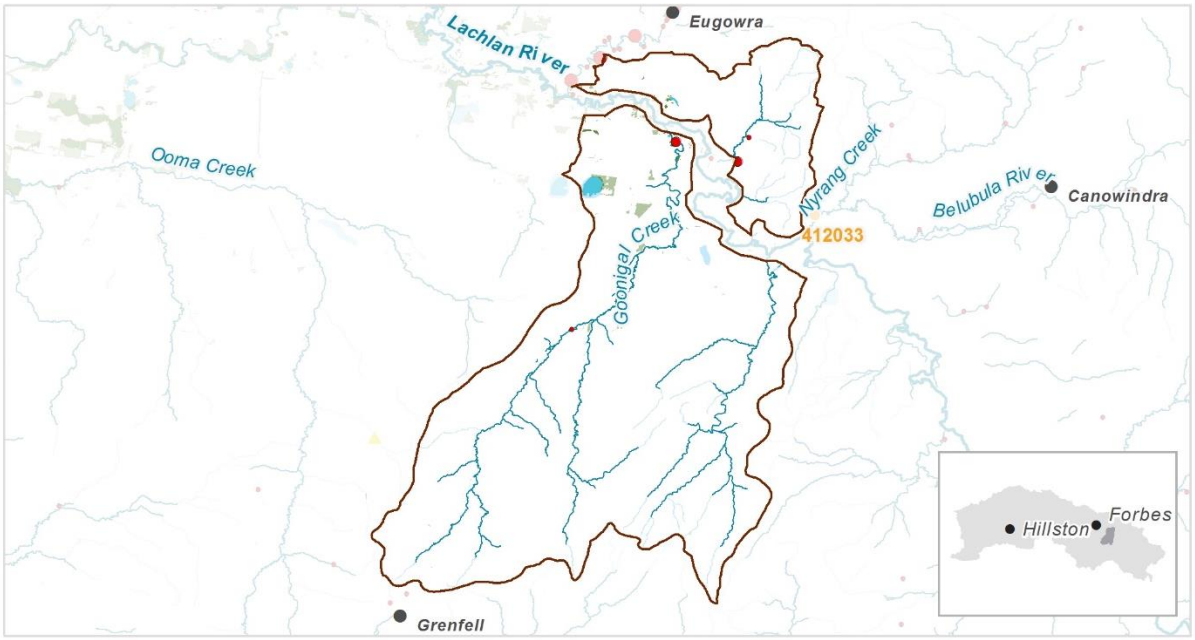
Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[99] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

PU27: Goonigal and Kangarooby creeks water source



Priority environmental assets and values

- Goonigal and Kangarooby creeks, and their tributaries, in-channel habitat, and fringing vegetation communities

Native fish[100]	• southern purple spotted gudgeon • obscure galaxias	• northern river blackfish • carp gudgeon	• yabby • flathead galaxias • Australian smelt
Birds	60 water-dependent bird species recorded, including the listed[101] waterbird species: glossy ibis		
Native vegetation	Nine water-dependent plant community types, including: • wetland sedgeland	• river red gum woodland	
Registered cultural assets	• modified tree		

[100] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[101] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Other species[102]	• Sloane's froglet	• spotted grass frog	• platypus

Hydrology

Gauge: 412068 *Goonigal Creek at Gooloogong*	**80th percentile**: 0 ML/d	**50th percentile**: 0 ML/d	**20th percentile**: 36.18 ML/d
	1.5 ARI: 1,682 ML/d	**2.5 ARI**: 2,982 ML/d	**5 ARI**: 4,253 ML/d

Low flows and freshes are highly altered (>50% departure from base case) and cease-to-flow periods are moderately altered (20-50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Cease-to-flow periods currently occur more frequently and low flows and freshes occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 1107 ML, of which 1103 ML are for production. There are three unregulated WALs for production <250 ML, and two WALs between 250-500 ML. The two larger WALs are located near where the tributaries meet the Lachlan River. They may impact on flows in the Lachlan River or reduce their connectivity with the main channel.

This planning unit has relatively low flows and water is mainly diverted when the rainfall has been inadequate. This means that cease-to-flows, low flows and freshes may be impacted by extraction (as confirmed by the *Risk assessment for the Lachlan Surface Water Resource Plan Area*).

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	M^+	H^-	H^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years

- Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
- Consider reviewing cease-to-pump rules
- Consider implementing a commence-to-pump threshold that is higher than cease-to-pump threshold

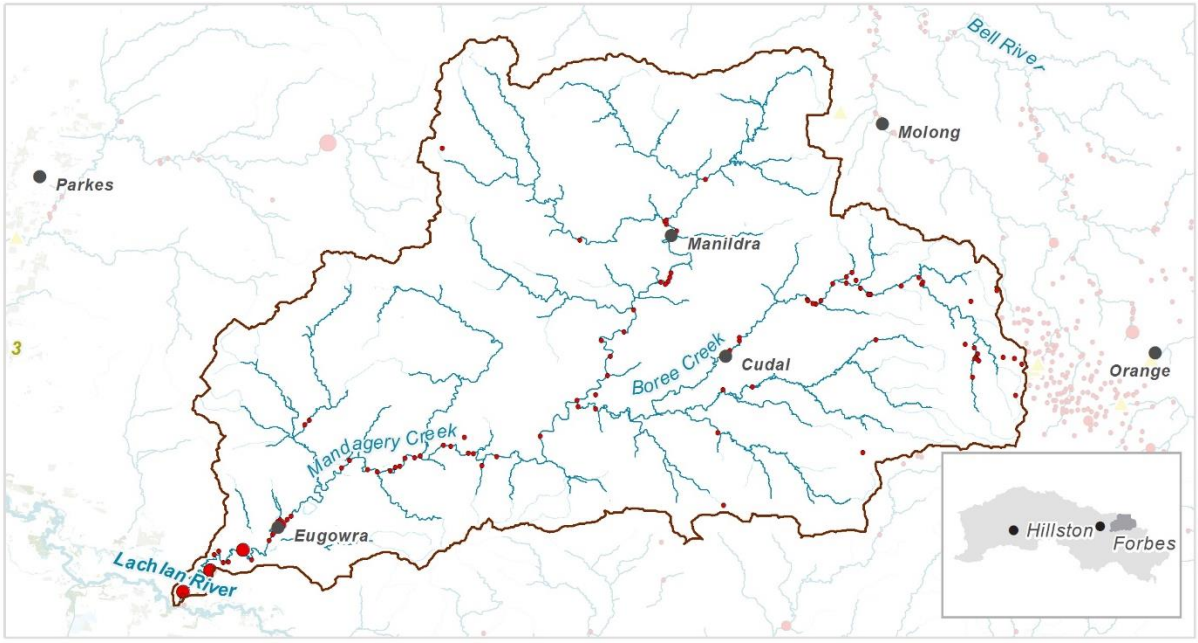
Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[102] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

PU28: Mandagery Creek water source



Priority environmental assets and values

- Mandagery Creek and its tributaries, in-channel habitat, and fringing vegetation communities

Native fish[103]	• southern purple spotted gudgeon • freshwater shrimp • obscure galaxias • carp gudgeon	• Murray cod • Australian smelt • freshwater catfish • yabby	• alpine crayfish • freshwater prawn • golden perch • northern river blackfish
Birds	81 water-dependent bird species recorded, including the listed[104] waterbird species: • glossy ibis • cattle egret	• sharp tailed sandpiper • Latham's snipe	• Australian painted snipe • blue-billed duck
Native vegetation	Six water-dependent plant community types, including river red gum woodland		

[103] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[104] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Registered cultural assets	• modified Trees		
Other species[105]	• Booroolong frog • Peron's tree frog • eastern snake-necked turtle	• eastern sign-bearing froglet • Corben's long-eared bat • eastern bentwing-bat	• spotted grass frog • Sloane's froglet • little pied bat • platypus

Hydrology

Gauge: 412030 *Mandagery Creek U/S Eugowra*	**80th percentile**: 2.41 ML/d	**50th percentile**: 33.35 ML/d	**20th percentile**: 182.40 ML/d
	1.5 ARI: 4,863 ML/d	**2.5 ARI**: 9,609 ML/d	**5 ARI**: 15,499 ML/d

Low flows are highly altered (>50% departure from base case) and freshes are moderately altered (20-50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Low flows and freshes occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 7838 ML, of which 7750 ML are for production. There are 90 unregulated WALs for production <250 ML, one WAL between 250-500 ML, and three WALs between 550-1000 ML. They are mainly distributed along Mandagery Creek, Boree Creek.

There are many small unregulated WALs in this planning unit. The cease-to-pump rule currently seems adequate to mitigate extraction impacts on cease-to-flows. However, if all WALs were to extract water around the same time, low flows and freshes may be substantially impacted (as confirmed by the *Risk assessment for the Lachlan Surface Water Resource Plan Area*)

It is important to protect flows in this water source because EWRs in the Lachlan River (Forbes to Condobolin) PU (Zone A PU3) are reliant on water contributions from this planning unit to meet the LTWP objectives.

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^+	H^-	M^-	L^-	L^-	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years

- Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
- Consider reviewing cease-to-pump rules
  - Investigate increasing cease-to-pump to 25 ML/d at Mandagery Creek upstream Eugowra gauge (412030).
- Consider implementing a commence-to-pump threshold that is higher than cease-to-pump threshold
  - Investigate implementing a commence-to-pump rule to protect freshes at 130 ML/d at Mandagery Creek upstream Eugowra gauge (412030)

[105] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

- Consider reviewing total daily extraction limits, especially for A and B flow classes
- Consider rostering landholder water access
- Consider implementing total individual daily extraction limits

Consider installing water level gauges at or near extraction sites

Consider improving the gauging network to better capture the distribution of flows, the behaviour of take and the typical annual extraction

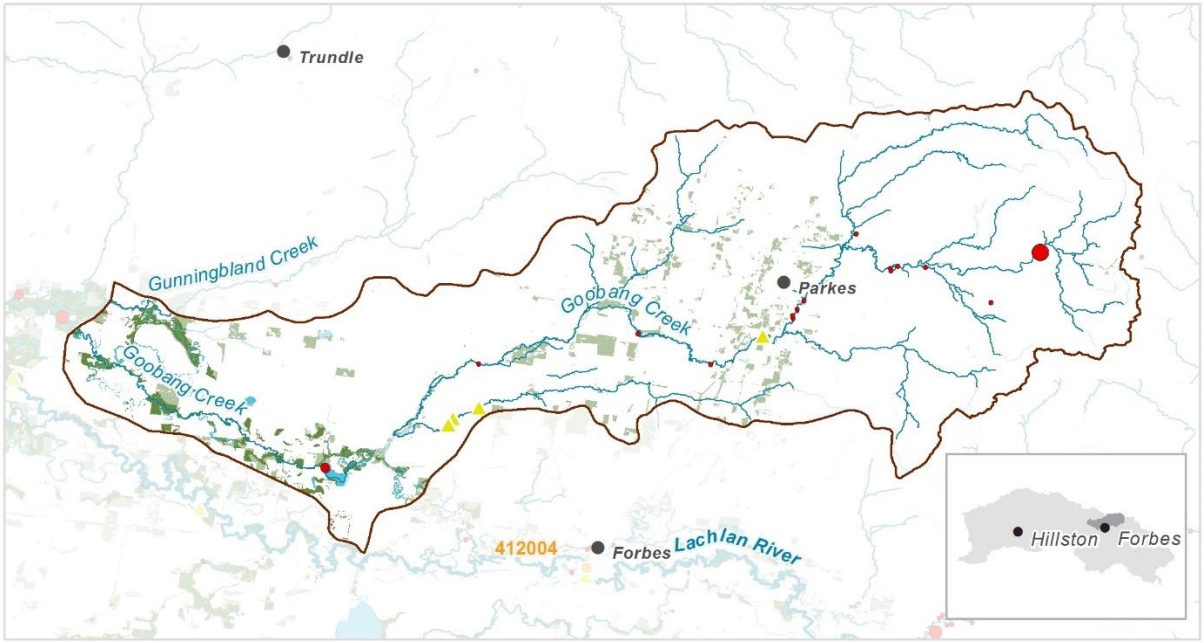
Consider water access licence purchases from willing sellers or the negotiation of enduring agreements with licence holders

Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

PU29: Goobang and Billabong creeks water source



Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):

- Goobang Creek
- Billabong Creek
- Ramsays Lagoon

Native fish[106]	• southern purple spotted gudgeon • unspecked hardyhead • northern river blackfish • carp gudgeon	• obscure galaxias • Murray-darling rainbowfish • bony herring • dwarf flat-headed gudgeon	• yabby • flathead galaxias • Australian smelt • freshwater prawn • freshwater catfish
Birds	99 water-dependent bird species recorded, including the listed[107] waterbird species: • glossy ibis • curlew sandpiper • freckled duck • buff-banded rail	• Latham's snipe • cattle egret • Australasian bittern • gull-billed tern	• sharp-tailed sandpiper • marsh sandpiper • Australian painted snipe • pacific golden plover

[106] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[107] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

	• oriental pratincole	• long-toed stint • red-necked stint	• pectoral sandpiper • wood sandpiper
Native vegetation	Ten water-dependent plant community types, including • canegrass swamp grassland wetland	• river red gum woodland	• shallow marsh wetland
Registered cultural assets	• artefacts	• modified trees	• resources, gathering
Other species[108]	• Sloane's froglet • Peron's tree frog • platypus	• eastern sign-bearing froglet • little pied bat	• giant banjo frog • spotted grass frog • eastern snake-necked turtle

Hydrology

Gauge: 412043 *Goobang Creek at Darby S Dam*	**80th percentile**: 0 ML/d	**50th percentile**: 3.39 ML/d	**20th percentile**: 144.24 ML/d
	1.5 ARI: 1,925 ML/d	**2.5 ARI**: 2,745 ML/d	**5 ARI**: 3,985 ML/d

Cease-to-flow periods and low flows are highly altered (>50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Cease-to-flow periods currently occur more frequently and low flows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 3718 ML, of which 2200 ML are for production. There are ten unregulated WALs for production <250 ML, two WALs between 250-500 ML, and two WALs between 550-1000 ML. They majority of WALs are located on Goobang Creek and are mainly concentrated at the top of the planning unit.

This planning unit has relatively low flows and water is mainly diverted when the rainfall has been inadequate. This means that cease-to-flows and low flows may be impacted by extraction (as confirmed by the *Risk assessment for the Lachlan Surface Water Resource Plan Area*).

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years

- Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
- Consider rostering landholder water access
- Consider reviewing cease-to-pump rules
- Consider implementing a commence-to-pump threshold that is higher than cease-to-pump threshold
- Consider implementing total and/or individual daily extraction limits

[108] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Consider improving the gauging network to better capture the distribution of flows and the amount and behaviour of take

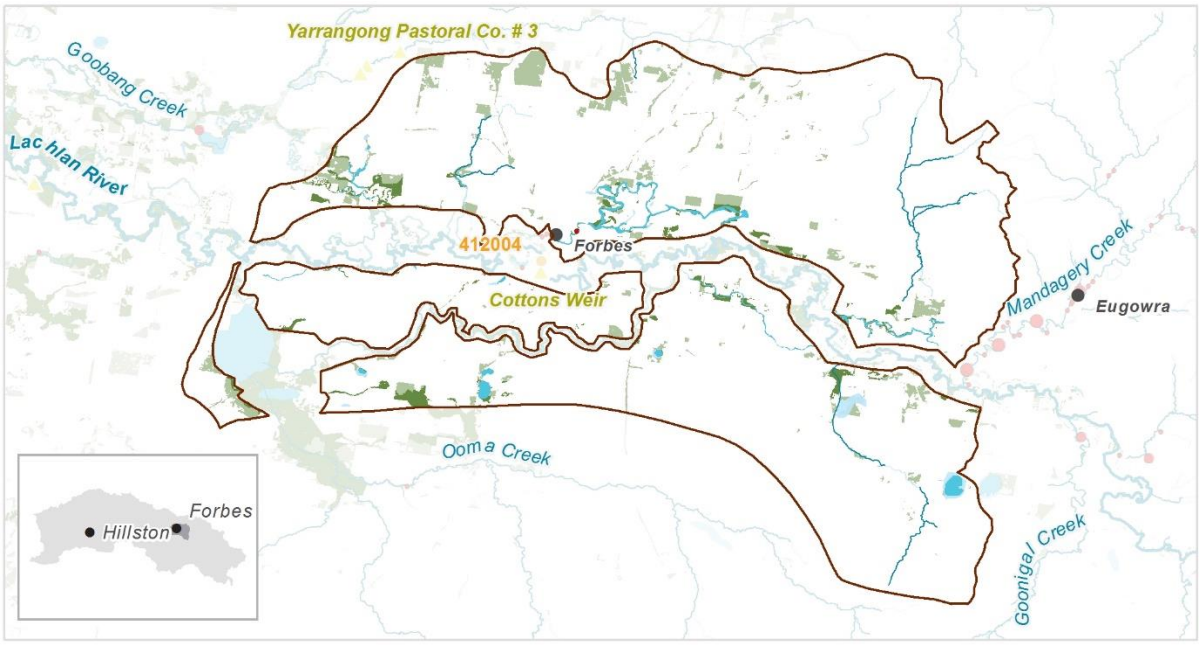
Consider installing water level gauges at or near extraction sites

Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

PU30: Lake Forbes and Back Yamma Creek water source



Priority environmental assets and values

Rivers, creeks, lakes, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):

- Back Yamma Creek
- Lake Forbes

Native fish[109]	• southern purple spotted gudgeon	• unspecked hardyhead • carp gudgeon	• Australian smelt • bony herring
Birds	77 water-dependent bird species recorded, including the listed[110] waterbird species:		
	• glossy ibis • blue-billed duck	• Latham's snipe • freckled duck	• Australian painted snipe

[109] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[110] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Native vegetation	Eleven water-dependent plant community types, including: • black box woodland	• river red gum woodland	• wetland sedgeland
Registered cultural assets	• modified trees		
Other species[111]	• Sloane's froglet • platypus	• eastern sign-bearing froglet	• spotted grass frog

Hydrology

Flows do not seem to be altered by more than 20% compared to the 'without development' model scenario as assessed by the Lachlan WRPA Risk Assessment.

The total volume of unregulated entitlements in the planning unit is 171 ML, of which 170 ML are for production. There are four unregulated WALs for production <250 ML. They are all distributed along anabranches on the northern side of the Lachlan River.

This planning unit has an overall low degree of alteration to flows from extraction.

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^+	L^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

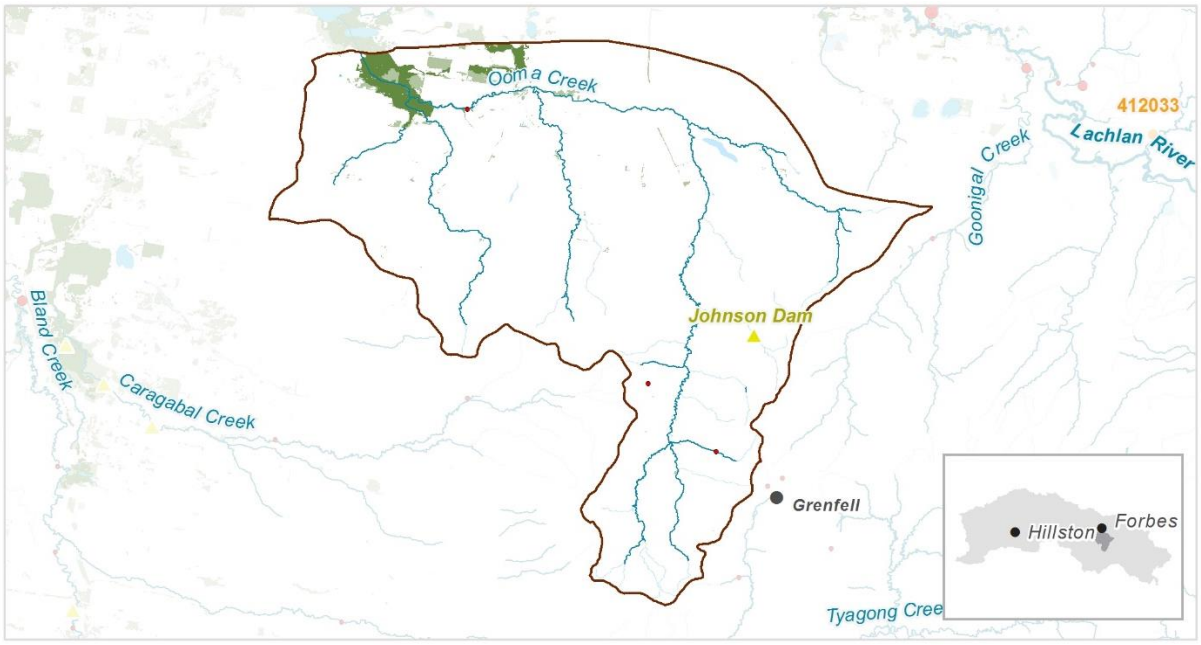
Ensure compliance with water access licence conditions including through metering of all licensed extraction

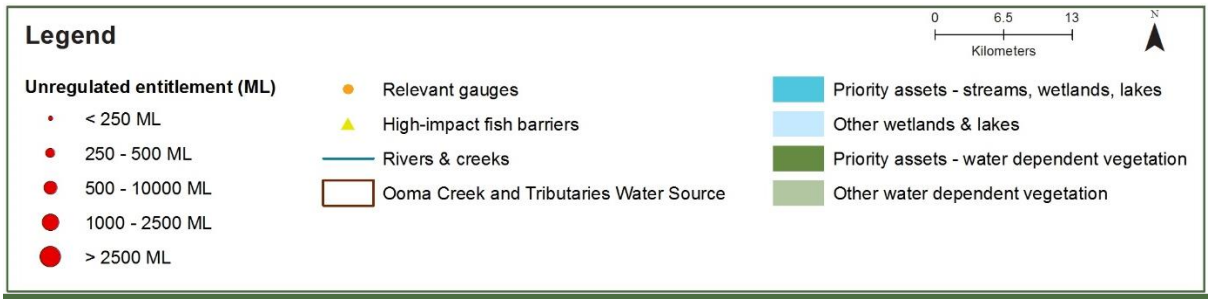
As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[111] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

PU31: Ooma Creek and tributaries water source





Priority environmental assets and values

- Ooma Creek and its tributaries, in-channel habitat and fringing vegetation communities

Native fish[112]	• southern purple spotted gudgeon • obscure galaxias	• golden perch • yabby • Australian smelt	• Murray cod • flathead galaxias • carp gudgeon
Birds	60 water-dependent bird species recorded		
Native vegetation	Eight water-dependent plant community types, including: • wetland sedgeland	• river red gum woodland	• canegrass swamp grassland wetland
Registered cultural assets	• modified trees		
Other species[113]	• Sloane's froglet • Peron's tree frog	• giant banjo frog • little pied bat	• Corben's long-eared bat • spotted grass frog

[112] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[113] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Hydrology

Gauge: 412068 *Goonigal Creek at Gooloogong*	**80th percentile**: 0 ML/d	**50th percentile**: 0 ML/d	**20th percentile**: 16.17 ML/d
	1.5 ARI: 752 ML/d	**2.5 ARI**: 1,332 ML/d	**5 ARI**: 1,901 ML/d

Low flows are highly altered (>50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Low flows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 216 ML, of which 116 ML are for production. There are two unregulated WALs for production <250 ML.

This planning unit has relatively low flows and water is mainly diverted when the rainfall has been inadequate. This means that low flows may be impacted by extraction (as confirmed by the *Risk assessment for the Lachlan Surface Water Resource Plan Area*).

EWRs in the Upper and Mid Lachlan floodplain PU (Zone A) are reliant on water contributions from this planning unit to meet the LTWP objectives.

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^+	H^-	L^-	L^-	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years

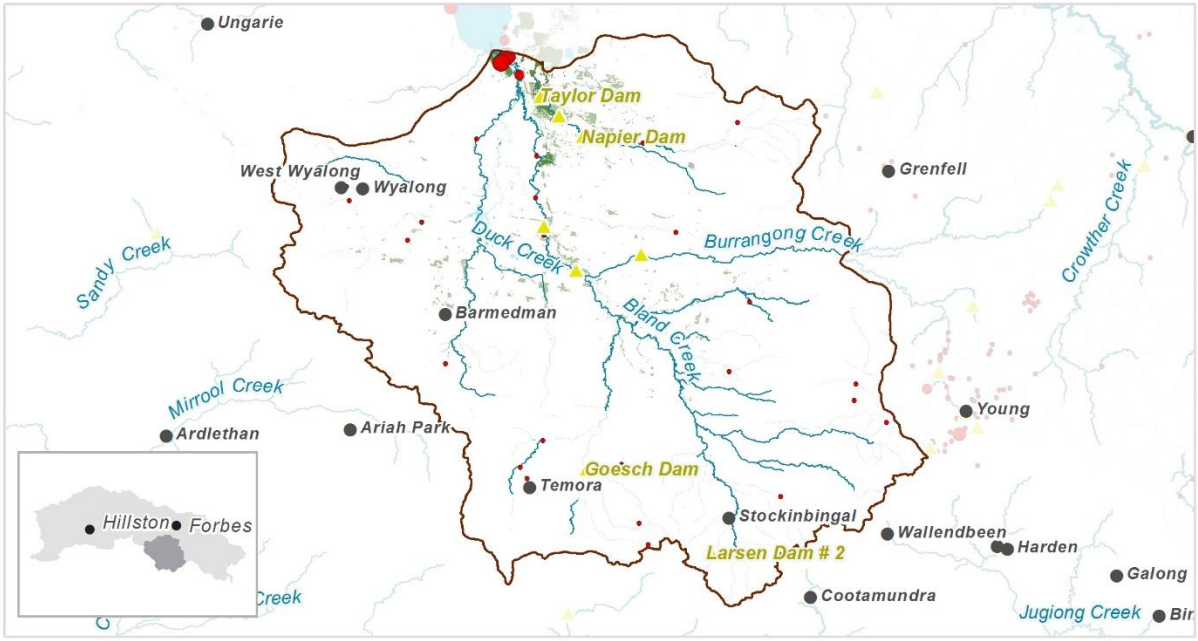
- Investigate opportunities to protect flows that provide connectivity between Ooma Creek and tributaries PU and Upper and Mid Lachlan floodplain PU in the *WSP for the Lachlan Unregulated Water Sources*

Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

PU32: Western Bland Creek water source



Priority environmental assets and values

- Bland Creek and its tributaries, in-channel habitat, and fringing vegetation communities

Native fish[114]	• southern purple spotted gudgeon • dwarf flat-headed gudgeon • northern river blackfish • unspecked hardyhead	• Murray-darling rainbowfish • bony herring • flathead gudgeon • Australian smelt • freshwater shrimp • freshwater catfish • flathead galaxias	• yabby • Suttons crayfish • freshwater prawn • golden perch • Murray cod • olive perchlet • obscure galaxias • carp gudgeon
Birds	83 water-dependent bird species recorded, including the listed[115] waterbird species: • glossy ibis • Latham's snipe	• freckled duck	• brolga

[114] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[115] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Native vegetation	13 water-dependent plant community types, including • cumbungi rushlands wetland • river red gum woodland • canegrass swamp grassland wetland • wetland sedgeland		
Registered cultural assets	• artefacts	• modified trees	• hearth
Other species[116]	• Sloane's froglet • eastern sign-bearing froglet • giant banjo frog • Peron's tree frog • eastern snake-necked turtle • spotted grass frog • southern myotis		

Hydrology

Gauge: 412103 *Bland Creek at Morangarell*	**80th percentile**: 0 ML/d	**50th percentile**: 0 ML/d	**20th percentile**: 60.21 ML/d
	1.5 ARI: 10,631 ML/d	**2.5 ARI**: 17,529 ML/d	**5 ARI**: 27,956 ML/d

Low flows are highly altered (>50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Low flows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 3641 ML, of which 3562 ML are for production. There are 20 unregulated WALs for production <250 ML, one WAL between 250-500 ML, and two WALs between 1000-2500 ML. They are distributed throughout the planning unit.

This planning unit has relatively low flows and water is mainly diverted when the rainfall has been inadequate. However, if all WALs were to extract water around the same time, low flows and baseflows may be substantially impacted (as confirmed by the *Risk assessment for the Lachlan Surface Water Resource Plan Area*). The two large WALs at the bottom of the planning unit may impact on the floodplain assets and values in the Bogandillon and Manna Cree water source PU.

EWRs in the Upper and Mid Lachlan floodplain PU (Zone A) are reliant on water contributions from this planning unit to meet LTWP objectives.

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

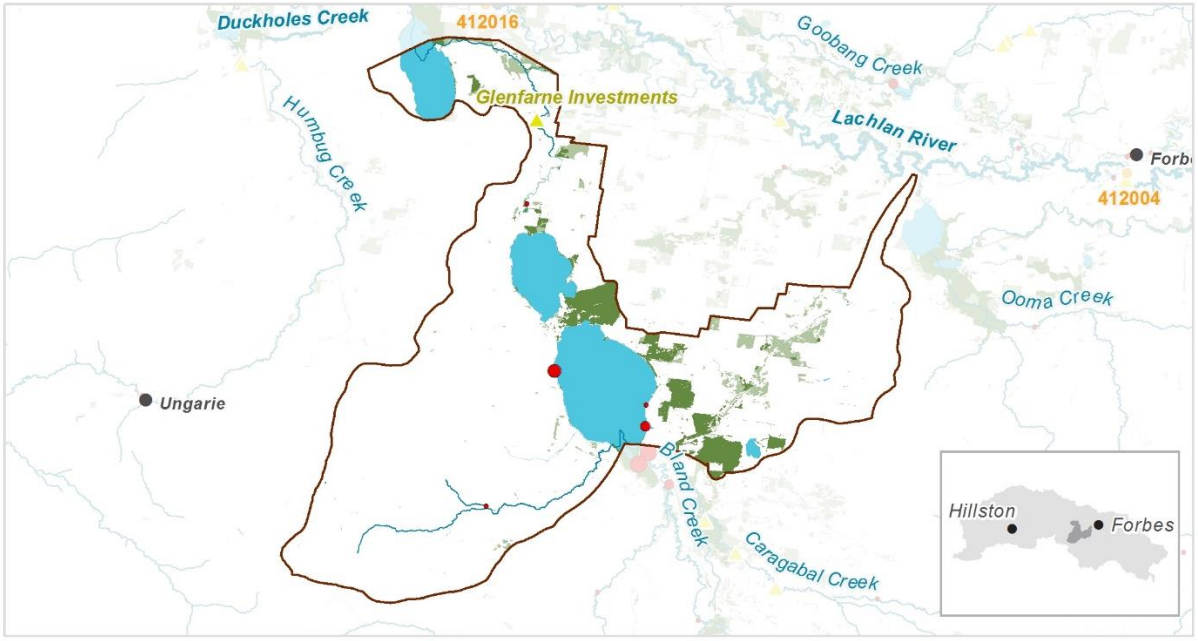
Investigate opportunities to reduce the extraction pressure on low flows and baseflows in the WSP for the Lachlan Unregulated Water Sources within five years.

- Consider rostering landholder water access during low flow months.
- Consider reviewing cease-to-pump rules to better protect low flows, especially during dry times or ecologically important months.
- Consider implementing total and/or individual daily extraction limits.

[116] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Investigate opportunities to protect flows that provide connectivity between Western Bland Creek PU and Upper and Mid Lachlan floodplain PU in the WSP for the Lachlan Unregulated Water Sources within next five years
Ensure compliance with water access licence conditions including through metering of all licensed extraction
As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values
Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

PU33: Bogandillon and Manna creeks water source



Priority environmental assets and values

Rivers, creeks, lakes, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):

- Bogandillon Swamp
- Lake Cowal
- Nerang Cowal
- Sandy Creek
- Manna Creek and its tributaries

Native fish[117]

- southern purple spotted gudgeon
- flathead galaxias
- flathead gudgeon
- unspecked hardyhead
- bony herring
- Murray-darling rainbowfish
- Australian smelt
- freshwater shrimp
- carp gudgeon
- freshwater prawn
- yabby
- golden perch
- Murray cod
- olive perchlet
- spangled perch

Birds

108 water-dependent bird species recorded, including the listed[118] waterbird species:

- freckled duck
- glossy ibis
- sharp-tailed sandpiper
- magpie goose
- brolga
- cattle egret
- Australasian bittern
- eastern great egret
- blue-billed duck

[117] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)
[118] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

	• curlew sandpiper • bar-tailed godwit • common greenshank • pacific golden plover • white-winged black tern	• Latham's snipe • buff-banded rail • marsh sandpiper • whimbrel • wood sandpiper	• common sandpiper • red-necked stint • sharp-tailed sandpiper • pectoral sandpiper
Native vegetation	15 water-dependent plant community types, including • canegrass swamp grassland wetland	• river red gum woodland	• wetland sedgeland
Registered cultural assets	none registered		
Other species[119]	• yellow-bellied sheathtail-bat • Corben's long-eared bat • eastern snake-necked turtle	• platypus • little pied bat	• water rat • Sloane's froglet • Macquarie turtle

Hydrology

Gauge: 412103 *Bland Creek at Morangarell*	**80th percentile**: 0 ML/d	**50th percentile**: 0 ML/d	**20th percentile**: 361.94 ML/d
	1.5 ARI: 63,903 ML/d	**2.5 ARI**: 105,372 ML/d	**5 ARI**: 168,052 ML/d

Low flows are highly altered (>50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Low flows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 1317 ML, of which 1305 ML are for production. There are four unregulated WALs for production <250 ML, one WAL between 250-500 ML, and one WAL between 500-1000 ML. They are all around the bottom of Bland Creek and Manna Creek.

EWRs in the Upper and Mid Lachlan floodplain PU (Zone A) are reliant on water contributions from this planning unit (in addition to water in the regulated system) to meet the LTWP objectives.

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on baseflows in the WSP for the Lachlan Unregulated Water Sources within five years.

- Consider reviewing cease-to-pump rules to better protect low flows, especially during low flow months.
- Consider implementing total and/or individual daily extraction limits.

Investigate opportunities to protect flows that provide connectivity between Bogandillon & Manna Creek PU and Upper and Mid Lachlan floodplain PU in the WSP for the Lachlan Unregulated Water Sources within next five years

[119] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

PU34: Humbug Creek water source

Priority environmental assets and values

- Humbug Creek and its tributaries, in-channel habitat and fringing vegetation communities
- Banar Lake

Native fish[120]	• southern purple spotted gudgeon • unspecked hardyhead	• bony herring • Australian smelt • yabby	• flathead galaxias • golden perch • carp gudgeon
Birds	67 water-dependent bird species recorded, including the listed[121] waterbird species • freckled duck • glossy ibis • gull-billed tern	• Latham's snipe • Australian painted snipe	• magpie goose • brolga

[120] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[121] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Native vegetation	14 water-dependent plant community types, including • black box - lignum woodland • wetland sedgeland	• river red gum woodland	• canegrass swamp grassland wetland
Registered cultural assets	none registered		
Other species[122]	• southern bell frog • giant banjo frog	• eastern snake-necked turtle	• Sloane's froglet • spotted grass frog

Hydrology

Flows do not seem to be altered by more than 20% compared to the 'without development' model scenario as assessed by the Lachlan WRPA Risk Assessment.

The total volume of unregulated entitlements for the water source is 9 ML, which is made up of two WALs for production <250 ML.

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^+	L^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

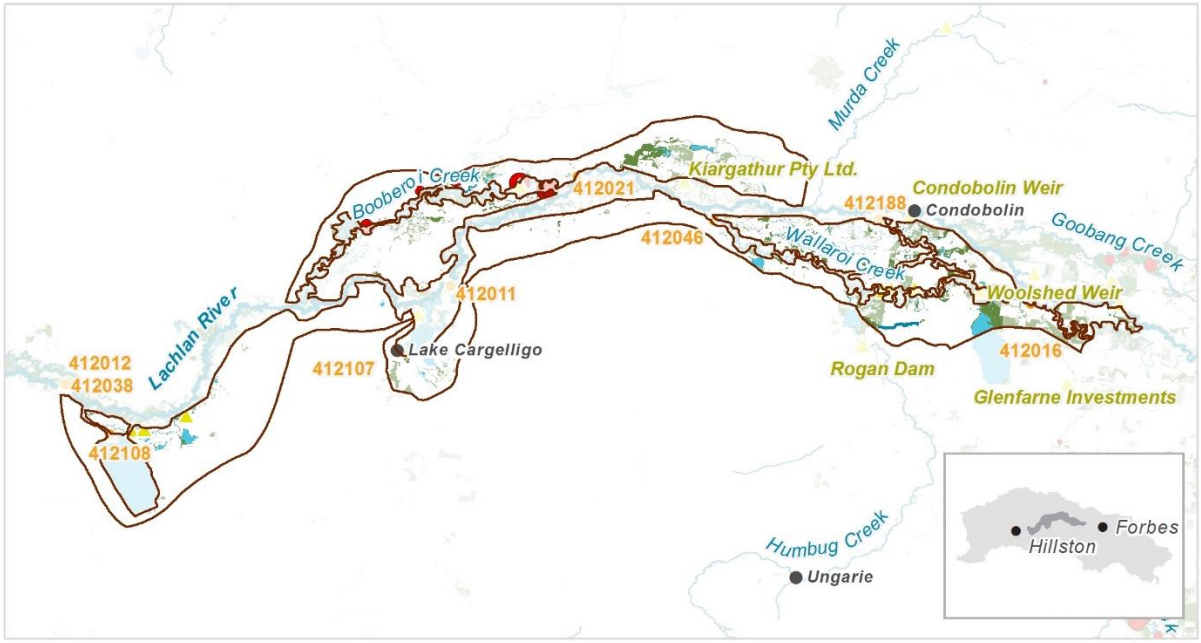
Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[122] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

PU35: Mid Lachlan unregulated water source



Priority environmental assets and values

Floodplain vegetation adjacent to Wallaroi Creek, Booberoi Creek, and the Lachlan River including, but not limited to:			• Mountain Creek
Native fish[123]	• flathead galaxias • unspecked hardyhead • northern river blackfish • Murray-Darling rainbowfish • freshwater prawn	• bony herring • flathead gudgeon • Australian smelt • freshwater shrimp • carp gudgeon • freshwater catfish	• yabby • golden perch • Murray cod • olive perchlet • silver perch
Birds	89 water-dependent bird species recorded, including the listed[124] waterbird species		
	• freckled duck • glossy Ibis • common sandpiper	• Latham's snipe • marsh sandpiper • brolga	• curlew sandpiper • eastern great egret • sharp-tailed sandpiper
	13 water-dependent plant community types, including		

[123] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[124] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Native vegetation	• black box - lignum woodland • river red gum woodland	• black box woodland • wetland sedgeland	• canegrass swamp grassland wetland • river cooba
Registered cultural assets	• artefacts • modified trees	• resources, gathering	• hearth
Other species[125]	• Sloane's froglet • spotted grass frog • Macquarie turtle	• Peron's tree frog • eastern snake-necked turtle	• eastern sign-bearing froglet

Hydrology

Low flows are moderately altered (20-50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Low flows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 12821 ML, of which 12765 ML are for production. There is one unregulated WALs for production <250 ML, one WAL between 250-500 ML, and two WALs between 500-1000 ML, one WAL between 1000-2500 ML and two WALs >2500 ML (3198 ML and 5030 ML). They are mainly located along Booberoi Creek.

EWRs in the Booberoi, the Mid Lachlan anabranches, and the Lachlan River (Condobolin to Lake Cargelligo) PUs (Zone A) are reliant on water contributions from this planning unit to meet the LTWP objectives.

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^+	M^-	L^-	L^-	L^-	L^-
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years

- Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
- Consider reviewing the cease-to-pump threshold
- Consider implementing total and/or individual daily extraction limits.

Protect environmental flows from the Lachlan River (Condobolin to Lake Cargelligo) and Booberoi PUs into the Mid Lachlan unregulated PU

Consider improving the gauging network and/or pump metering to better capture the distribution of flows and the amount and behaviour of take.

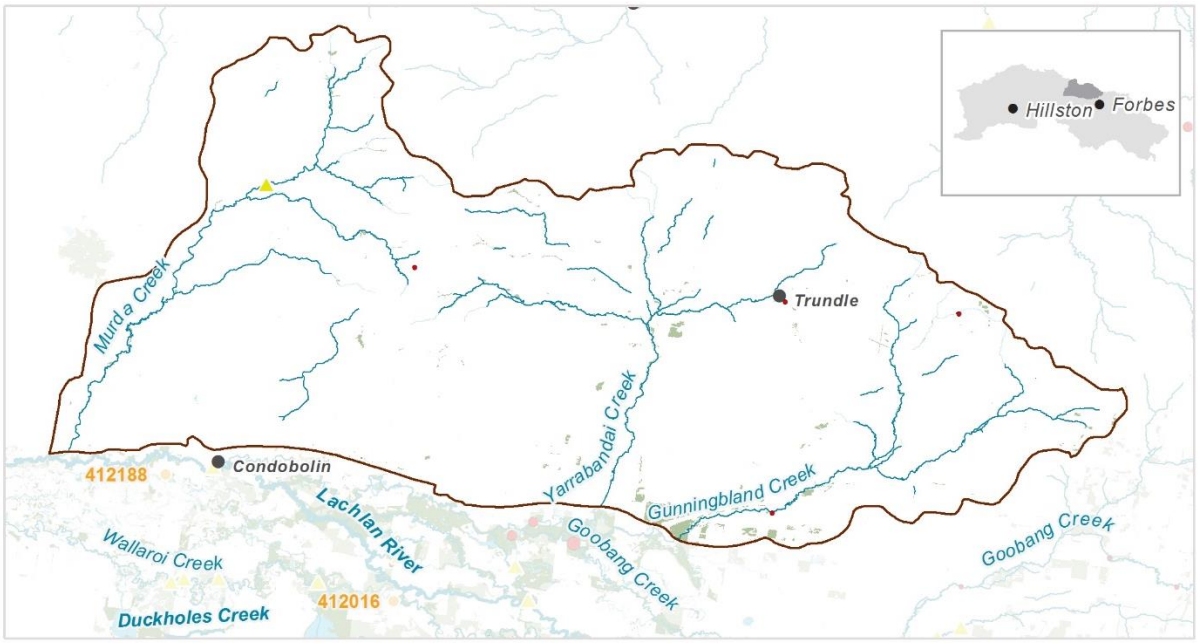
Ensure compliance with water access licence conditions including through metering of all licensed extraction

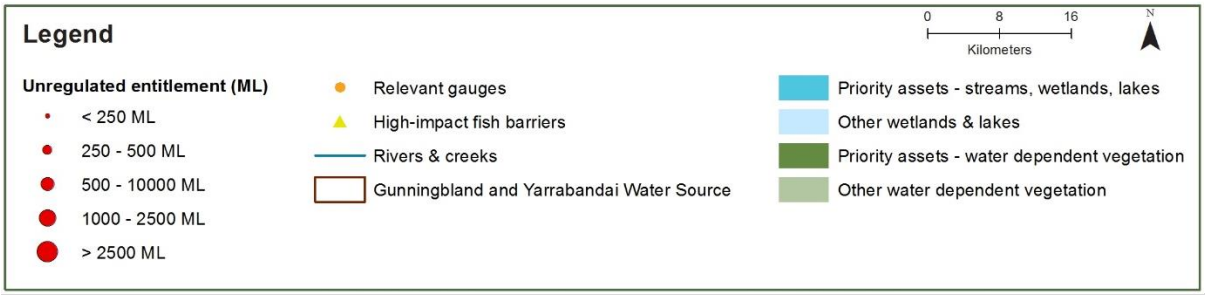
As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[125] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

PU36: Gunningbland and Yarrabandai water source





Priority environmental assets and values

Creeks, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):

- Gunningbland Creek and tributaries
- Murda Creek and tributaries
- Yarrabandai Creeks and tributaries

Native fish[126]	• unspecked hardyhead • freshwater catfish • flathead galaxias	• Murray-darling rainbowfish • dwarf flat-headed gudgeon • carp gudgeon	• Australian smelt • freshwater shrimp • bony herring • spangled perch
Birds	63 water-dependent bird species recorded, including the listed[127] waterbird species: • glossy ibis	• brolga	• buff-banded rail

[126] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[127] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Native vegetation	Ten water-dependent plant community types, including: • canegrass swamp grassland wetland	• river red gum woodland	• wetland sedgeland
Registered cultural assets	• artefacts	• modified trees	• hearth
Other species[128]	• Sloane's froglet • Peron's tree frog • Corben's long-eared bat	• eastern sign-bearing froglet • yellow-bellied sheathtail-bat	• spotted grass frog • giant banjo frog • little pied bat

Hydrology

Flows do not seem to be altered by more than 20% compared to the 'without development' model scenario as assessed by the Lachlan WRPA Risk Assessment.

The total volume of unregulated entitlements in the planning unit is 233 ML, of which 219 ML are for production. There are four unregulated WALs for production <250 ML. They are all distributed throughout the planning unit.

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^+	L^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

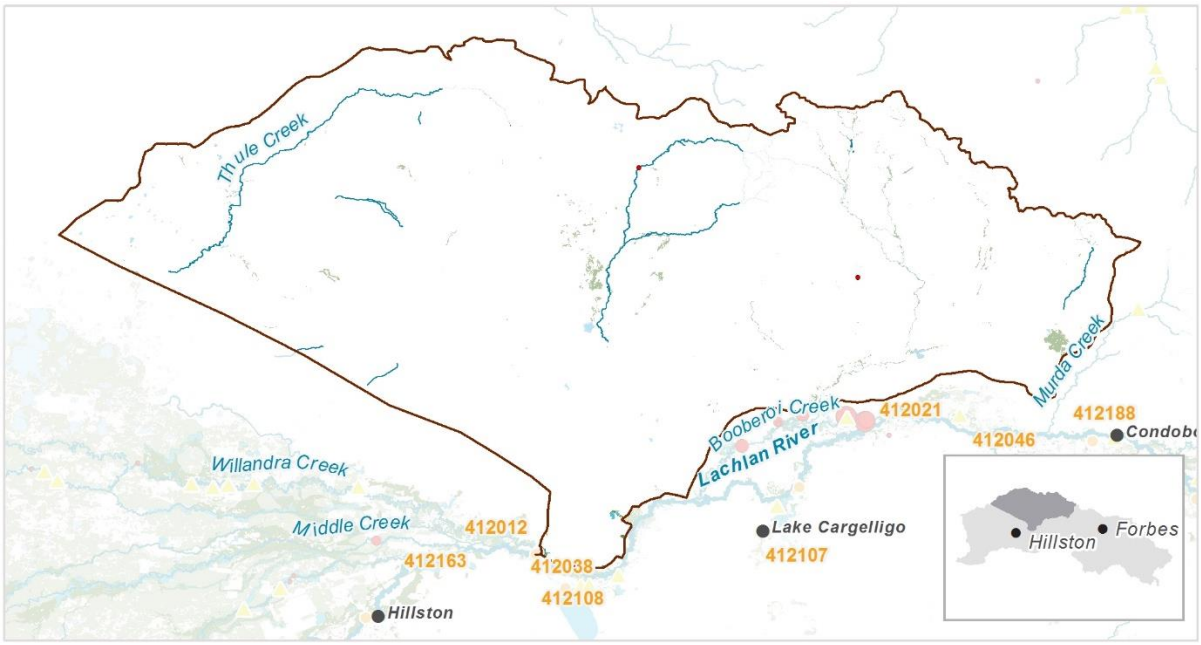
Ensure compliance with water access licence conditions including through metering of all licensed extraction

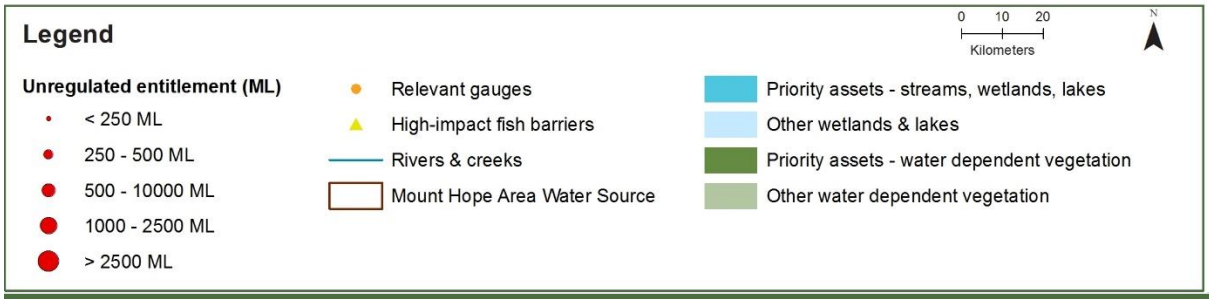
As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[128] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

PU37: Mount Hope area water source





Priority environmental assets and values

No priority environmental assets in this planning unit

Important environmental assets listed below

Native fish[129]	• unspecked hardyhead • Murray-Darling rainbowfish • yabby	• flathead gudgeon • carp gudgeon • spangled perch • bony herring	• freshwater shrimp • Australian smelt • dwarf flat-headed gudgeon
Birds	82 water-dependent bird species recorded, including • glossy Ibis • blue-billed duck • sharp-tailed sandpiper	• Latham's snipe • cattle egret • brolga	• freckled duck • Australian painted snipe
Native vegetation	14 water-dependent plant community types, including • black box - lignum woodland	• lignum shrubland wetland	• canegrass swamp grassland wetland

[129] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

	• river red gum woodland	• wetland sedgeland	• black box woodland
Registered cultural assets	• artefacts	• modified trees	
Other species[130]	• Sloane's froglet • yellow-bellied sheathtail-bat	• giant banjo frog • Corben's long-eared bat	• inland forest bat • spotted grass frog

Hydrology

Flows do not seem to be altered by more than 20% compared to the 'without development' model scenario as assessed by the Lachlan WRPA Risk Assessment.

The total volume of unregulated entitlements in the planning unit is 27 ML. There are no unregulated WALs for production in this planning unit.

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^+	L^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

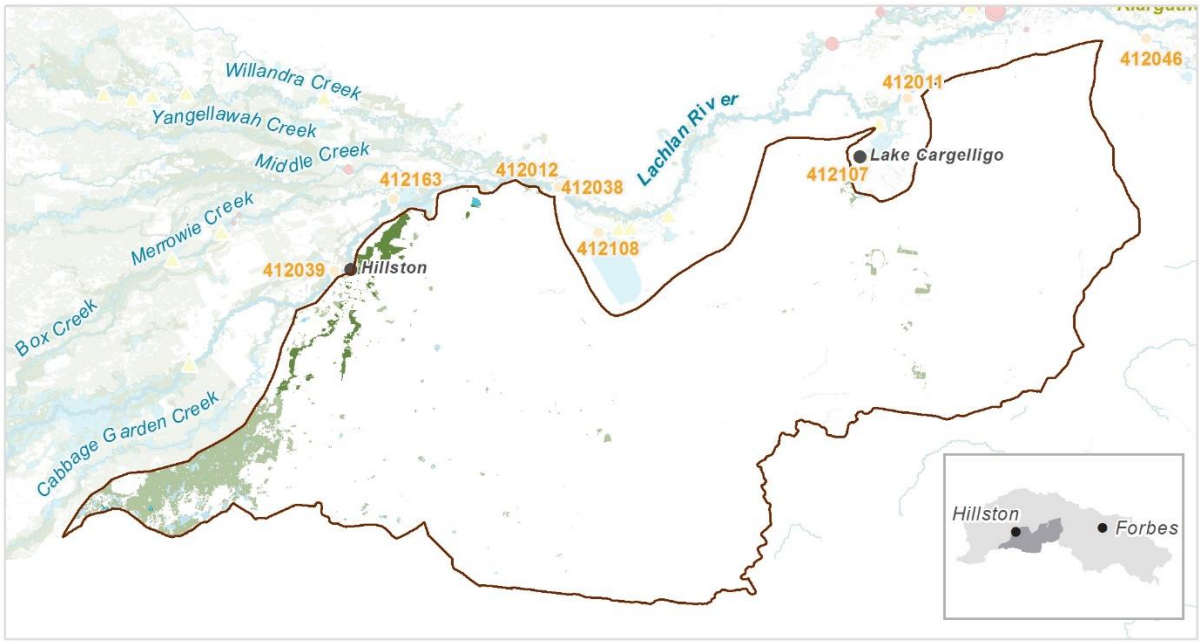
Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[130] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

PU38: Naradhan area water source



Priority environmental assets and values

- Naradhan Creek and its in-channel habitat and fringing vegetation communities

Native fish[131]	-
Birds	78 water-dependent bird species recorded, including the listed[132] waterbird species • glossy Ibis • sharp-tailed sandpiper • blue-billed duck • black-necked stork • freckled duck
Native vegetation	14 water-dependent plant community types, including • canegrass swamp grassland wetland • black box - lignum woodland • canegrass swamp grassland wetland • river red gum woodland • lignum shrubland wetland • black box woodland • wetland sedgeland

[131] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[132] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Registered cultural assets	• modified trees		
Other species[133]	• southern bell frog • Sloane's froglet	• eastern sign-bearing froglet • little pied bat	• spotted grass frog • giant banjo frog

Hydrology

Flows do not seem to be altered by more than 20% compared to the 'without development' model scenario as assessed by the Lachlan WRPA Risk Assessment.

There are no extraction licences in this planning unit.

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^+	L^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

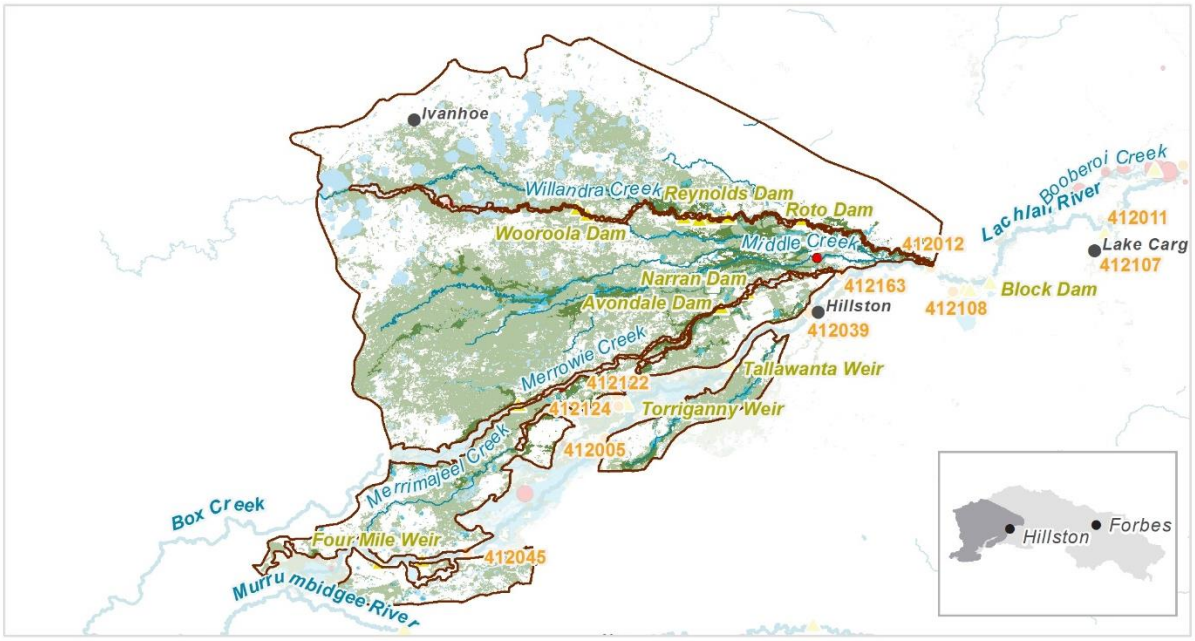
Ensure compliance with water access licence conditions including through metering of all licensed extraction

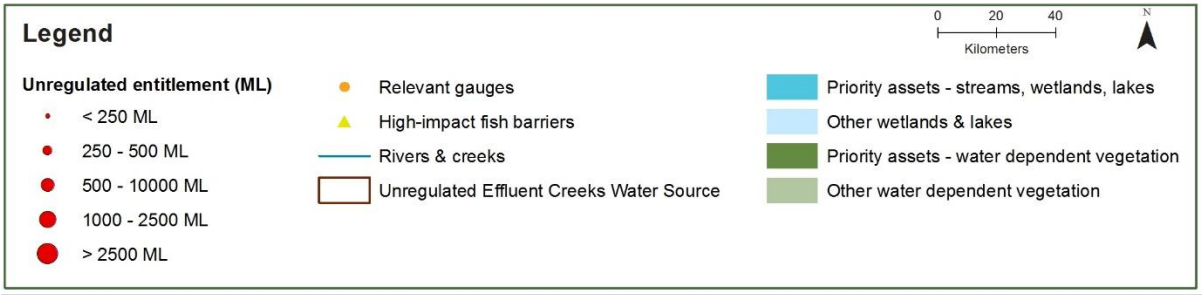
As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[133] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

PU39: Unregulated effluent creeks water source





Priority environmental assets and values

Lachlan River distributary channels, wetlands & their associated floodplains & water-dependant native vegetation, including (but not limited to):

- Canegrass Swamp
- Conoble Creek
- Kilarney Swamp
- Reedy Lake
- Saltbush Swamp
- Toopuntal Swamp
- Waverley Creek
- Yangellawah Creek

Native fish[134]	• olive perchlet • silver perch • flathead galaxias • unspecked hardyhead • carp gudgeon	• Murray-darling rainbowfish • bony herring • flathead gudgeon • dwarf flat-headed gudgeon	• freshwater shrimp • yabby • freshwater prawn • golden perch • Murray cod • Australian smelt
Birds	90 water-dependent bird species recorded, including the listed[135] waterbird species		

[134] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

[135] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

	• glossy ibis • cattle egret • sharp-tailed sandpiper • marsh sandpiper	• Australasian bittern • Australian painted snipe • eastern great egret	• blue-billed duck • freckled duck • Latham's snipe
Native vegetation	14 water-dependent plant community types, including: • black box - lignum woodland • river red gum woodland	• black box woodland • wetland sedgeland	• canegrass swamp grassland wetland • lignum shrubland wetland
Registered cultural assets	• artefacts • modified trees	• hearths • resources, gathering	• habitation structure • earth mound
Other species[136]	• eastern sign-bearing froglet • eastern snake-necked turtle • Peron's tree frog • water rat	• Sloane's froglet • southern bell frog • little pied bat • Macquarie turtle	• giant banjo frog • spotted grass frog • Corben's long-eared bat

Hydrology

Low flows are highly altered (>50% departure from base case) and freshes and high and infrequent flows are moderately altered (20-50% departure from base case) as assessed by the Lachlan WRPA Risk Assessment. Low flows currently occur more frequently, and freshes and High and infrequent flows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 3218 ML, of which 2762 ML are for production. There are eight unregulated WALs for production <250 ML, one WAL between 250-500 ML, and one WAL between 1000-2500 ML. They are distributed throughout the planning unit.

Water is mainly diverted when the rainfall has been inadequate. Regulation in the Lachlan River and its tributaries have most likely impacted on high and infrequent flows, and low flows and freshes may be substantially impacted by extraction (as confirmed by the *Risk assessment for the Lachlan Surface Water Resource Plan Area*).

Flows in the Unregulated effluent creeks PU are reliant on water contributions from Willandra Creek, Merrowie Creek, Merrimajeel Creek, Box Creek, Muggabah Creek, Lower Lachlan watercourse and Western Lachlan watercourse PUs (Zone A).

	Cease-to-flow	Low flows and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^0	H^+	M^-	M^-	M^-	M^-
Relevant rule	Trade not permitted into the water source Trade within the water source is permitted, subject to assessment No pool drawdown					

Recommended management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years

- Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
- Consider installing water level gauges at or near extraction sites

[136] Other species list includes flow-dependent frog species, platypus, water rats, turtles and other State or Commonwealth listed water-dependent species where they have been recorded

- Consider reviewing cease-to-pump rules to better protect low flows, especially during dry times or ecologically important months.
    - Investigate increasing cease-to-pump to 30 ML/d at Willandra Creek @ Willandra Homestead gauge (412042).

Consider introducing cease-to-pump and commence-to-pump rules (and any associated required amendments to WAL conditions) that protect held and planned environmental water entering unregulated streams and off-channel pools (wetlands)[137]

- Investigate opportunities to protect flows that provide connectivity between Willandra Creek, Merrowie Creek, Merrimajeel Creek, Box Creek, Muggabah Creek, Lower Lachlan watercourse and Western Lachlan watercourse PUs into the unregulated effluent creeks water source planning unit
- Protect water for the environment that originates from held and planned water entitlements.[138]

Ensure compliance with water access licence conditions including through metering of all licensed extraction

As a minimum, maintain existing rules in the *Water Sharing Plan for the Lachlan Unregulated Water Sources* that protect environmental assets and values

Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[137] In-line with the Basin Plan requirement for implementation of prerequisite policy measures that provide for delivered environmental water to be protected. It is also recommended by the Matthews reports (2017)

[138] Refer to EWR tables for relevant Zone A PUs listed (Chapter 2)

References

Richies M, Gilligan D, Danaher K, Pursey J 2016, *Fish Communities and Threatened Species Distributions of NSW*, Report prepared for the Commonwealth Government, NSW Department of Primary Industries, Wollongbar.

NSW DPIE–Water 2019, *Risk Assessment for the Lachlan Water Resource Plan Area (SW10)*, NSW Department of Planning, Industry and Environment.