DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT

Gwydir Long Term Water Plan

Part B: Gwydir planning units

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Cover photo: Glossy ibis in the Gwydir Wetlands, Daryl Albertson/DPIE

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Contents

List of tables

List of figures

Acknowledgement of Traditional Owners

The NSW Department of Planning, Industry and Environment – Biodiversity and Conservation 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 Gwydir catchment, the NSW Department of Planning, Industry and Environment – Biodiversity and Conservation pays its respects to the Traditional Owners – the Kamilaroi/Gomeroi Nation – past, present and emerging, as well as those of other Nations for whom this river is significant. We look forward to developing new partnerships and building upon existing relationships to improve the health of our rivers and wetlands including in recognition of their traditional and ongoing cultural and spiritual significance.

Figure 1 **Nardoo at Lynworth, in the West Gingham Wetlands**
Photo: T. Cooke

Abbreviations

GL/yr	gigalitres per year
AHIMS	Aboriginal Heritage Information Management System
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–BC	NSW Department of Planning, Industry and Environment – Biodiversity and Conservation
DPIE–WATER	NSW Department of Planning, Industry and Environment – Water
DPIF	NSW Department of Primary Industries Fisheries
EEC	Endangered ecological community
EWA	Environmental water allowance
EWAG	Environmental Water Advisory Group
EWR	Environmental water requirement
FFDI	Forest Fire Danger Index
GCM	Global Climate Model
GDE	Groundwater dependent ecosystem
ha	hectares
HEW	Held environmental water
JAMBA	Japan-Australia Migratory Bird Agreement
LF	Large fresh
LLS	Local Land Services (NSW)
LTA	Long term average
LTWP	Long Term Water Plan
m/s	metres per second
MDBA	Murray-Darling Basin Authority
MER	Monitoring, evaluation and reporting
mg/L	milligrams per litre
ML	megalitre
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
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
RRG	River red gum
SDL	Sustainable diversion limit
SF	Small fresh
VF	Very low flow
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 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).
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 Contingency Allowance (ECA)	Held water entitlements, in addition to planned environmental water, up to 45,000 ML held in Copeton Dam to be used for environmental purposes.
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	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	Water that is committed by the Basin Plan, a water resource plan or a plan made under state water management law to achieving environmental outcomes.
Planning Unit	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.
Supplementary access	A category of water entitlement where water is made available to licence holder accounts during periods of high river flows that cannot otherwise be controlled by river operations. Water can be taken and debited from licence accounts during a declared period of high flow.
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 system	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 passed. 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

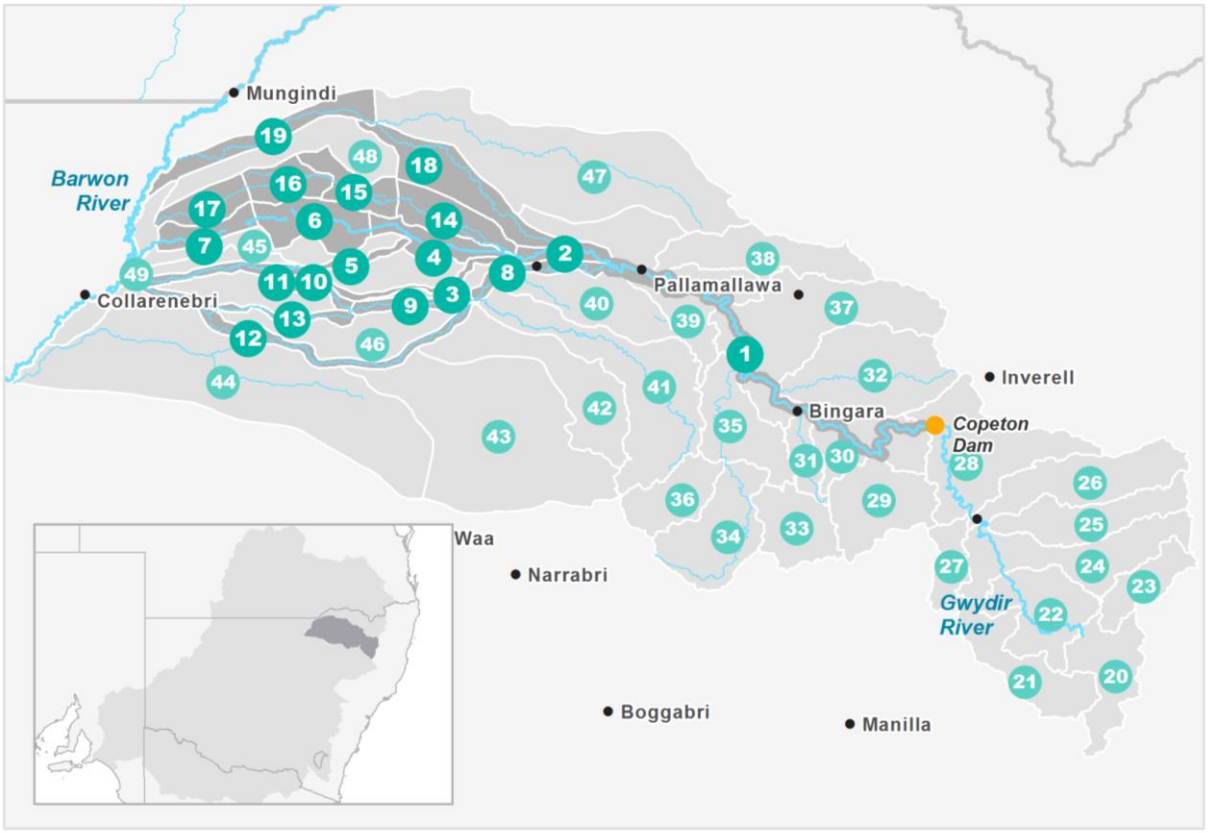
To manage the complexity of the Gwydir Water Resource Plan Area (WRPA), the Gwydir Long Term Water Plan (LTWP) has been divided into 49 planning units (PUs) (Figure 2). Planning units delineate areas with a unique set of mechanisms for managing water for environmental outcomes. Planning units are classified 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 1–19), 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 20–49), 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 PUs 1–19, which are regulated or can be affected by regulated water.
- Chapter 3 contains Zone B PUs 20–49, which are unregulated and unable to be influenced by regulated water deliveries.



Legend

Zone A Planning Units

Zone B Planning Units

N

0 35 70

Kilometers

Planning Units

1. Gwydir downstream of Copeton
2. Main Gwydir River
3. Tarren Creek
4. Lower Gwydir
5. Goonal Creek
6. Central Lower Gwydir
7. Western Gwydir Floodplain
8. Upper Mehi
9. Central Mehi
10. Lower Mehi
11. Ballin Boora
12. Moomin Creek
13. Mallowa Creek
14. Upper Gingham
15. Central Gingham
16. Lower Gingham
17. Western Gingham Floodplain
18. Carole Creek
19. Gil Gil Creek
20. Rocky River
21. Roumalla Creek
22. Upper Gwydir River
23. Boorolong Creek
24. Laura Creek
25. Georges Creek
26. Moredun Creek
27. Bakers Creek
28. Copeton Darm
29. Keera Creek
30. Mackenzies Flat
31. Halls Creek
32. Myall Creek
33. Cobbodah Creek
34. Upper Horton
35. Lower Horton
36. Rocky Creek
37. Warialda Creek
38. Mosquito Creek
39. Slaughterhouse Creek
40. Moree
41. Tycannah Creek
42. Gurley Creek
43. Millie Creek
44. Thalabah Creek
45. Gwydir water source
46. Mehi water source
47. Gil Gil water source
48. Gingham water source
49. Barwon water source

Figure 2 The Gwydir 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 (PU1-19) are located downstream of Copeton Dam on either the Gwydir River or its distributary channels. Discretionary environmental water released from Copeton Dam can be delivered (together with operational water, consumptive water and natural high flows, i.e. dam spills) to help meet Environmental Water Requirements (EWRs) of priority environmental assets and functions in these planning units. 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 some of the smaller river flow categories 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 Copeton Dam 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.

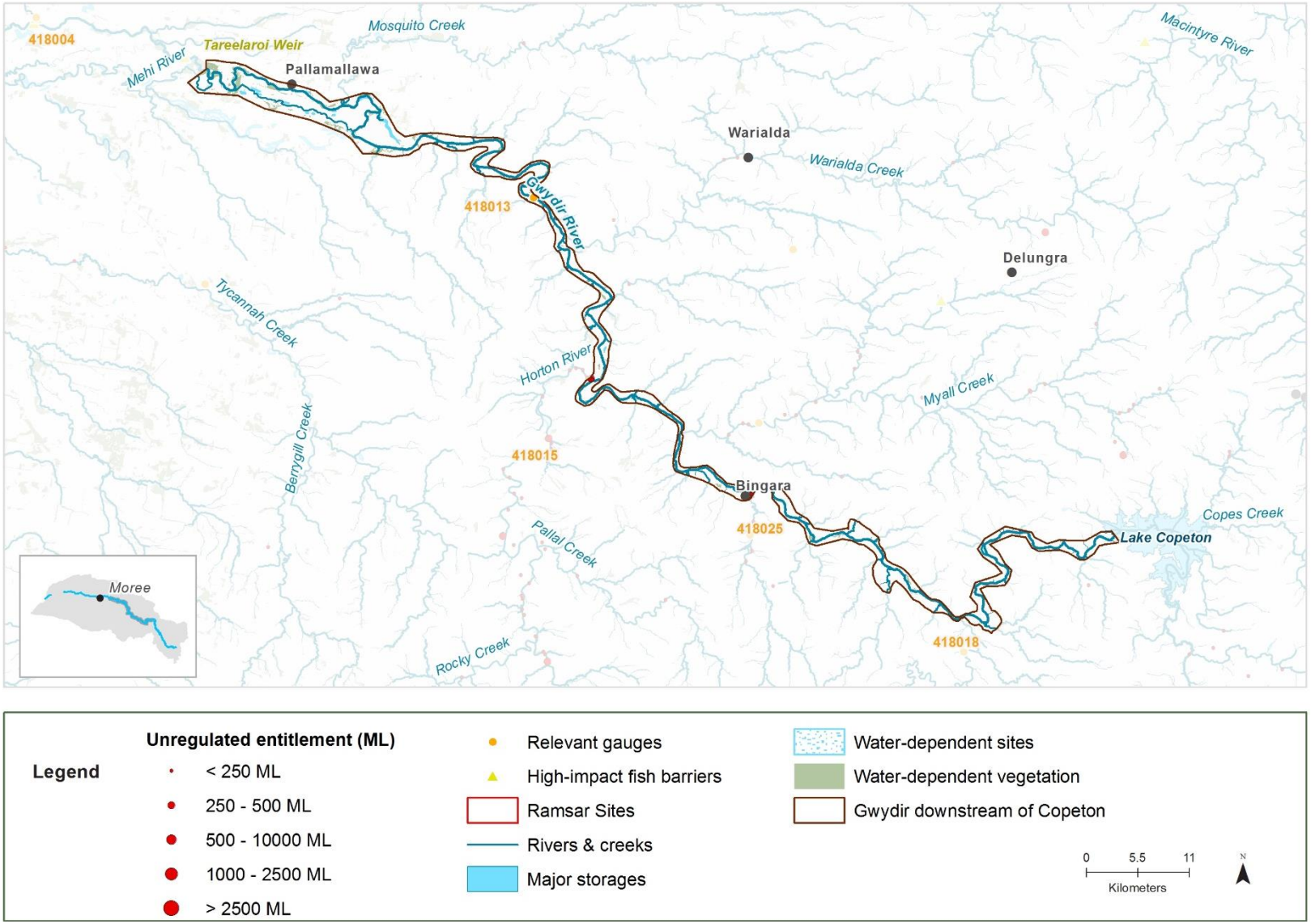
EWRs may be met with discretionary environmental water, consumptive deliveries, operational flows (e.g. conveyance flows or bulk water transfers between storages), unregulated flows (i.e. spills from dams), or a combination of these.

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 and rely on natural events. 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 Bunnor waterhole off the Gingham Watercourse
Photo: T. Cooke

PU1: Gwydir River downstream of Copeton Dam



Priority environmental assets and values			
Gwydir River and associated in-channel habitat and fringing vegetation communities and water-dependent assets including, but not limited to:			
• Patches of high biodiversity • Critical fish refuge		• Lowland Darling River endangered ecological community • Barbers Lagoon	
Native fish[1]	• unspecked hardyhead • carp gudgeon • Murray-Darling rainbowfish • bony herring	• Australian smelt • spangled perch • golden perch • silver perch	• Murray cod • freshwater catfish • olive perchlet (P) • purple spotted gudgeon
Birds	61 water-dependent bird species recorded, including the listed[2] waterbird species: eastern great egret and Latham's snipe		
Native vegetation	16 water-dependent PCTs, including river red gum woodlands and coolibah woodlands		
Registered cultural assets	• Modified trees		
Other species	• yellow-bellied sheathtail-bat • eastern snake-necked turtle • Macquarie River turtle	• broad-palmed frog • Peron's tree frog	• spotted grass frog • platypus

[1] 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)

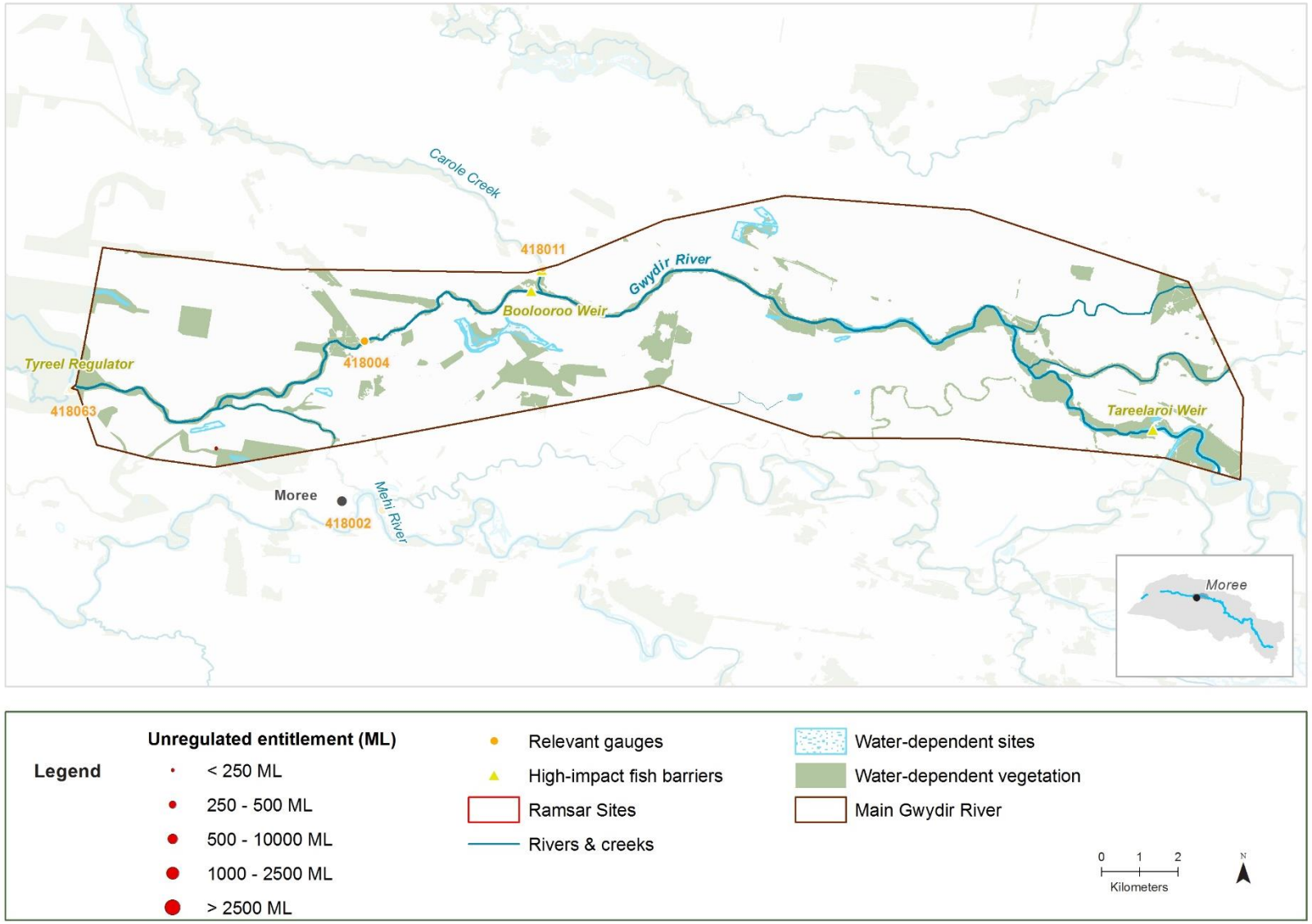
[2] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Flow category[3]		Gauge[3]	Flow rate / volume[3]	Timing[3]	Minimum duration[3]	Frequency (LTA frequency)[3]	Maximum inter-event period[3]	Additional requirements and comments
Cease-to-flow	CF1	Gwydir @ Gravesend (418013)	0 ML/day	In line with historical low flow season (typically April to June)	Maximum of 10-20 days (hot conditions) or 20-30 days (cooler conditions)	CF event durations of more than 30 days should occur in no more than 5% of years	N/A	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[4]	VF1	Gwydir DS Copeton (418026)	>30 ML/day	Any time	360 days per year (160 days per year in very dry years)	N/A	N/A	
Baseflow	BF1	Gwydir @ Gravesend (418013)	>170 ML/day	Any time	270 days per year (or 150 days per year in very dry years)	N/A	N/A	
	BF2	Gwydir @ Gravesend (418013)	>170 ML/day	September to March	180 days per year (80 days per year in very dry years)	5–10 years in 10 (75%)	2 years	
Small fresh	SF1	Gwydir @ Gravesend (418013)	>990 ML/day	October to April (can occur any time)	10 days	Annual (100%)	1 year	These EWRs may not be met by HEW alone with the current volumes that are available. Maximum release rates from Copeton Dam are constrained to 6,500 ML/day. Flows above this threshold are dependent on natural events. HEW may be used to contribute to these flows if delivered in addition to irrigation deliveries in higher irrigation delivery years, or natural events.
	SF2	Gwydir @ Gravesend (418013)	990–8,600 ML/day	September to April	14 days	5–10 years in 10 (75%)	2 years	

[3] See Glossary for definitions and explanatory text on how to interpret the EWR table.
[4] This flow category is also supported by Main Gwydir River VF1

Flow category[3]		Gauge[3]	Flow rate / volume[3]	Timing[3]	Minimum duration[3]	Frequency (LTA frequency)[3]	Maximum inter-event period[3]	Additional requirements and comments
Large fresh	LF1	Gwydir @ Gravesend (418013)	>8,600 ML/day	July to September (can occur any time)	5 days	5–10 years in 10 (75%)	2 years	These EWRs cannot be met by HEW. Maximum release rates from Copeton Dam are constrained to 6,500 ML/day. Flows above this threshold are dependent on natural events downstream of Copeton Dam. Remaining natural flows must be protected to meet these EWRs. LF3 and above will result in overbank events in downstream planning units.
	LF2	Gwydir @ Gravesend (418013)	>8,600 ML/day	October to April	5 days	3–5 years in 10 (40%)	4 years	
	LF3	Gwydir @ Gravesend (418013)	>26,500 ML/day	August to February (can occur any time)	2-6 days	3–5 years in 10 (40%)	4 years	
	LF4	Gwydir @ Gravesend (418013)	>70,600 ML/day	September to May (can occur any time)	1-4 days	2–3 years in 10 (25%)	5 years	
Bankfull	BK1	Gwydir @ Gravesend (418013)	90,000–100,000 ML/day	August to February (can occur any time)	1-4 days	2 years in 10 (20%)	8 years	
Large overbank	OB5	Gwydir @ Gravesend (418013)	>100,000 ML/day	Any time	1 day (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 years	

PU2: Main Gwydir River



Priority environmental assets and values			
Gwydir River and associated in-channel habitat and fringing vegetation communities, and water-dependent assets including, but not limited to:			
• Lowland Darling River endangered ecological community		• Critical fish refuge • Yarraman Lagoon	
Native fish[5]	• unspecked hardyhead • Murray-Darling rainbowfish • freshwater catfish	• Australian smelt • spangled perch • golden perch • silver perch (P)	• Murray cod • olive perchlet (P) • carp gudgeon • bony herring
Birds	47 water-dependent bird species recorded including the listed[6] waterbird species:		
	• common sandpiper	• Latham's snipe	• eastern great egret
Native vegetation	11 water-dependent PCTs, including river red gum woodlands, coolibah woodlands, and lignum shrubland wetlands		
Registered cultural assets	• Modified trees		
Other species	• eastern snake-necked turtle • salmon striped frog	• spotted grass frog	• water-rat

[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)

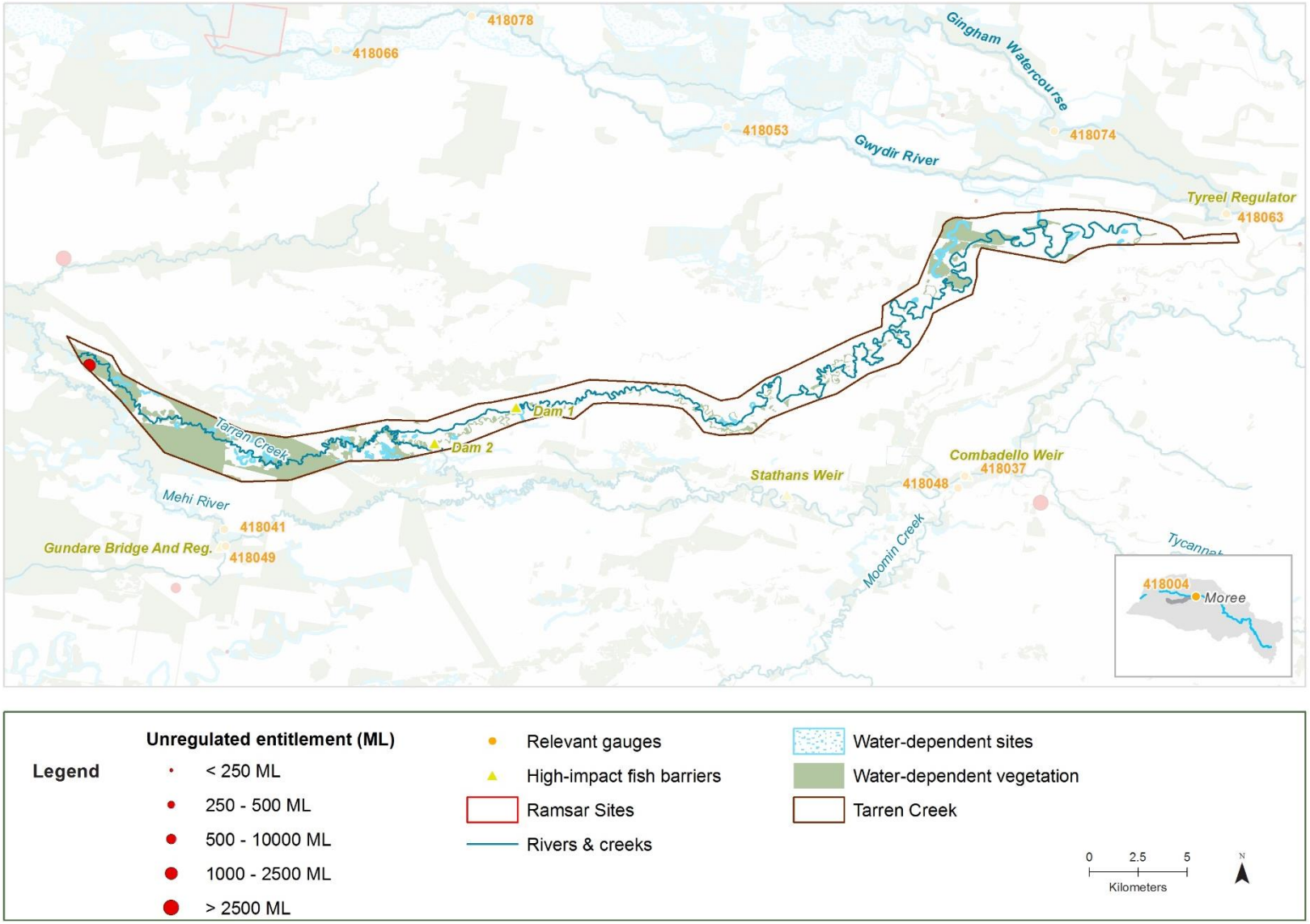
[6] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Flow category[7]		Gauge[7]	Flow rate / volume[7]	Timing[7]	Minimum duration[7]	Frequency (LTA frequency)[7]	Maximum inter-event period[7]	Additional requirements and comments
Cease-to-flow	CF1	Gwydir @ Yarraman (418004)	0 ML/day	In line with historical low flow season (typically April to June)	Maximum of 30–40 days (hot conditions) or 50–60 days (cooler conditions)	CF event durations of 60 days should never be exceeded	N/A	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	Gwydir @ Yarraman (418004)	>20 ML/day	Any time	350 days per year (150 days per year in very dry years)	N/A	N/A	
Baseflow	BF1	Gwydir @ Yarraman (418004)	>130 ML/day	Any time	200 days per year (80 days per year in very dry years)	N/A	N/A	
	BF2	Gwydir @ Yarraman (418004)	>130 ML/day	September to March	150 days (or 60 days in very dry years)	5–10 years in 10 (75%)	2 years	
Small fresh	SF1	Gwydir @ Yarraman (418004)	>540 ML/day	October to April (can occur any time)	10 days	Annual (100%)	1 year	These EWRs may not be able to be met with HEW alone with the current volumes that are available and under current constraints. Flows >2000 ML/day are dependent on the remaining natural events. HEW may be used to contribute to these flows if delivered in addition to irrigation deliveries in higher irrigation delivery years, or natural events.
	SF2	Gwydir @ Yarraman (418004)	540–4,860 ML/day	September to April	14 days	5–10 years in 10 (75%)	2 years	
Large fresh	LF1	Gwydir @ Yarraman (418004)	>4,860 ML/day	July to September (can occur any time)	5 days	5–10 years in 10 (75%)	2 years	These EWRs cannot be met with HEW. Flows >2000 ML/day are

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

Flow category[7]		Gauge[7]	Flow rate / volume[7]	Timing[7]	Minimum duration[7]	Frequency (LTA frequency)[7]	Maximum inter-event period[7]	Additional requirements and comments
	LF2	Gwydir @ Yarraman (418004)	>4,860 ML/day	October to April	5 days	3–5 years in 10 (40%)	4 years	dependent on large natural flow events. Remaining natural flows must be protected to meet these EWRs. LF3, LF4 and LF6 flows will result in large overbank and wetland inundation events in downstream planning units.
	LF3	Gwydir @ Yarraman (418004)	>11,000 ML/day	August to February (can occur any time)	1–2 days	3–5 years in 10 (40%)	4 years	
	LF4	Gwydir @ Yarraman (418004)	>40,000 ML/day	September to May (can occur any time)	1–2 days	2–3 years in 10 (25%)	5 years	
	LF6	Gwydir @ Yarraman (418004)	>250,000 ML event	Any time	1–2 months	1–3 years in 10 (15%)	10 years	
Bankfull	BK1	Gwydir @ Yarraman (418004)	50,000–60,000 ML/day	August to February (can occur any time)	1–2 days	2–3 years in 10 (25%)	7 years	
Large Overbank	OB5	Gwydir @ Yarraman (418004)	>60,000 ML/day	Any time	1 day (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 years	

PU3: Tarren Creek



Priority environmental assets and values			
Tarren Creek, associated in-channel habitat, and fringing and floodplain wetland vegetation communities			
Native fish[8]	• carp gudgeon (P) • Murray-Darling rainbowfish (P)	• bony herring (P) • Australian smelt (P)	• spangled perch (P) • purple spotted gudgeon (P)
Birds	31 water-dependent bird species recorded, including the listed[9] waterbird species:		
	• magpie goose	• eastern great egret	• Latham's snipe
Native vegetation	Seven water-dependent PCTs, including coolibah woodlands		
Registered cultural assets	None registered		
Other species	None recorded		
Unregulated WALs	There is one unregulated water access licences (WALs) for production of 1458 ML in the planning unit. The WAL is located at the end of Tarren Creek, just before it re-joins Mehi 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 entering unregulated streams and off-channel pools (wetlands).[10] • Consider protection of water for the environment in this planning unit to protect connectivity between this planning unit and Lower Mehi planning unit ecologically important flows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years		

[8] 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)

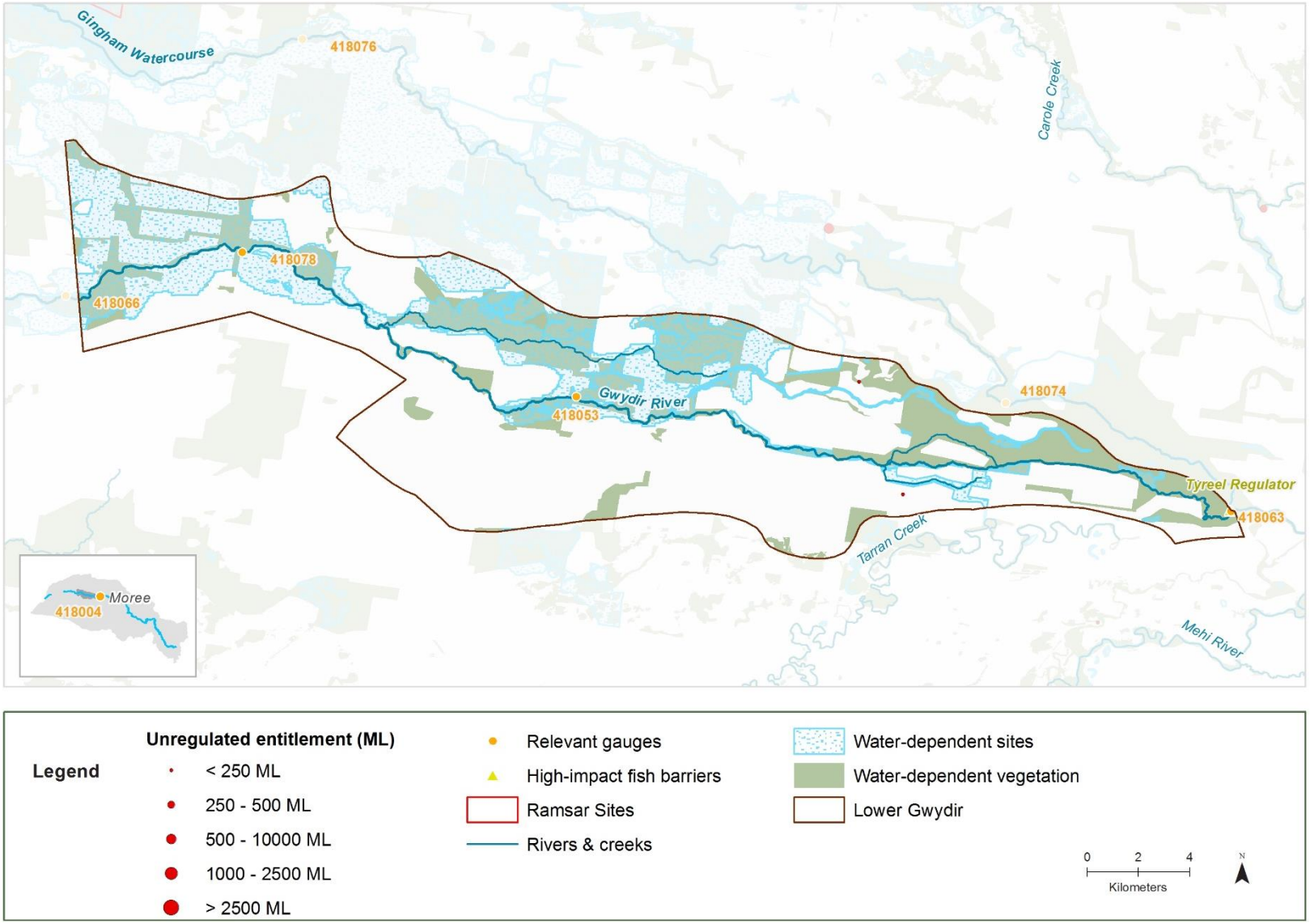
[9] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

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

Flow category[11]		Gauge[11]	Flow rate / volume[11]	Timing[11]	Minimum duration[11]	Frequency (LTA frequency)[11]	Maximum inter-event period[11]	Additional requirements and comments
Large fresh	LF6	Gwydir @ Yarraman (418004)	>250,000 ML event	Any time	1–2 months	1–3 years in 10 (15%)	10 years	These EWRs cannot be met with HEW. Flows >2000ML/day are dependent on large natural flow events. Remaining natural flows must be protected to meet these EWRs.
Bankfull	BK1	Gwydir @ Yarraman (418004)	50,000–60,000 ML/day	August to February (can occur any time)	1–2 days	2–3 years in 10 (25%)	7 years	
Large overbank	OB5	Gwydir @ Yarraman (418004)	>60,000 ML/day	Any time	1 day (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 years	

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

PU4: Lower Gwydir



Priority environmental assets and values			
Gwydir River and associated in-channel habitat and fringing vegetation communities, and water-dependent assets including, but not limited to: • Gwydir Watercourse and associated floodplain and wetland vegetation communities • A portion of the Gwydir Wetlands • Wirrit Waterhole • North Arm and Big Leather flow paths • Fish refuge			
Native fish[12]	• unspecked hardyhead • Murray-Darling rainbowfish • bony herring	• Australian smelt • spangled perch • golden perch • silver perch (P)	• Murray cod • freshwater catfish • olive perchlet (P) • carp gudgeon
Birds	40 water-dependent bird species recorded, including the listed[13] eastern great egret		
Native vegetation	Six water-dependent PCTs, including river red gum woodlands, coolibah woodlands and wetland woodlands, river cooba wetlands		
Registered cultural assets	• Modified trees	• Burial sites	• Ceremonial grounds/ring
Other species	• eastern snake-necked turtle	• broad-palmed frog	• spotted grass frog
Unregulated WALs	The total volume of unregulated entitlements in the planning unit is 86.5 ML, of which 82 ML are for production. There is one unregulated WAL for production <250 ML (82 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 entering unregulated streams and off-channel pools (wetlands).[14] • Consider protection of water for the environment in this planning unit to reduce impact on high and infrequent flows and protect ecologically important flows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years		

[12] 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)

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

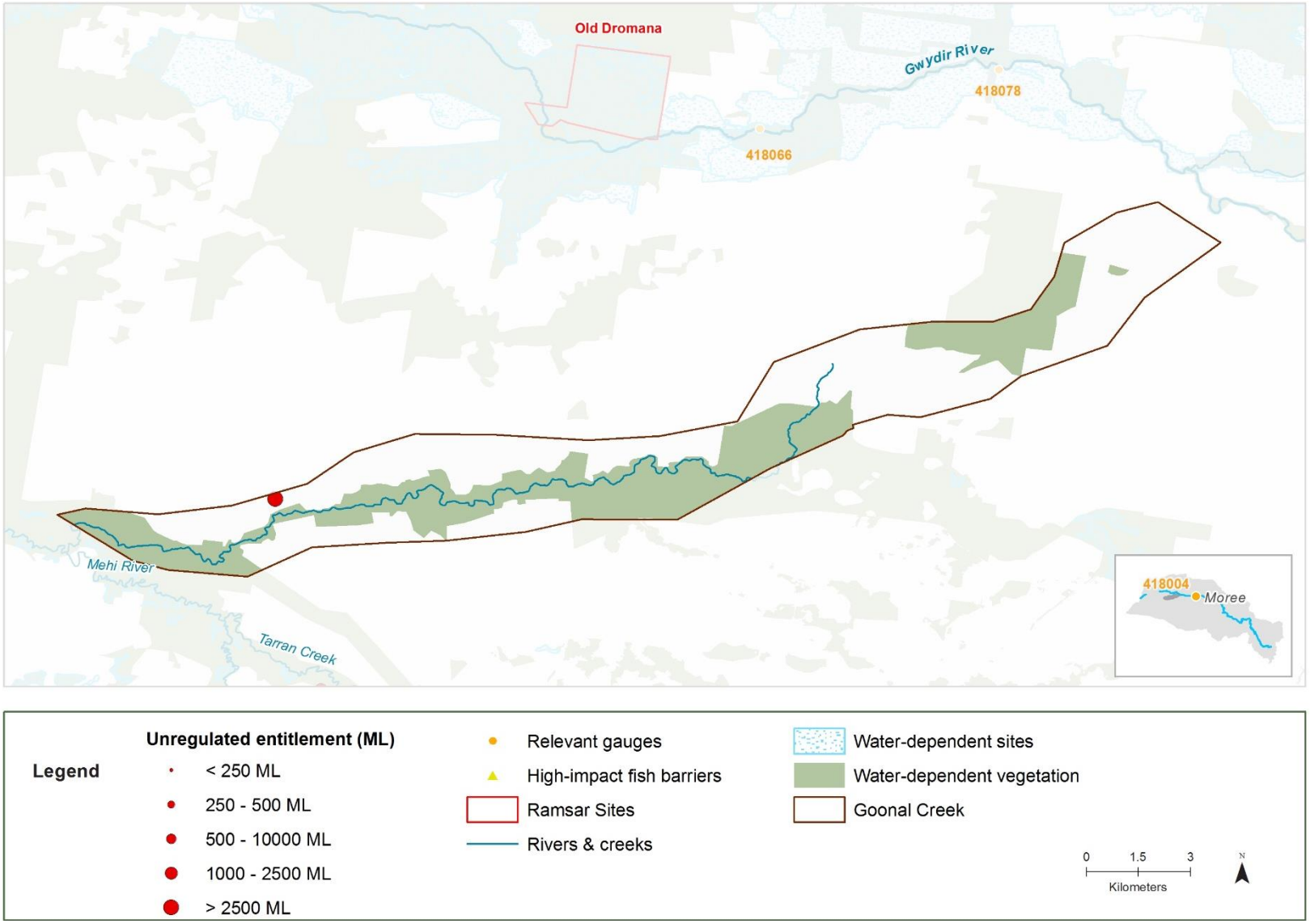
[14] In-line with the Basin Plan requirement for implementation of prerequisite policy measures that provide for delivered environmental water to be protected. It is also recommended by the Matthews reports (2017).

Flow category[15]		Gauge[15]	Flow rate / volume[15]	Timing[15]	Minimum duration[15]	Frequency (LTA frequency)[15]	Maximum inter-event period[15]	Additional requirements and comments
Cease-to-flow	CF1	Gwydir @ Brageen Crossing DS Tyreel (418053)	0 ML/day	In line with historical low flow season, typically April to June	Maximum of 40–60 days (hot conditions) or 60–80 days (cooler conditions)	CF event durations of more than 80 days should occur in no more than 5% of years.	N/A	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	Gwydir @ Brageen Crossing (418053)	> 10 ML/day	Any time	320 days per year (90 days per year in very dry years)	N/A	N/A	
Baseflow	BF1	Gwydir DS Tyreel (418063)	>50 ML/day	Any time	180 days per year (75 days in very dry years)	N/A	1 year	
	BF2	Gwydir DS Tyreel (418063)	>50 ML/day	September to March	150 days per year (60 days per year in very dry years)	5–10 years in 10 (75%)	2 years	
Small fresh	SF1	Gwydir DS Tyreel (418063)	>250 ML/day	October to April (can occur any time)	10 days	Annual (100%)	1 year	These EWRs may be able to be met by HEW alone or in conjunction with other flows.
	SF2	Gwydir DS Tyreel (418063)	>250 ML/day	September to April	14 days	5–10 years in 10 (75%)	2 years	
Large fresh	LF1	Gwydir DS Tyreel (418063)	>800 ML/day	July to September (can occur any time)	5 days	5–10 years in 10 (75%)	2 years	These EWRs may not be met with HEW alone with the current volumes that are available. Flows >800 ML/day are dependent on the remaining natural events. At the smaller range of flows, HEW may be used to contribute to these flows if delivered in addition to irrigation
	LF2	Gwydir DS Tyreel (418063)	>800 ML/day	October to April	5 days	3–5 years in 10 (40%)	4 years	

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

Flow category[15]		Gauge[15]	Flow rate / volume[15]	Timing[15]	Minimum duration[15]	Frequency (LTA frequency)[15]	Maximum inter-event period[15]	Additional requirements and comments
								deliveries in higher delivery years. Otherwise, HEW can only contribute to these flows if it is already in the system when a natural event occurs.
Bankfull	BK1	Gwydir DS Tyreel (418063)	1,500–3,500 ML/day	August to February (can occur any time)	2–5 days	4 years in 10 (40%)	N/A	These EWRs cannot be met by HEW. Flows >1000 ML/day at Gwydir DS Tyreel and >2000 ML/day at Gwydir @ Yarraman are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs. This large overbank event will also result in large overbank events in downstream planning units.
Small overbank	OB1	Gwydir @ Allambie (418078)	>10,000 ML event	September to March (can occur any time)	3 days (2–8 months of asset inundation)	7–8 years in 10 (75%)	2 years	
	OB2	Gwydir @ Allambie (418078)	>30,000 ML event	October to April (but can occur any time	10 days (2–6 months of asset inundation)	4–7 years in 10 (55%)	3 years	
	OB3	Gwydir @ Allambie (418078)	>60,000 ML event	August to February (can occur any time)	5 days (2–3 months of asset inundation)	3–5 years in 10 (40%)	4 years	
Large overbank	OB5	Gwydir @ Yarraman (418004)	>60,000 ML/day	Any time	1 day (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 years	

PU5: Goonal Creek



Priority environmental assets and values			
Goonal Creek, associated in-channel habitat, and fringing and floodplain wetland vegetation communities			
Native fish[16]	• carp gudgeon (P)	• bony herring (P)	• spangled perch (P)
Birds	27 water-dependent bird species recorded, including the listed[17] waterbird species: brolga and eastern great egret		
Native vegetation	Five water-dependent PCTs, including coolibah woodlands		
Registered cultural assets	• Modified tree	• Ceremonial ring	
Other species	None recorded		
Unregulated WALs	There is one unregulated water access licences (WALs) for production of 5138 ML in the planning unit. The WAL is located at the end of Goonal Creek, just before it re-joins Mehi 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 entering unregulated streams and off-channel pools (wetlands).[18] • Consider protection of water for the environment in this planning unit to protect connectivity between this planning unit and Lower Mehi planning unit ecologically important flows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years		

[16] 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)

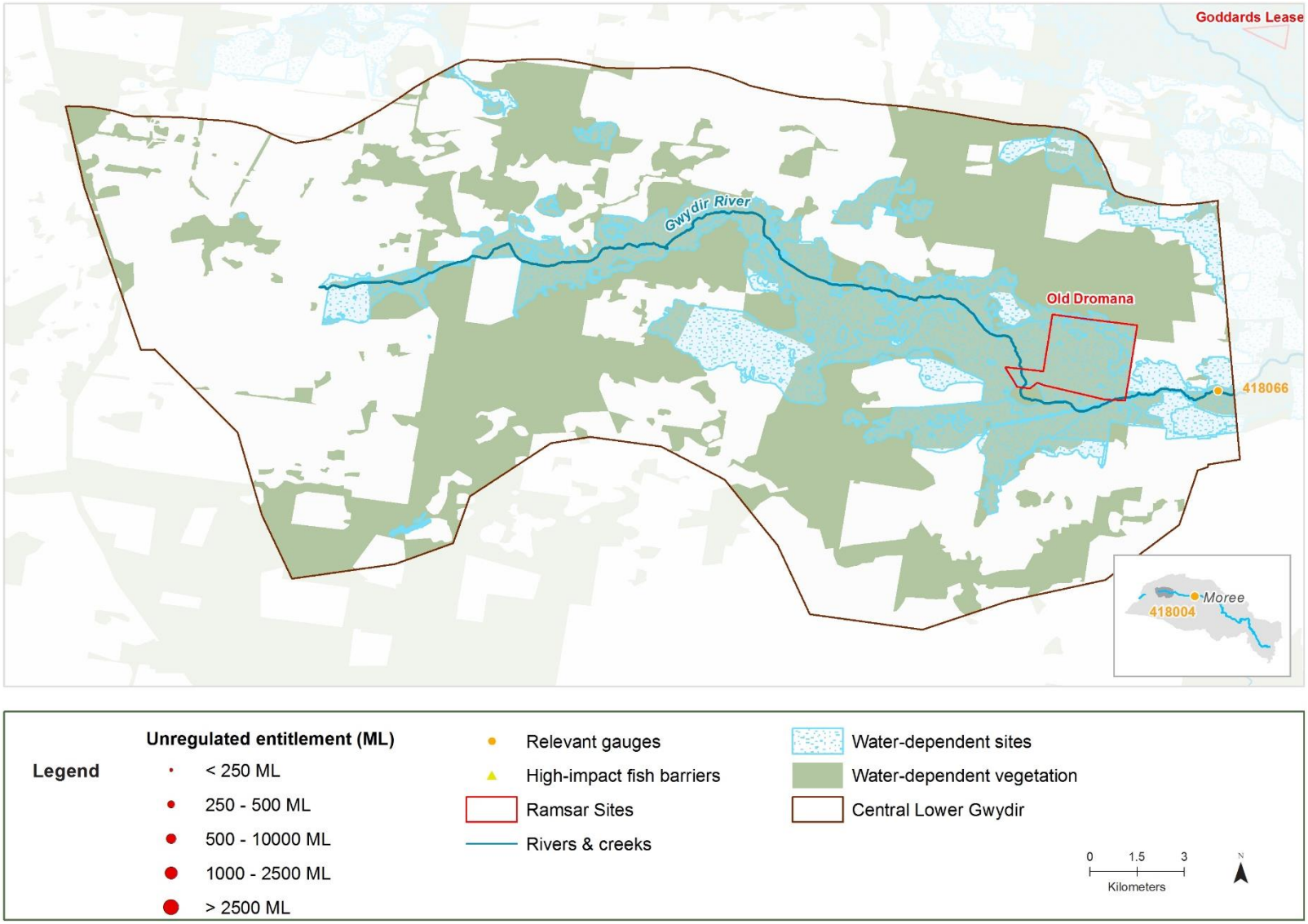
[17] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

[18] 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[19]		Gauge[19]	Flow rate / volume[19]	Timing[19]	Duration[19]	Frequency (LTA frequency)[19]	Maximum inter-event period[19]	Additional requirements and comments
Large fresh	LF6	Gwydir @ Yarraman (418004)	>250,000 ML event	Any time	1–2 months	1–3 years in 10 (15%)	10 years	These EWRs cannot be met with HEW. Flows >2000ML/day are dependent on large natural flow events. Remaining natural flows must be protected to meet these EWRs.
Bankfull	BK1	Gwydir @ Yarraman (418004)	50,000–60,000 ML/day	August to February (can occur any time)	1–2 days	2–3 years in 10 (25%)	7 years	
Large overbank	OB5	Gwydir @ Yarraman (418004)	>60,000 ML/day	Any time	1 day (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 years	

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

PU6: Central Lower Gwydir



Priority environmental assets and values			
Gwydir Watercourse and associated floodplain and wetland vegetation communities, and water-dependent assets including, but not limited to: • Gin Holes • Old Dromana Ramsar site • Wandoona/Troy Waterhole • The largest area of the Lower Gwydir Wetlands • Bulyeroi Lagoon			
Native fish[20]	• unspecked hardyhead (P) • Murray-Darling rainbowfish (P) • freshwater catfish (P)	• Australian smelt (P) • spangled perch • bony herring • carp gudgeon	• Murray cod (P) • olive perchlet (P) • golden perch (P) • silver perch (P)
Birds	73 water-dependent bird species recorded, including the listed[21] waterbird species:		
	• blue-billed duck • freckled duck • magpie goose • Australian painted snipe • common greenshank	• black-tailed godwit • eastern great egret • black-necked stork • sharp-tailed sandpiper • marsh sandpiper	• brolga • gull-billed tern • Caspian tern • Latham's snipe • cattle egret
Native vegetation	12 water-dependent PCTs, including:		
	• coolibah woodlands and wetland woodlands • water couch marsh grasslands	• spike rush mixed marshlands • river cooba wetlands • cumbungi rushlands	• Lignum shrublands • largest remaining area of marsh club-rush sedgeland
Registered cultural assets	• Modified trees		
Other species	• eastern sign-bearing froglet • spotted grass frog	• broad-palmed frog • Peron's tree frog	• yellow-bellied sheathtail-bat • little pied bat

[20] 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)

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

Flow category[22]		Gauge[22]	Flow rate / volume[23]	Timing[22]	Minimum duration[22]	Frequency (LTA frequency)[22]	Maximum inter-event period[22]	Additional requirements and comments[22]
Cease-to-flow	CF1[24]	Gwydir @ Millewa (418066)	0 ML/day	In line with historical low flow season, typically April to June	Events should not persist longer than 24 months[25]	CF event durations of 24 months should only occur once in 10 years	N/A	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	Gwydir @ Millewa (418066)	>6,000 ML event	Any time	3–6 months	9–10 years in 10 (95%)	18 months	These EWRs can be met with low flow wetland PEW or HEW under current constraints at flows <250ML/day. Currently, HEW may be used to contribute to flows between 250–500 ML/day if delivered in addition to natural events.
	WL2	Gwydir @ Allambie (418078)	>36,000 ML event	September to March (can occur any time)	3–6 months (2–8 months of asset inundation)	8–9 years in 10 (85%)	2 years	
Large wetland inundation	WL3	Gwydir @ Allambie (418078)	>45,000 ML event	October to April	3–6 months (2–6 months of asset inundation)	5–8 years in 10 (65%)	3 years	These EWRs may not be met by HEW alone. HEW may be used to contribute to these flows if delivered in addition to natural events. Remaining natural flows must be protected to meet these EWRs.
	WL4	Gwydir @ Allambie (418078)	>65,000 ML event	August to February (can occur any time)	3–4 months (2–3 months of asset inundation)	3–5 years in 10 (40%)	5 years	

[22] See Glossary for definitions and explanatory text on how to interpret the EWR table.
[23] Flows are net of irrigation deliveries and extraction
[24] CF1 events are broken by wetland inundating flows (WL1)

Flow category[22]		Gauge[22]	Flow rate / volume[23]	Timing[22]	Minimum duration[22]	Frequency (LTA frequency)[22]	Maximum inter-event period[22]	Additional requirements and comments[22]
Large fresh	LF6	Gwydir @ Yarraman (418004)	>250,000 ML event	Any time	1–2 months	1–3 years in 10 (15%)	10 years	These EWRs cannot be met by HEW. Flows >2000 ML/day at Gwydir @ Yarraman are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs. These large overbank events will also result in large overbank events in downstream planning units.
Bankfull	BK1	Gwydir @ Yarraman (418004)	50,000–60,000 ML/day	August to February (can occur any time)	1–2 days	2–3 years in 10 (25%)	7 years	
Large overbank	OB5	Gwydir @ Yarraman (418004)	>60,000 ML/day	Any time	1 day (1–6 months of asset inundation)	1 year in 10	10–15 years	

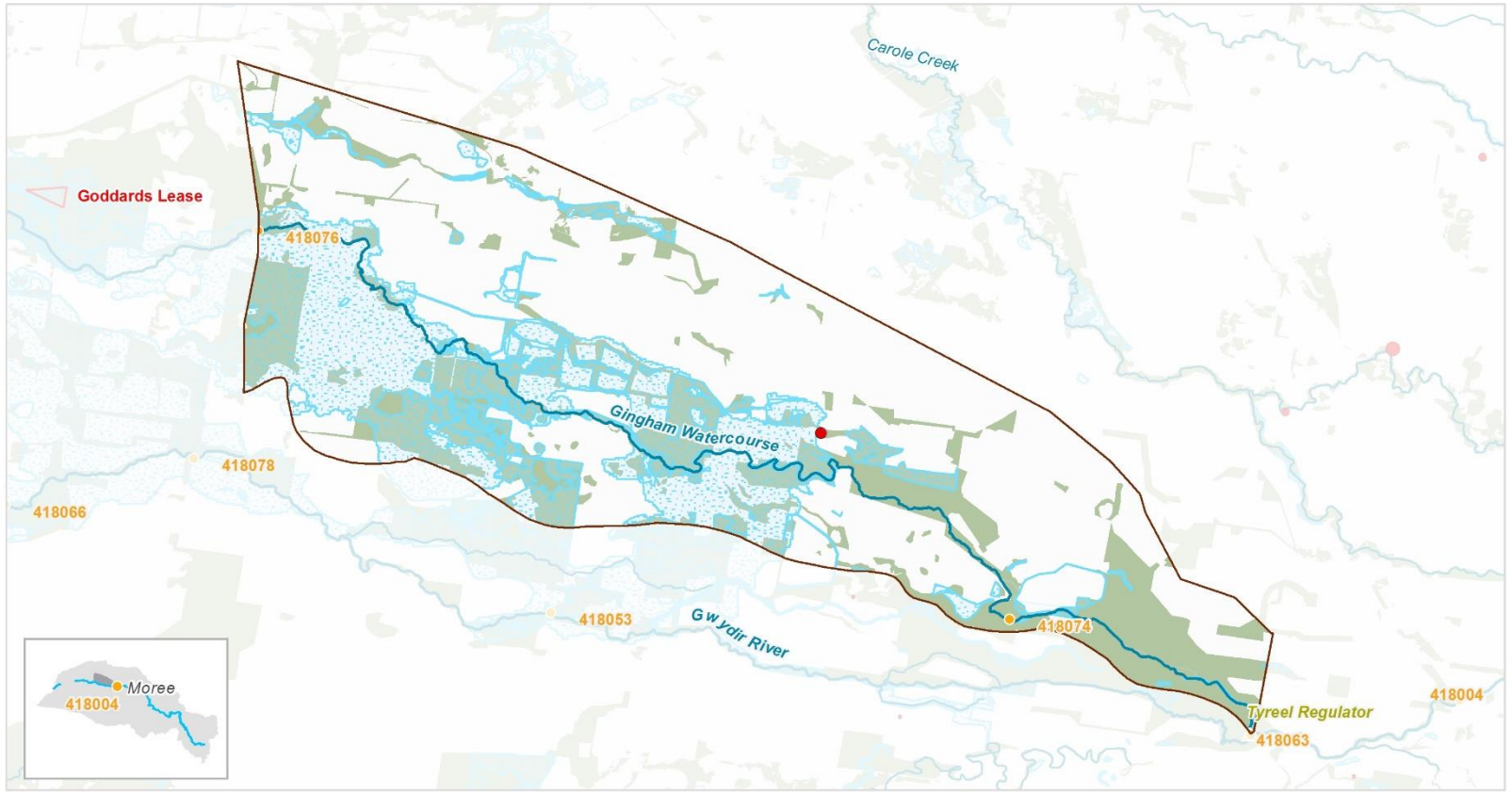
PU7: Western Gwydir Floodplain

Priority environmental assets and values			
Gwydir Watercourse and its associated floodplain vegetation communities			
Native fish[26]	• carp gudgeon • Murray-Darling rainbowfish (P) • Australian smelt (P)	• bony herring • spangled perch • golden perch (P)	• silver perch (P) • Murray cod (P) • olive perchlet (P)
Birds	15 water-dependent bird species recorded, including the listed[27] eastern great egret		
Native vegetation	Five water-dependent PCTs, including black box woodlands and coolibah woodlands		
Registered cultural assets	• Modified trees		
Other species	None recorded		

Flow category[28]		**Gauge**[28]	**Flow rate /volume**[28]	**Timing**[28]	**Duration**[28]	**Frequency (LTA frequency)**[28]	**Maximum inter-event period**[28]	**Additional requirements and comments**[28]
Large fresh	LF6	Gwydir @ Yarraman (418004)	>250,000 ML event	Any time	1–2 months	1–3 years in 10 (15%)	10 years	These EWRs cannot be met with HEW. Flows >2000ML/day are dependent on large natural flow events. Remaining natural flows must be protected to meet these EWRs.
Bankfull	BK1	Gwydir @ Yarraman (418004)	50,000–60,000 ML/day	August to February (can occur any time)	1–2 days	2–3 years in 10 (25%)	7 years	
Large overbank	OB5	Gwydir @ Yarraman (418004)	>60,000 ML/day	Any time	1 day (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 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] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)
[28] See Glossary for definitions and explanatory text on how to interpret the EWR table.

PU8: Upper Gingham



Priority environmental assets and values			
Gingham Watercourse and associated in-channel habitat and fringing and floodplain vegetation communities, and water-dependent assets including, but not limited to: • The Raft and Gwydir Lagoon • A portion of the Gingham Wetlands • Fish refuge		• Remnant wetland including the Gully property (Jackson Paddock) and other small remnant wetlands • Talmoi, Baroona and Tillaloo Waterholes	
Native fish[29]	• unspecked hardyhead • carp gudgeon • Murray-Darling rainbowfish • freshwater catfish	• Australian smelt • spangled perch • golden perch • silver perch (P)	• Murray cod • olive perchlet (P) • purple spotted gudgeon (P) • bony herring
Birds	66 water-dependent bird species recorded, including the listed[30] waterbird species: • blue-billed duck • magpie goose • cattle egret	• eastern great egret • black-necked stork • brolga	• sharp-tailed sandpiper • Latham's snipe • common greenshank
Native vegetation	14 water-dependent PCTs, including: • coolibah woodlands • lignum shrublands	• coolibah wetland woodlands • water couch marsh grasslands and wetlands	• river red gum woodlands
Registered cultural assets	• Modified tree		
Other species	• eastern snake-necked turtle	• broad-palmed frog • Peron's tree frog	• salmon striped frog • broad-shelled turtle
Unregulated WALs	**There is one unregulated water access licences (WALs) for production of 648 ML in the planning unit.**		
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[31] • Consider protection of water for the environment in this planning unit to protect ecologically important flows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years		

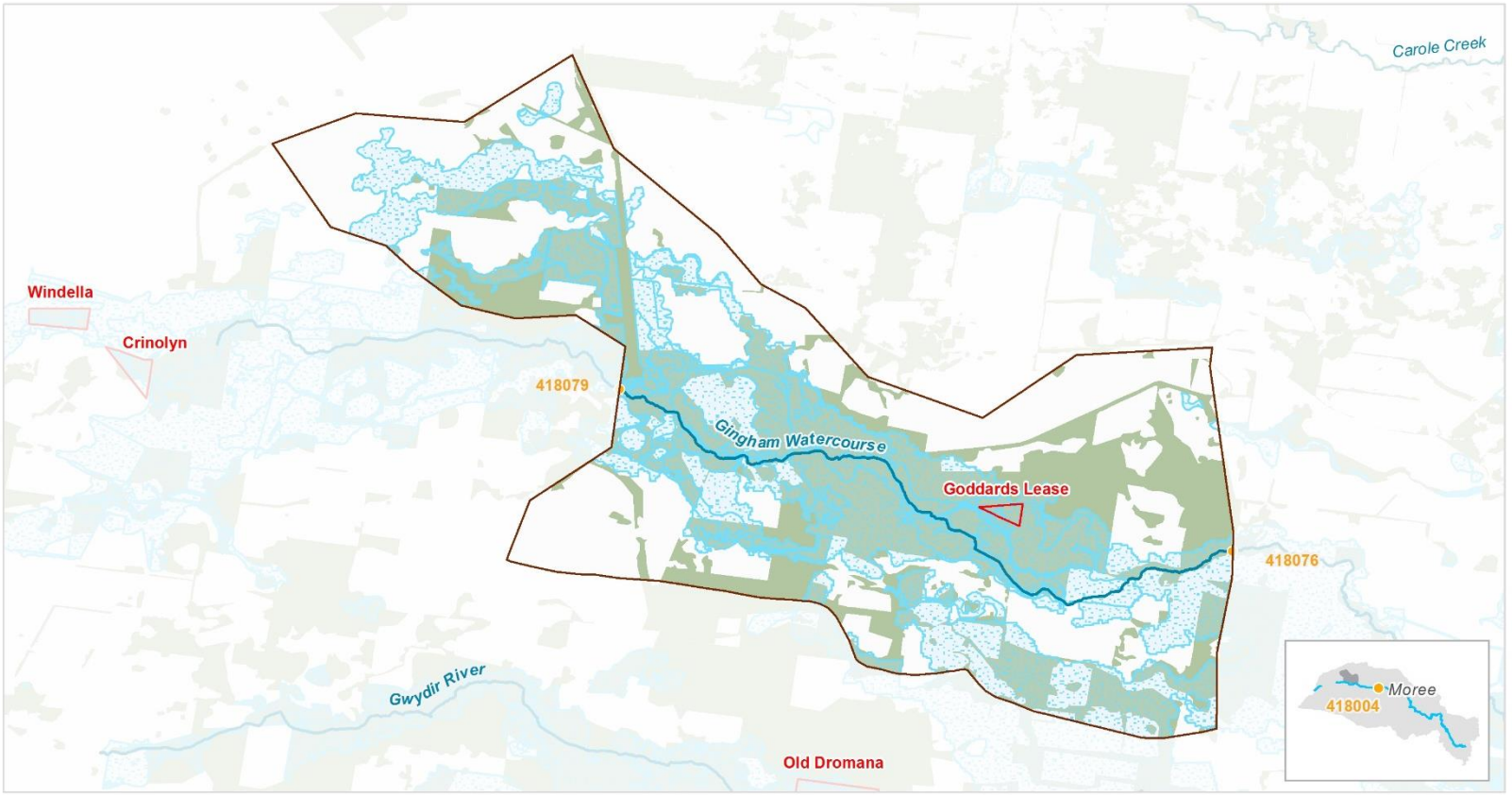
[29] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)
[30] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)
[31] 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[32]		Gauge[32]	Flow rate /volume[32]	Timing[32]	Minimum duration[32]	Frequency (LTA frequency)[32]	Maximum inter-event period[32]	Additional requirements and comments[32]
Cease-to-flow	CF1	Gingham @ Teralba (418074)	0 ML/day	In line with historical low flow season, typically April to June	Maximum of 40–60 days per year (hot conditions) or 60–80 days per year (cooler conditions)	CF event durations of more than 80 days should occur in no more than 10% of years	N/A	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	Gingham @ Teralba (418074)	>10 ML/day	Any time	300 days per year (90 days per year in very dry years)	N/A	N/A	
Baseflow	BF1	Gingham @ Teralba (418074)	>50 ML/day	Any time	150 days per year (80 days per year in very dry years)	N/A	N/A	
	BF2	Gingham @ Teralba (418074)	>50 ML/day	September to March	130 days per year (50 days per year in very dry years)	5–10 years in 10 (75%)	2 years	
Small fresh	SF1	Gingham @ Teralba (418074)	>250 ML/day	October to April (can occur any time)	10 days	Annual (100%)	1 year	These EWRs may not be able to be met by HEW alone with the current volumes that are available and under current constraints. Flows >500 ML/day are dependent on the remaining natural events. Currently, HEW may be used to contribute to these flows if delivered in addition to natural events.
	SF2	Gingham @ Teralba (418074)	250-1,000 ML/day	September to April	14 days	5–10 years in 10 (75%)	2 years	

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

Flow category[32]		Gauge[32]	Flow rate /volume[32]	Timing[32]	Minimum duration[32]	Frequency (LTA frequency)[32]	Maximum inter-event period[32]	Additional requirements and comments[32]
Large fresh	LF1	Gingham @ Teralba (418074)	>1,000 ML/day	July to September (can occur any time)	5 days	5–10 years in 10 (75%)	2 years	These EWRs cannot be met by HEW with the current volumes that are available and under current constraints. Flows >500 ML/day at Gwydir @ Teralba gauge are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs.
	LF2	Gingham @ Teralba (418074)	>1,000 ML/day	October to April	5 days	3–5 years in 10 (40%)	4 years	
	LF6	Gwydir @ Yarraman (418004)	>250,000 ML event	Any time	1–2 months	1–3 years in 10 (15%)	10 years	
Small wetland inundation	WL1	Gingham @ Teralba (418074)	>10,000 ML event	Any time	1–6 months	8–10 years in 10 (90%)	18 months	These EWRs may not be able to be met by HEW alone with the current volumes that are available and under current constraints. Flows >500 ML/day are dependent on the remaining natural events. Currently, HEW may be used to contribute to these flows if delivered following natural events. Remaining natural flows must be protected to meet these EWRs.
	WL2	Gingham @ Teralba (418074)	>30,000 ML event	September to March (can occur any time)	1–6 months (2–8 months of asset inundation)	8–9 years in 10 (85%)	2 years	
Large wetland inundation	WL3	Gingham @ Teralba (418074)	>45,000 ML event	October to April	1–3 months (2–6 months of asset inundation)	5–8 years in 10 (65%)	3 years	
	WL4	Gingham @ Teralba (418074)	>60,000 ML event	August to February (can occur any time)	1–3 months (2–3 months of asset inundation)	3–5 years in 10 (40%)	5 years	These EWRs cannot be met by HEW. Flows >2000 ML/day at Gwydir @ Yarraman gauge and flows >500 ML/day at Gwydir @ Teralba gauge are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs.
Large overbank	OB5	Gwydir @ Yarraman (418004)	>60,000 ML/day	Any time	1 day (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 years	

PU9: Central Gingham



Priority environmental assets and values			
Gingham Watercourse and associated in-channel habitat and fringing, and floodplain vegetation communities, and water-dependent assets including, but not limited to: • Lagoons and waterholes including Gingham Waterhole, Racecourse and Little Lagoons, Bunnor Waterbird Lagoons, and other unnamed lagoons • Egret, heron and ibis colonial nesting waterbird breeding sites including areas on Bunnor, Lynworth, Yarrol, Muwonga and Glendara • Goddard's Lease Ramsar site • Large areas of productive wetland foraging and waterbird breeding habitat • Largest continuous intact area of the Gwydir's mosaic of wetlands remaining on the Gwydir floodplain			
Native fish[33]	• carp gudgeon • unspecked hardyhead • Murray-Darling rainbowfish • bony herring	• Australian smelt (P) • spangled perch • golden perch • silver perch (P)	• Murray cod (P) • olive perchlet • purple spotted gudgeon (P)
Birds	90 water-dependent bird species recorded, including the listed[34] waterbird species: • blue-billed duck • freckled duck • magpie goose • Australian painted snipe • common greenshank	• cattle egret • eastern great egret • black-necked stork • sharp-tailed sandpiper • marsh sandpiper	• brolga • gull-billed tern • Caspian tern • black-tailed godwit • Latham's snipe
Native vegetation	Patches of Lowland Darling River endangered ecological community and • Extensive lignum shrubland • coolibah wetland woodlands	• non-woody wetland vegetation communities including water couch, spike rush, typha and marsh club-rush	• River red gum woodlands • Myall woodlands
Registered cultural assets	• Modified trees		
Other species	• spotted grass frog • broad-palmed frog • Peron's tree frog • water rat	• eastern sign-bearing froglet • yellow-bellied sheathtail-bat • eastern snake-necked turtle	• Beccari's freetail-bat • little pied bat • salmon striped frog

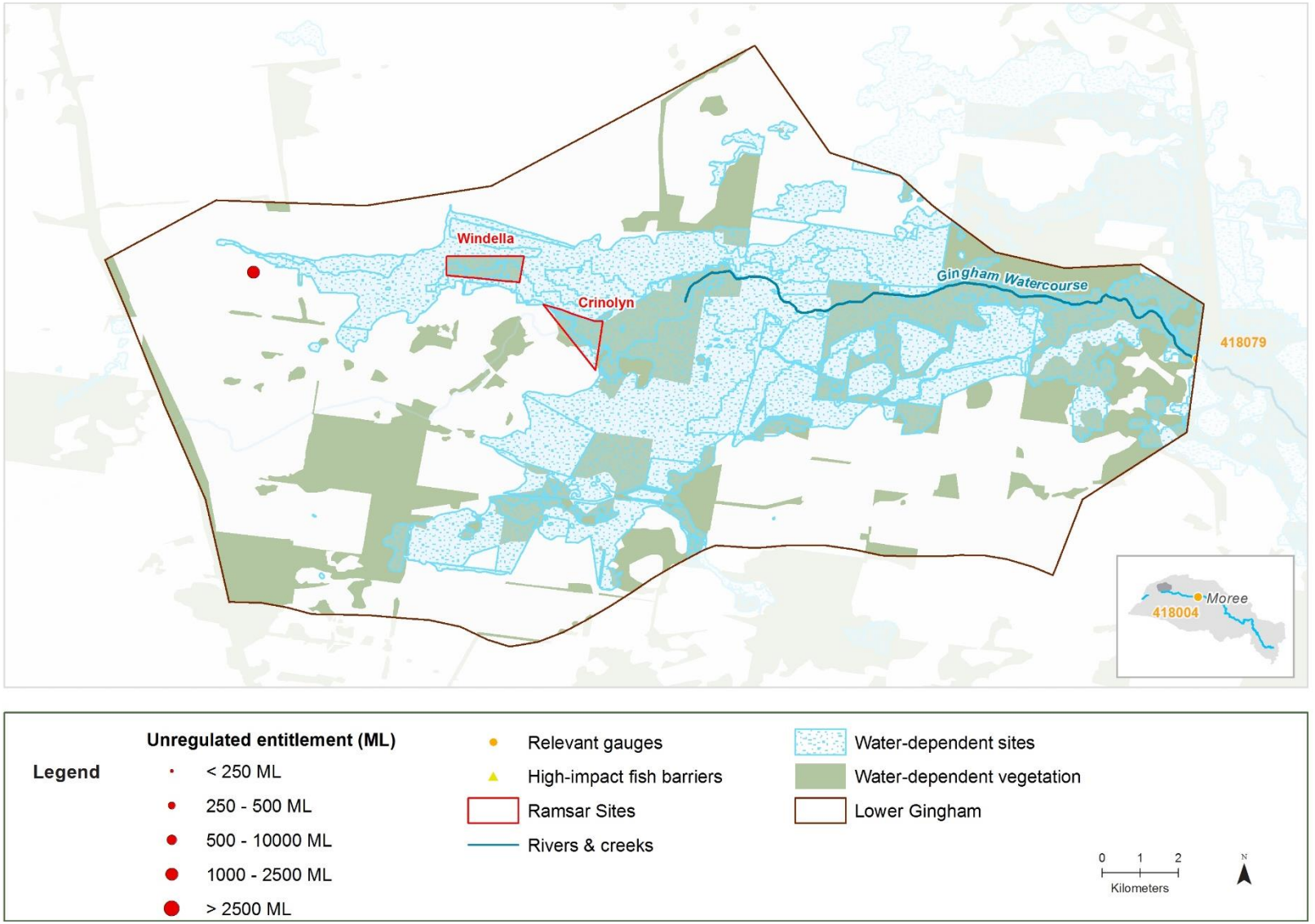
[33] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)
[34] Listed as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

Flow category[35]		Gauge[35]	Flow rate /volume[35]	Timing[35]	Minimum duration[35]	Frequency (LTA frequency)[35]	Maximum inter-event period[35]	Additional requirements and comments[35]
Cease-to-flow	CF1	Gingham @ Tillaloo (418076)	0 ML/day	In line with historical low flow season, typically April to June	Events should not persist longer than 24 months[36]	CF event durations of 24 months should not occur more than once in 10	N/A	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	Gingham @ Tillaloo (418076)	>8,000 ML event	Any time	2–6 months	8–10 years in 10 (90%)	18 months	These EWRs can be met in some years by using HEW and EWA, but cannot be met by HEW alone with the current volumes that are available and under current constraints. Flows >250 ML/day are mainly dependent on the remaining natural events. Currently, HEW may be used to contribute to these in addition to natural events. Constraints need to be relaxed and remaining natural flows must be protected to meet these EWRs.
	WL2	Gingham @ Tillaloo (418076)	>25,000 ML event	September to March (can occur any time)	2–6 months (2–8 months of asset inundation)	8–9 years in 10 (85%)	2 years	
Large wetland inundation	WL3	Gingham @ Tillaloo (418076)	>40,000 ML event	October to April	2–6 months (2–6 months of asset inundation)	5–8 years in 10 (65%)	3 years	
	WL4	Gingham @ Tillaloo (418076)	>50,000 ML event	August to February (can occur any time)	2–6 months (2–3 months of asset inundation)	3–5 years in 10 (40%)	5 years	
Large fresh	LF6	Gwydir @ Yarraman (418004)	>250,000 ML event	Any time	1–2 months (3–8 months of asset inundation)	1–3 years in 10 (15%)	5 years	These EWRs cannot be met by HEW. Flows >2000 ML/day at Gwydir @ Yarraman gauge are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs.
Large overbank	OB5	Gwydir @ Yarraman (418004)	>60,000	Any time	1 day (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 years	

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

[36] CF events are broken by wetland inundating flows (WL1)

PU10: Lower Gingham



Priority environmental assets and values			
Floodplain vegetation communities associated with the Gingham watercourse and water-dependent assets including, but not limited to:			
• Windella and Crinolyn Ramsar sites • Bronkeedna Waterhole • Curragundi Waterhole	• Brighton Waterhole • A portion of the Gingham Wetlands • Boyanga Waterhole	• Aid Blair Waterhole • Molladree Waterhole • Waterbird feeding and breeding habitat	
Native fish[37]	• carp gudgeon (P) • Murray-Darling rainbowfish (P) • Australian smelt (P)	• golden perch (P) • spangled perch (P) • silver perch (P) • bony herring (P)	• Murray cod (P) • olive perchlet (P) • purple spotted gudgeon (P)
Birds	66 water-dependent bird species recorded, including the listed[38] waterbird species:		
	• blue-billed duck • freckled duck • magpie goose • Australian painted snipe • common greenshank	• cattle egret • eastern great egret • black-necked stork • sharp-tailed sandpiper • marsh sandpiper	• brolga • gull-billed tern • Caspian tern • black-tailed godwit • Latham's snipe
Native vegetation	Eight water-dependent PCTs, including:		
	• river cooba wetlands • Lignum shrublands	• coolibah wetland woodlands • Coolibah woodlands	• water couch marsh grasslands • Typha tall grassland wetlands
Registered cultural assets	• Burial sites	• Modified trees	
Other species	• eastern sign-bearing froglet • eastern snake-necked turtle	• spotted grass frog	• Peron's tree frog
Unregulated WALs	There is one unregulated water access licences (WALs) for production of 1612 ML in the planning unit. The WAL is located adjacent to the Gingham watercourse.		

[37] 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)
[38] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

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[39]

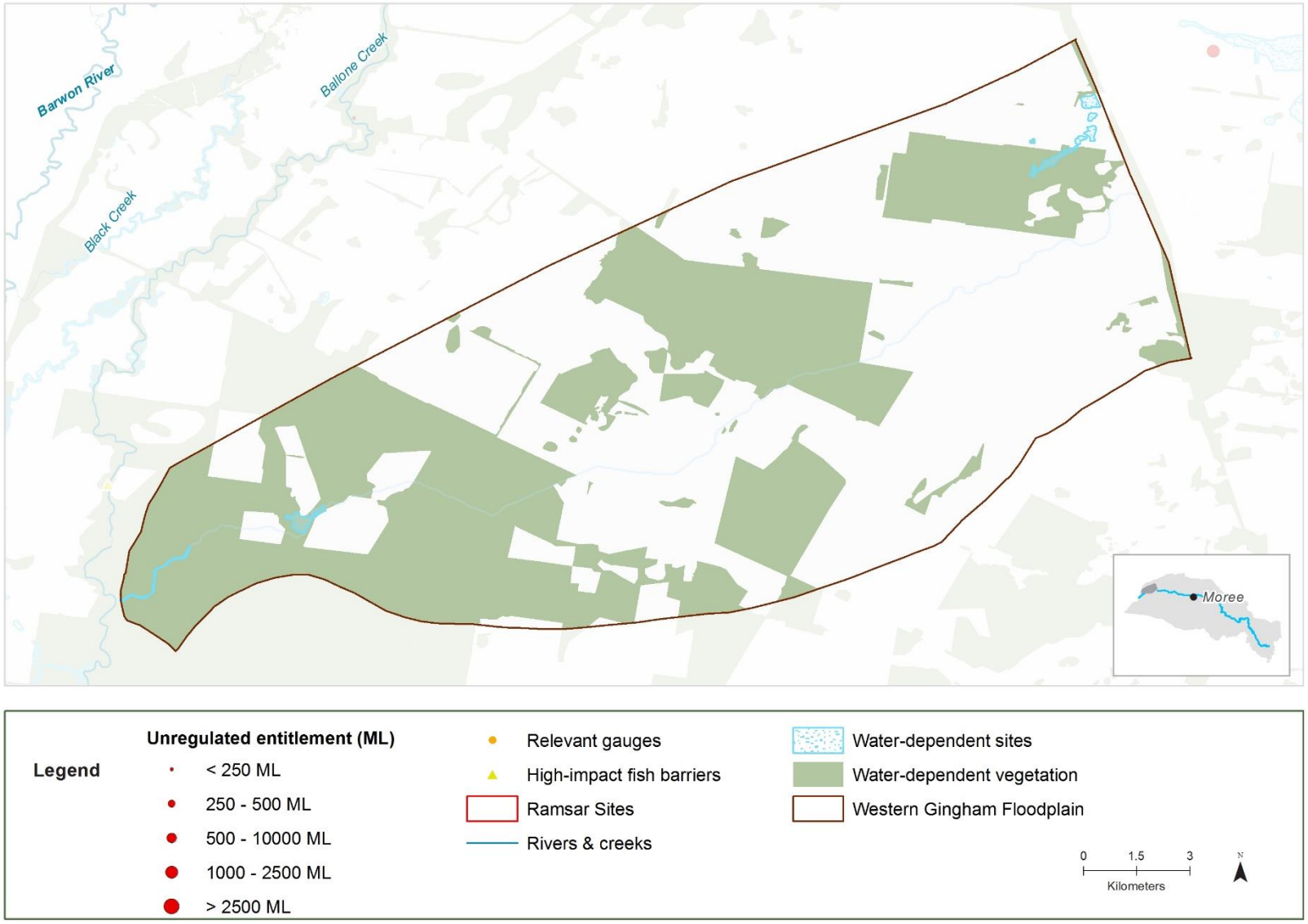
- Consider protection of water for the environment in this planning unit to protect ecologically important flows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years

Flow category[40]		Gauge[40]	Flow rate / volume[40]	Timing[40]	Minimum duration[40]	Frequency (LTA frequency)[40]	Maximum inter-event period[40]	Additional requirements and comments[40]
Cease-to-flow	CF1	Gingham @ Gingham Brd (418079)	0 ML/day	In line with historical low flow season, typically April to June	Events should not persist longer than 24 months[41]	CF event durations of more than 24 months should only occur once in 10 years	N/A	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	Gingham @ Gingham Brd (418079)	>3,000 ML event	Any time	1-4 months	8–10 years in 10 (90%)	1 year	These EWRs can be met by HEW or EWA in some years but cannot be met by HEW alone with the current volumes that are available and under current constraints. Flows >250 ML/day at Gwydir @ Tillaloo gauge are mainly dependent on the remaining natural events. Currently, HEW may be used to contribute to these flows if delivered in addition to natural events. Constraints need to be relaxed and remaining natural flows must be protected to meet these EWRs.
	WL2	Gingham @ Gingham Brd (418079)	>15,000 ML event	September to March (can occur any time)	1–4 months (2–8 months of asset inundation)	8–9 years in 10 (85%)	2 years	
Large wetland inundation	WL3	Gingham @ Gingham Brd (418079)	>20,000 ML event	October to April	1–4 months (2–6 months of asset inundation)	5–8 years in 10 (65%)	3 years	

[39] 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).
[40] See Glossary for definitions and explanatory text on how to interpret the EWR table.
[41] CF1 events are broken by wetland inundating flows (WL1)

Flow category[40]		Gauge[40]	Flow rate / volume[40]	Timing[40]	Minimum duration[40]	Frequency (LTA frequency)[40]	Maximum inter-event period[40]	Additional requirements and comments[40]
	WL4	Gingham @ Gingham Brd (418079)	>30,000 ML event	August to February (can occur any time)	1–4 months (2–3 months of asset inundation)	3–5 years in 10 (40%)	5 years	These EWRs cannot be met by HEW. Flows >2000 ML/day at Gwydir @ Yarraman gauge are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs.
Large Fresh	LF6	Gwydir @ Yarraman (418004)	>250,000 ML event	September to May (can occur any time)	1–2 months (3–8 months of asset inundation)	1–3 years in 10 (15%)	5 years	
Bankfull	BK1	Gwydir @ Yarraman (418004)	>50,000–60,000 ML/day	September to May (can occur any time)	1–2 days (3–8 months of asset inundation)	2–3 years in 10 (25%)	7 years	
Large overbank	OB5	Gwydir @ Yarraman (418004)	>60,000 ML/day	Any time	1 day (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 years	

PU11: Western Gingham Floodplain

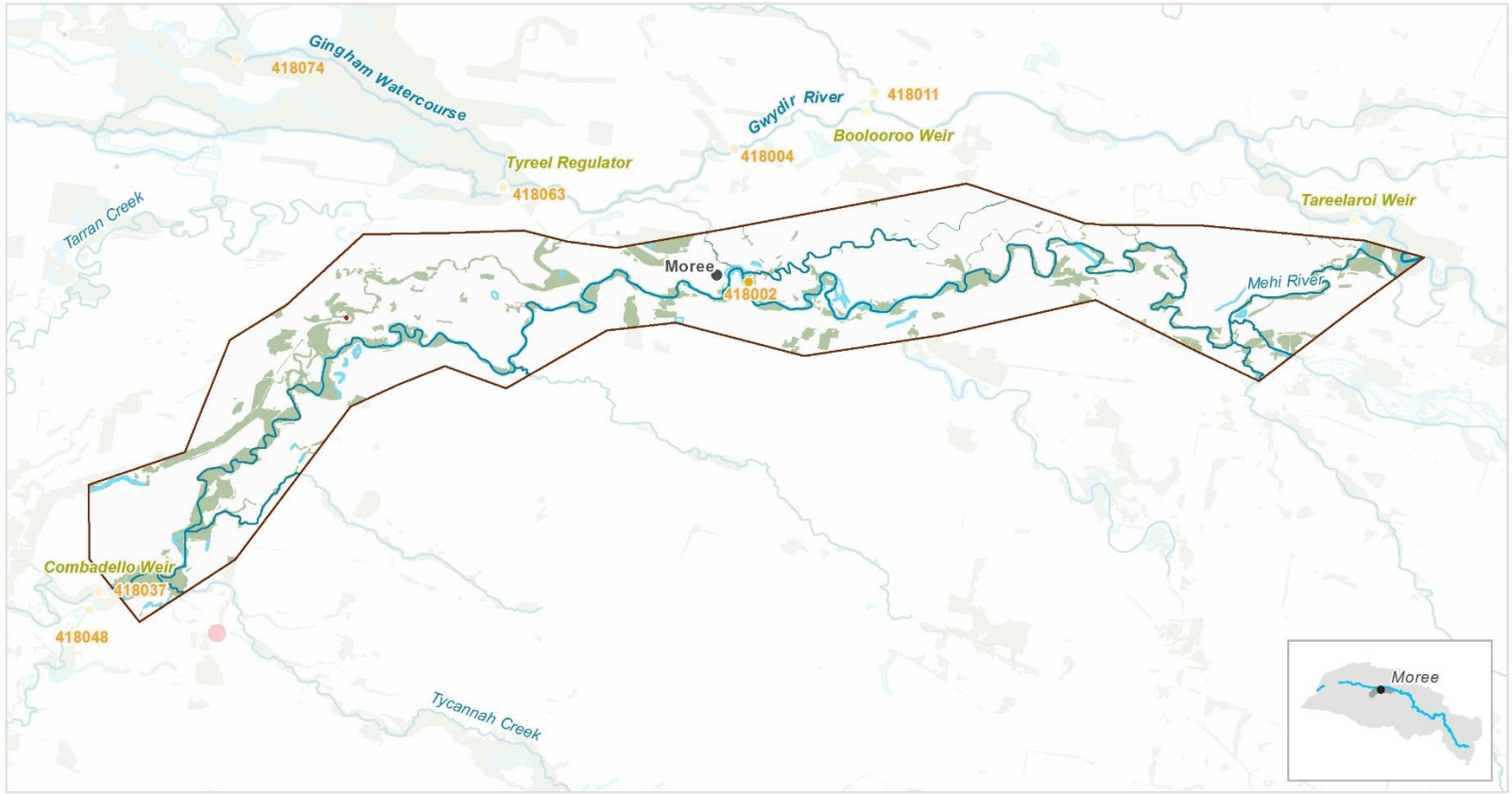


Priority environmental assets and values			
Floodplain vegetation communities associated with the Gingham watercourse			
Native fish[42]	• carp gudgeon (P) • Murray-Darling rainbowfish (P) • bony herring (P)	• spangled perch (P) • golden perch (P) • silver perch (P)	• Murray cod (P) • olive perchlet (P)
Birds	Five water-dependent birds recorded, including the listed[43] brolga		
Native vegetation	Six water-dependent PCTs, including: • black box woodland wetlands • River red gum woodlands	• coolibah woodlands and wetland woodlands	• water couch marsh grasslands
Registered cultural assets	None registered		
Other species	None recorded		

Flow category[44]		**Gauge**[44]	**Flow rate / volume**[44]	**Timing**[44]	**Minimum duration**[44]	**Frequency (LTA frequency)**[44]	**Maximum inter-event period**[44]	**Additional requirements and comments**[44]
Bankfull	BK1	Gwydir @ Yarraman (418004)	>50,000–60,000 ML/day	September to May (can occur any time)	1–2 days (3–8 months of asset inundation)	2–3 years in 10 (25%)	7 years	These EWRs cannot be met by HEW with the current volumes that are available and under current constraints. Flows >2000 ML/day at Gwydir @ Yarraman gauge are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs.
Large overbank	OB5	Gwydir @ Yarraman (418004)	>60,000 ML/day	Any time	1 day (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 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] See Glossary for definitions and explanatory text on how to interpret the EWR table.

PU12: Upper Mehi



Priority environmental assets and values			
Mehi River, associated in-channel habitat, and fringing and floodplain wetland vegetation communities, and water-dependent assets including, but not limited to:			
• Critical fish refuge	• Carlyle Lagoon		• Whittaker's Lagoon
Native fish[45]	• unspecked hardyhead • carp gudgeon • Murray-Darling rainbowfish • spangled perch	• golden perch • silver perch (P) • Murray cod • bony herring	• Australian smelt • freshwater catfish • olive perchlet (P) • purple spotted gudgeon (P)
Birds	51 water-dependent bird species recorded, including the listed[46] waterbird species:		
	• black-necked stork • sharp-tailed sandpiper	• magpie goose • cattle egret	• eastern great egret
Native vegetation	11 water-dependent PCTs, including river red gum woodlands, coolibah woodlands		
Registered cultural assets	• Modified trees	• Camping areas	• Habitation structure
Other species	• eastern sign-bearing froglet • eastern snake-necked turtle • spotted grass frog	• broad-palmed frog • salmon striped frog	• Peron's tree frog • water rate
Unregulated WALs	There is one unregulated water access licences (WALs) for production of 40 ML in the planning unit. The WAL is located downstream of Moree on Greenbah Creek, which flows into the Mehi.		

[45] 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)

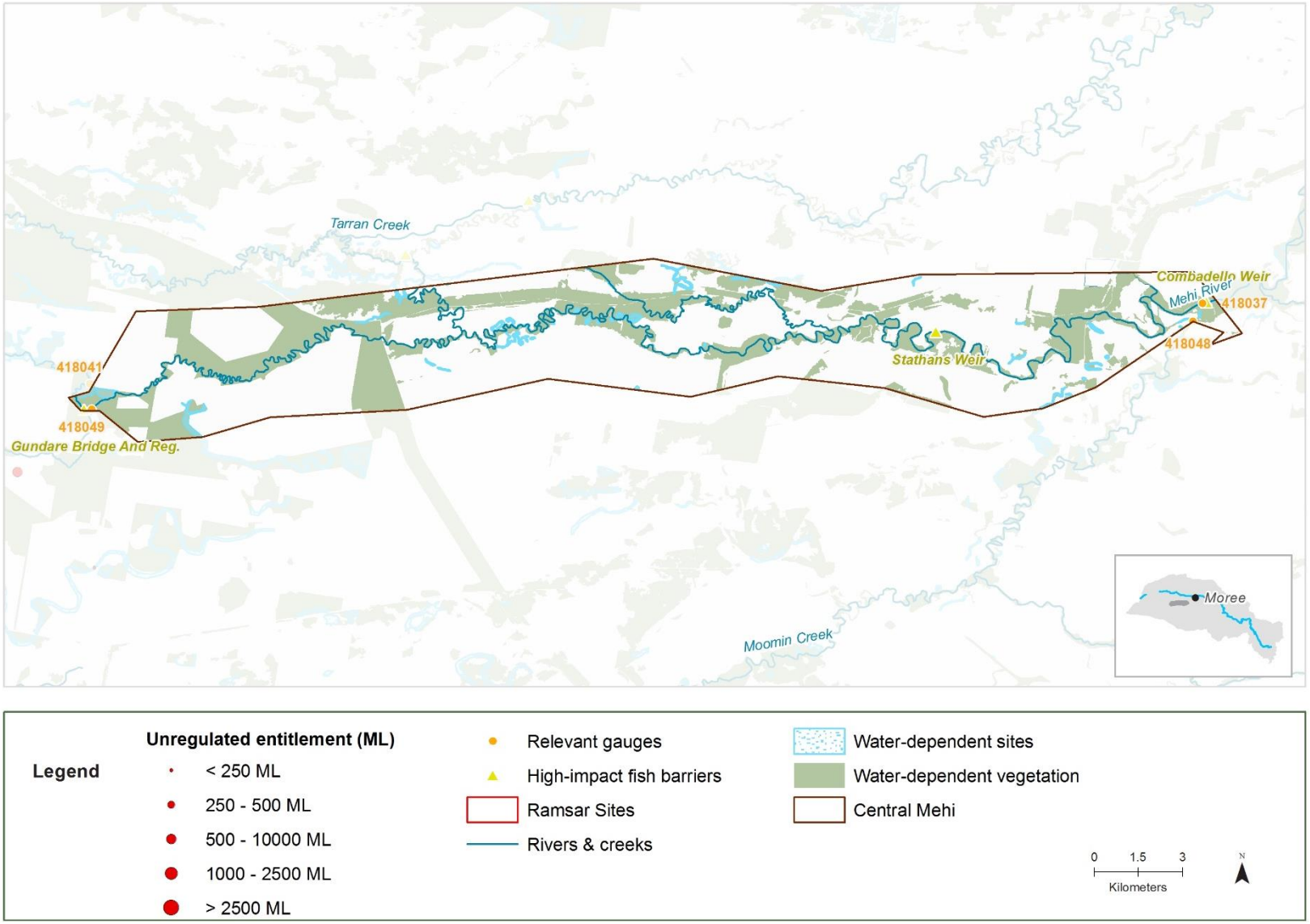
[46] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Flow category[47]		Gauge[47]	Flow rate /volume[47]	Timing[47]	Minimum duration[47]	Frequency (LTA frequency)[47]	Maximum inter-event period[47]	Additional requirements and comments[47]
Cease-to-flow[48]	CF1	Mehi @ Moree (418002)	0 ML/day	In line with historical low flow season, typically April to June	Maximum of 40–60 days (hot conditions) or 60–80 days (cooler conditions)	CF event durations of more than 80 days should never be exceeded	N/A	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[48]	VF1	Mehi @ Moree (418002)	>20 ML/day	Any time	330 days per year (140 days per year in very dry years)	N/A	N/A	
Baseflow[48]	BF1	Mehi @ Moree (418002)	>130 ML/day	Any time	200 days per year (80 days per year in very dry years)	N/A	1 year	
	BF2	Mehi @ Moree (418002)	>130 ML/day	September to March	160 days per year (60 days per year in very dry years)	5–10 years in 10 (75%)	2 years	
Small fresh[48]	SF1	Mehi @ Moree (418002)	>345 ML/day	October to April (can occur any time)	10 days	Annual (100%)	1 year	These EWRs may not be able to be met by HEW. Flows >3,000 ML/day are dependent on the remaining natural events. At the smaller range of flows, current volumes of HEW may be used to contribute to these flows if delivered in addition to irrigation deliveries in higher irrigation delivery years, or natural events.
	SF2	Mehi @ Moree (418002)	345–2,800 ML/day	September to April	14 days	5–10 years in 10 (75%)	2 years	

[47] See Glossary for definitions and explanatory text on how to interpret the EWR table.
[48] These EWRs are based on the current conditions of the Mehi, and not attempting to reinstate natural conditions as the environment has changed to adapt to river regulation

Flow category[47]		Gauge[47]	Flow rate /volume[47]	Timing[47]	Minimum duration[47]	Frequency (LTA frequency)[47]	Maximum inter-event period[47]	Additional requirements and comments[47]
Large fresh[48]	LF1	Mehi @ Moree (418002)	>2,800 ML/day	July to September (can occur any time)	5 days	5–10 years in 10 (75%)	2 years	These EWRs rely on large natural flows cannot be met by HEW. Flows >3,000 ML/day at Mehi @ Moree are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs. This large overbank will also result in large overbank events in downstream planning units.
	LF2	Mehi @ Moree (418002)	>2,800 ML/day	October to April	5 days	3–5 years in 10 (40%)	4 years	
	LF3	Mehi @ Moree (418002)	>10,000 ML/day	August to February (can occur any time)	1-5 days (2–3 months of asset inundation)	3–5 years in 10 (40%)	7 years	
Large overbank[48]	OB5	Mehi @ Moree (418002)	>20,000-30,000 ML/day	Any time	1–2 days (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 years	

PU13: Central Mehi



Priority environmental assets and values			
Mehi River, associated in-channel habitat, and fringing and floodplain wetland vegetation communities and water-dependent assets including, but not limited to: • Critical fish refuge in upstream sections • Cobban Lagoon • Minnaminane Waterhole • Coolibah Waterholes			
Native fish[49]	• unspecked hardyhead (P) • Australian smelt • Murray-Darling rainbowfish • spangled perch	• carp gudgeon • golden perch (P) • silver perch (P) • bony herring	• Murray cod • freshwater catfish (P) • olive perchlet (P) • purple spotted gudgeon (P)
Birds	39 water-dependent bird species recorded, including the listed[50] waterbird species: eastern great egret and Latham's snipe		
Native vegetation	11 water-dependent PCTs, including: • river red gum woodlands	• coolibah woodlands	
Registered cultural assets	• Modified trees	• Camping areas	
Other species	• eastern snake-necked turtle	• broad-palmed frog • Peron's tree frog	• spotted grass frog

[49] 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)

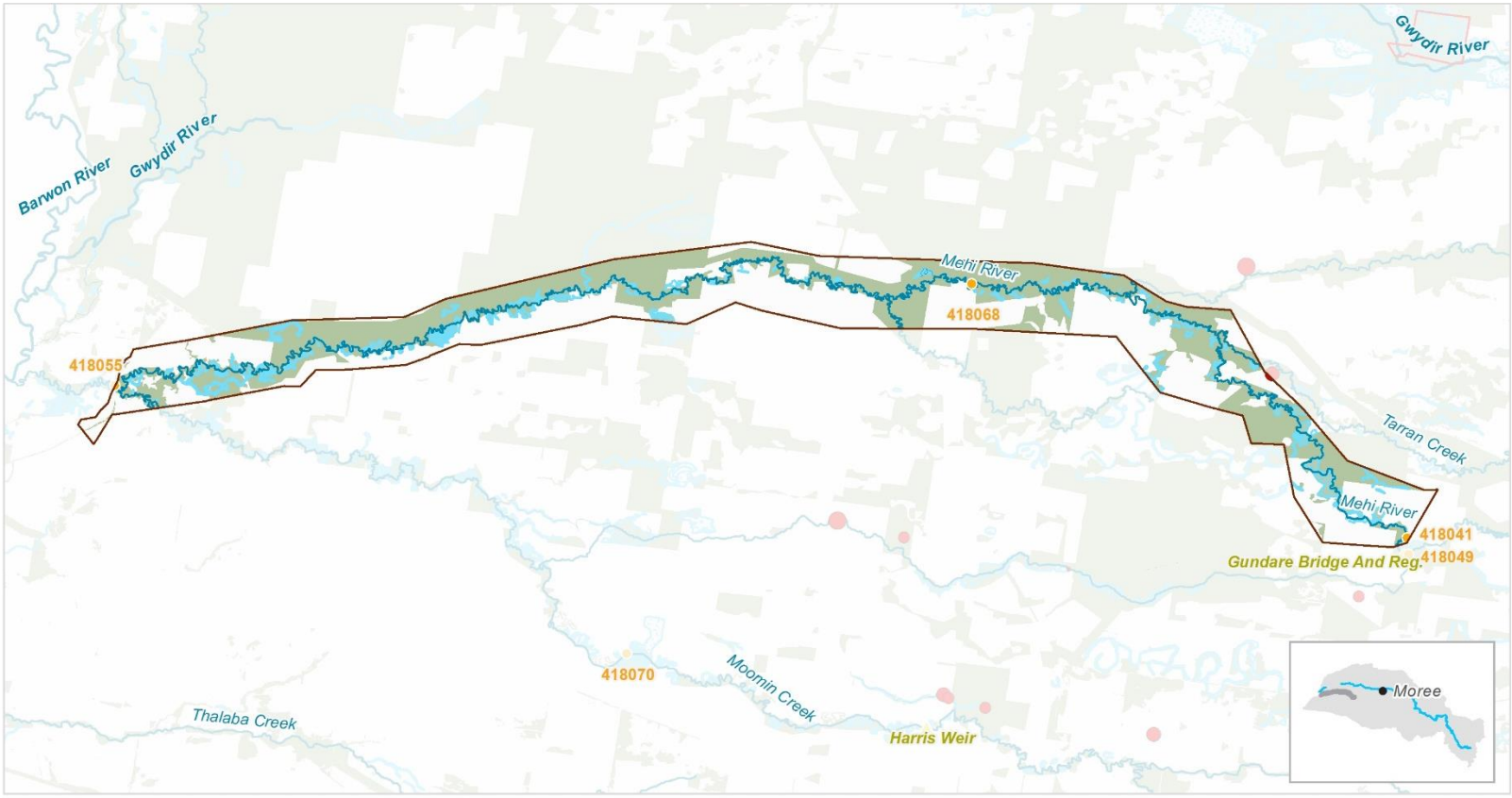
[50] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Flow category[51]		Gauge[51]	Flow rate /volume[51]	Timing[51]	Minimum duration[51]	Frequency (LTA frequency)[51]	Maximum inter-event period[51]	Additional requirements and comments[51]
Cease-to-flow[52]	CF1	Mehi DS Combadello (418037)	0 ML/day	In line with historical low flow season, typically April to June	Maximum of 40–60 days (hot conditions) or 60–80 days (cooler conditions)	CF event durations of 80 days should never be exceeded	N/A	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[52]	VF1	Mehi DS Combadello (418037)	10 ML/day	Any time	280 days per year (or 60 days per year in very dry years)	N/A	N/A	
Baseflow[52]	BF1	Mehi DS Combadello (418037)	>80 ML/day	Any time	180 days per year (or 65 days per year in very dry years)	N/A	1 year	
	BF2	Mehi DS Combadello (418037)	>80 ML/day	September to March	140 days per year (or 30 days per year in very dry years)	5–10 years in 10 (75%)	2 years	
Small fresh[52]	SF1	Mehi DS Combadello (418037)	>220 ML/day	October to April (can occur any time)	10 days	Annual (100%)	1 year	These EWRs can be met with current volumes of HEW. Some may be met by addition of HEW to irrigation deliveries and PEW at flows <2,200 ML/day.
	SF2	Mehi DS Combadello (418037)	220–1,500 ML/day	September to April	14 days	5–10 years in 10 (75%)	2 years	

[51] See Glossary for definitions and explanatory text on how to interpret the EWR table.
[52] These EWRs are based on the current conditions of the Mehi, and not attempting to reinstate natural conditions as the environment has changed to adapt to river regulation

Flow category[51]		Gauge[51]	Flow rate /volume[51]	Timing[51]	Minimum duration[51]	Frequency (LTA frequency)[51]	Maximum inter-event period[51]	Additional requirements and comments[51]
Large fresh[52]	LF1	Mehi DS Combadello (418037)	>1,500 ML/day	July to September (can occur any time)	5 days	5–10 years in 10 (75%)	2 years	These EWRs may not be able to be met by HEW. Flows >2,200 ML/day are dependent on the remaining natural events. Currently, at the smaller range of flows, HEW may be used to contribute to these flows if delivered in addition to irrigation deliveries in higher irrigation delivery years, or natural events (PEW).
	LF2	Mehi DS Combadello (418037)	>1,500 ML/day	October to April	5 days	3–5 years in 10 (40%)	4 years	
	LF6	Mehi @ Moree (418002)	>150,000 ML event	September to May (can occur any time)	1–2 months (3–8 months of asset inundation)	2–3 years in 10 (25%)	5 years	These EWRs cannot be met by HEW. Flows >3,000 ML/day at Mehi @ Moree are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs. These larger events will also result in large overbank events in downstream planning units.
Large overbank[52]	OB5	Mehi @ Moree (418002)	>20,000–30,000 ML/day	Any time	1–2 days (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 years	

PU14: Lower Mehi



Priority environmental assets and values			
Mehi River, associated in-channel habitat, and fringing and floodplain wetland vegetation communities			
Native fish[53]	• carp gudgeon • Murray-Darling rainbowfish • spangled perch • Australian smelt	• bony herring • silver perch • Murray cod	• olive perchlet (P) • golden perch • purple spotted gudgeon (P)
Birds	39 water-dependent bird species recorded including the listed[54] eastern great egret		
Native vegetation	11 water-dependent PCTs, including: • river red gum woodlands • coolibah woodlands and coolibah wetland woodlands	• black box woodland wetlands	• lignum shrubland wetlands
Registered cultural assets	• Modified trees	• Ceremonial rings	
Other species	• eastern sign-bearing froglet • eastern snake-necked turtle	• spotted grass frog • broad-palmed frog	• Peron's tree frog

[53] 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)

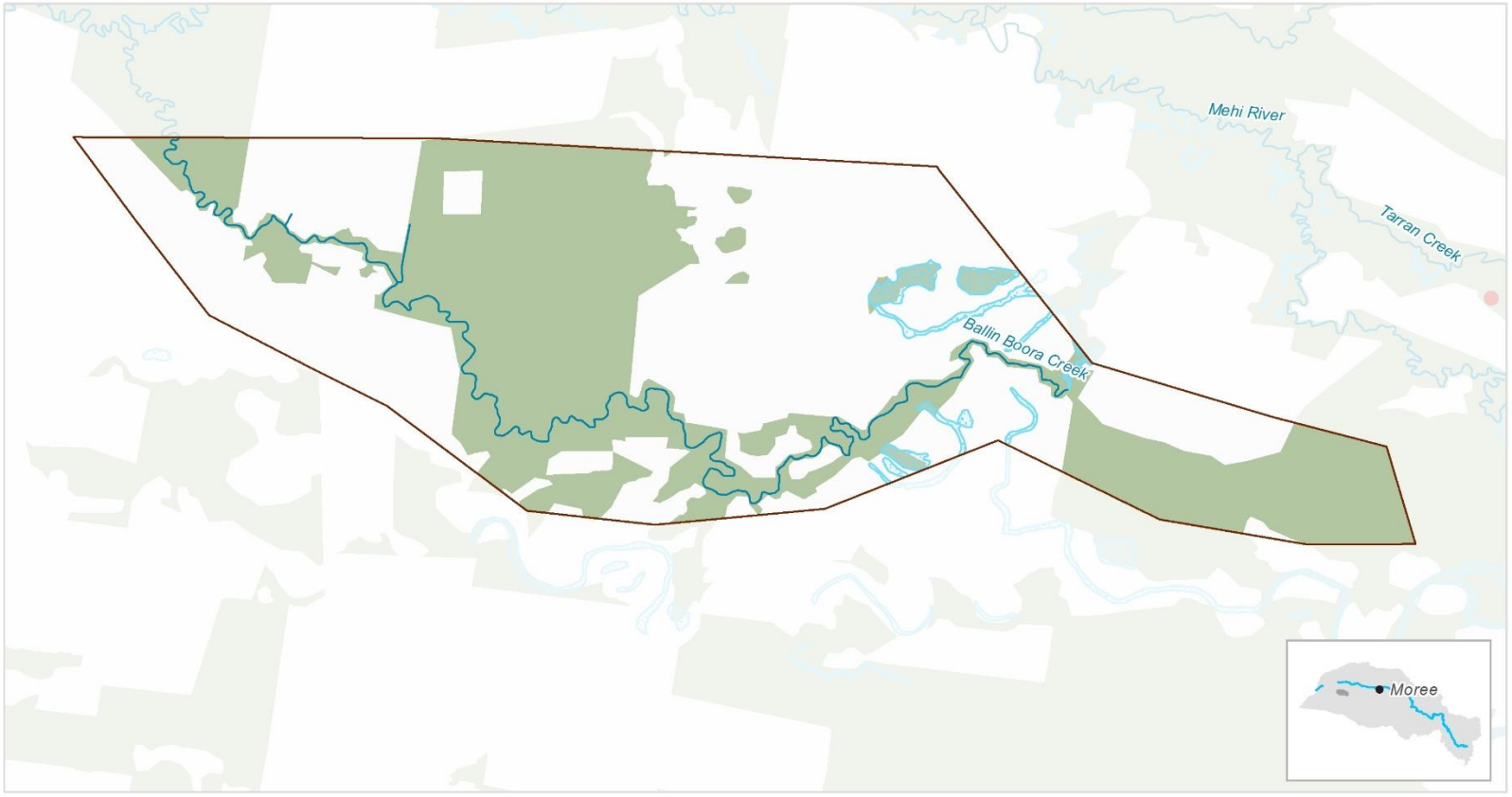
[54] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Flow category[55]		Gauge[55]	Flow rate /volume[55]	Timing[55]	Minimum duration[55]	Frequency (LTA frequency)[55]	Maximum inter-event period[55]	Additional requirements and comments[55]
Cease-to-flow[56]	CF1	Mehi @ Collarenebri (418055)	0 ML/day	In line with historical low flow season, typically April to June	CF events should not persist longer than 100 days	CF event durations of more than 100 days should occur in no more than 15% of years	N/A	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[56]	BF1	Mehi near Collarenebri (418055)	>40 ML/day	Any time	130 days per year (or 40 days in very dry years)	N/A	N/A	
	BF2	Mehi near Collarenebri (418055)	>40 ML/day	September to March	110 days per year (30 days per year in very dry years)	5–10 years in 10 (75%)	2 years	
Small fresh[56]	SF1	Mehi DS Gundare (418085)	>100 ML/day	October to April (can occur any time)	10 days	Annual (100%)	1 year	These EWRs can be met with current volumes of HEW. HEW can contribute to flows <1,000 ML/day if delivered in addition to irrigation deliveries and PEW.
	SF2	Mehi DS Gundare (418085)	100–850 ML/day	September to April	14 days	5–10 years in 10 (75%)	2 years	
	SF3	Mehi near Collarenebri (418055)	>90 ML/day	October to April (can occur any time)	10 days	Within 12 months following LF5	4 years	
Large fresh[56]	LF1	Mehi DS Gundare (418085)	>850 ML/day	July to September (can occur any time)	5 days	5–10 years in 10 (75%)	2 years	These EWRs may not be able to be met by HEW alone. Currently, at the smaller range of flows, HEW may be used to contribute to these flows if delivered in addition to irrigation deliveries in higher irrigation delivery years, or
	LF2	Mehi DS Gundare (418085)	>850 ML/day	October to April	5 days	3–5 years in 10 (40%)	4 years	

[55] See Glossary for definitions and explanatory text on how to interpret the EWR table.
[56] These EWRs are based on current conditions of the Mehi, and aren't attempting to reinstate natural conditions as the environment has changed to adapt to river regulation

Flow category[55]		Gauge[55]	Flow rate /volume[55]	Timing[55]	Minimum duration[55]	Frequency (LTA frequency)[55]	Maximum inter-event period[55]	Additional requirements and comments[55]
	LF5	Mehi near Collarenebri (418055)	>800 ML/day	July to September (can occur any time)	5 days	Triggered when LF1 at Barwon @ Collarenebri is detected within 18 months of LF2 at Darling @ Wilcannia	4 years	PEW. Flows >1,000 ML/day are dependent on the remaining natural events. Remaining natural flows must be protected to ensure the higher range of flows can occur in the system.
	LF6	Mehi @ Moree (418002)	>150,000 ML event	September to May (can occur any time)	1–2 months (3–8 months of asset inundation)	2–3 years in 10 (25%)	5 years	These EWRs cannot be met by HEW with the current volumes that are available and under current constraints. Flows >3,000 ML/day at Mehi @ Moree are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs. These larger events will also result in large overbank events in downstream planning units.
Large overbank[56]	OB5	Mehi @ Moree (418002)	>20,000–30,000 ML/day	Any time	1–2 days minimum (1–6 months of asset inundation)	1 year in 10 (10%)	10 years	

PU15: Ballin Boora Creek



Priority environmental assets and values			
Ballin Boora Creek and associated floodplain wetland vegetation communities			
Native fish[57]	• carp gudgeon (P) • Murray-Darling rainbowfish (P)	• Australian smelt (P) • spangled perch (P) • bony herring (P)	• silver perch (P) • purple spotted gudgeon (P)
Birds	41 water-dependent bird species recorded, including the listed[58] waterbird species:		
	• black-necked stork • common greenshank	• cattle egret • eastern great egret • sharp-tailed sandpiper	• marsh sandpiper • magpie goose
Native vegetation	Five water-dependent PCTs, including:		
	• coolibah woodlands • riparian river cooba shrublands	• lignum shrublands • cumbungi riparian wetlands	• river redgum woodlands
Registered cultural assets	None registered		
Other species	None recorded		

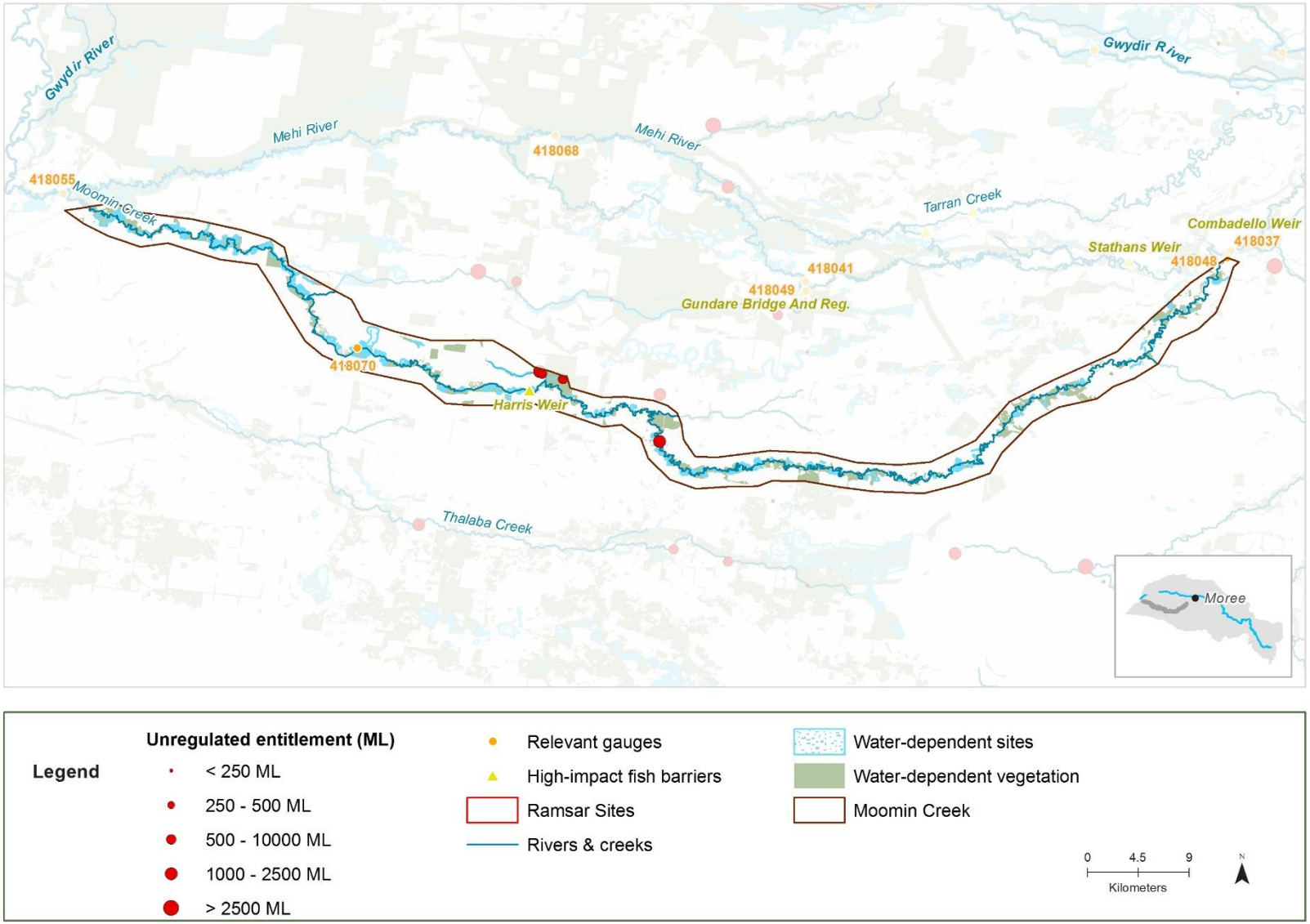
[57] Native fish species recorded in the planning unit via catch records and/or Australian Museum Records where they exist. Species marked with a (P) are expected to occur in the planning unit based on MaxEnt modelling with a minimum 33% probability of occurrence (Richies et al. 2016)

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

Flow category[59]		Gauge[59]	Flow rate / volume[59]	Timing[59]	Minimum duration[59]	Frequency (LTA frequency)[59]	Maximum inter-event period[59]	Additional requirements and comments[59]
Baseflow	BF1	No gauge (metered only)	600–1,200 ML event delivered at 20–50 ML/day via infrastructure	Any time	12–60 days	N/A	3 years	These flows must be delivered via infrastructure Depending on the objectives being targeted, flows do not need to be continuous and can be delivered across multiple events
Small overbank	OB1	Mehi US Ballin Boora (418068)	>3,000 ML event (>2,000 ML/day)	September to March (can occur any time)	1 day (2–8 months of asset inundation)	7–8 years in 10 (75%)	2 years	These EWRs are estimated to provide connectivity from the Mehi River into Ballin Boora Creek. They cannot be met by HEW. Flows >3,000 ML/day at Mehi @ Moree are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs.
	OB2	Mehi US Ballin Boora (418068)	>7,000 ML event (>2,000 ML/day)	October to April (can occur any time)	2 days (2–6 months of asset inundation)	4–7 years in 10 (55%)	3 years	
	OB3	Mehi US Ballin Boora (418068)	>21,000 ML event (>2,000 ML/day)	August to February (can occur any time)	5 days (2–3 months of asset inundation)	3–5 years in 10 (40%)	4 years	
Large overbank	OB5	Mehi @ Moree (418002)	>20,000–30,000 ML/day	Any time	1–2 days (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 years	

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

PU16: Moomin Creek



Priority environmental assets and values			
Moomin Creek, associated in-channel habitat, and fringing and floodplain wetland vegetation communities, and water-dependent assets including, but not limited to: • Coolibah Lagoon • Mongyer Lagoon			
Native fish[60]	• unspecked hardyhead (P) • Murray-Darling rainbowfish • freshwater catfish (P) • purple spotted gudgeon (P)	• golden perch • silver perch (P) • Murray cod • bony herring	• olive perchlet (P) • Australian smelt • spangled perch • carp gudgeon
Birds	39 water-dependent bird species recorded, including the listed[61] waterbird species: gull-billed tern and eastern great egret		
Native vegetation	13 water-dependent PCTs, including: • river red gum woodlands • black box woodland	• coolibah woodlands	• lignum shrublands
Registered cultural assets	• Modified trees	• Midden and open camp sites	
Other species	None recorded		
Unregulated WALs	The total volume of unregulated entitlements in the planning unit is 4120 ML. There are two unregulated WALs for production are between 500-1000 ML, and two are between 1000-2500 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[62] • Consider protection of water for the environment to protect connectivity between the Moomin and Mehi planning units in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years		

[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)

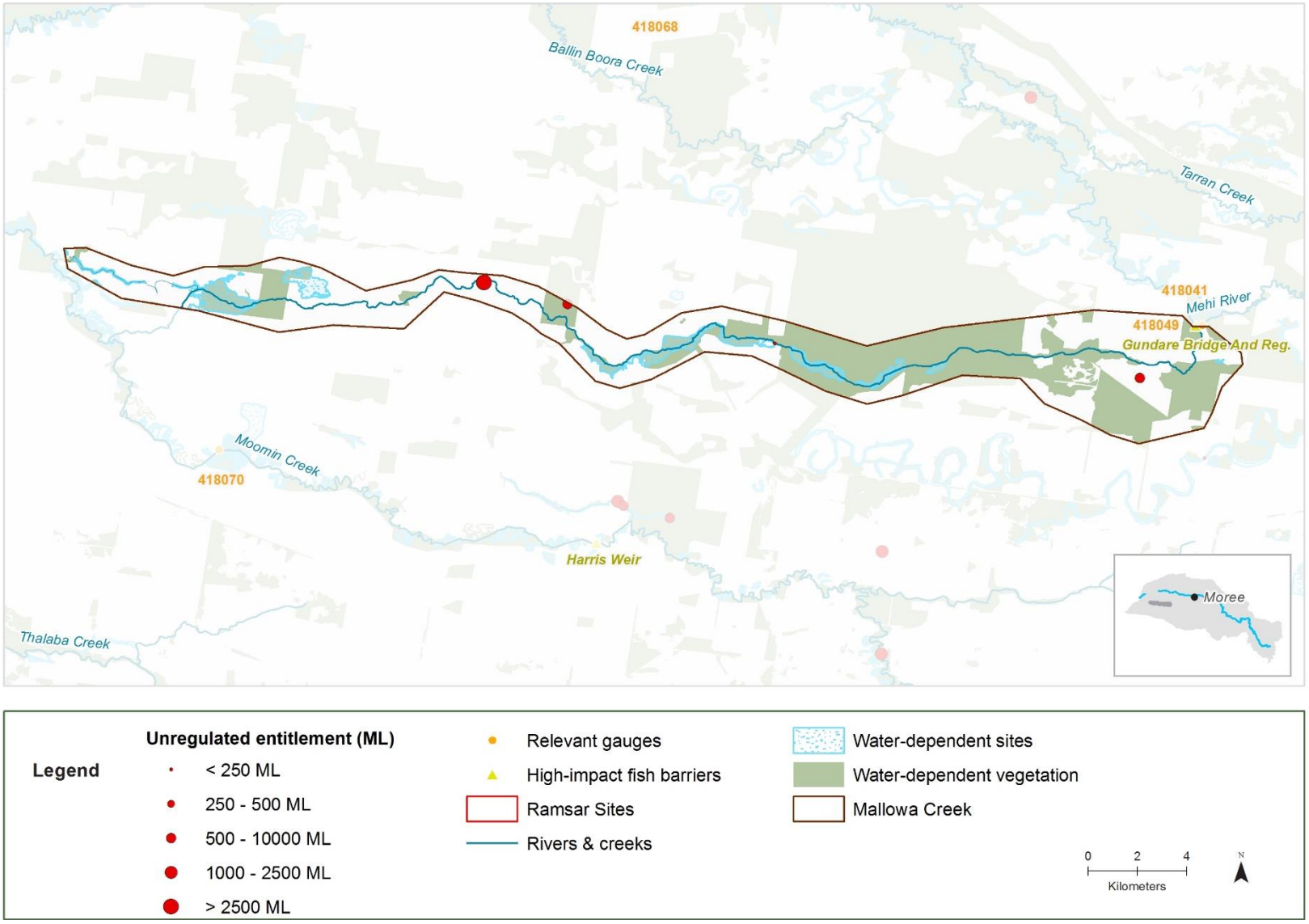
[62] In-line with the Basin Plan requirement for implementation of prerequisite policy measures that provide for delivered environmental water to be protected. It is also recommended by the Matthews reports (2017).

Flow category[63]		Gauge[63]	Flow rate / volume[63]	Timing[63]	Minimum duration[63]	Frequency (LTA frequency)[63]	Maximum inter-event period[63]	Additional requirements and comments[63]
Cease-to-flow	CF1	Moomin @ Moomin Plains (418070)	0 ML/day	In line with historical low flow season, typically April to June	CF events should not persist longer than 100 days	CF event durations of more than 100 days should occur in no more than 10% of years	N/A	When restarting flows, avoid 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. Flows should ideally be >0.03–0.05 m/s to prevent stratification of pools.
Baseflow	BF1	Moomin @ Combadello (418048)	>30 ML/day	Any time	205 days per year (70 days per year in very dry years)	N/A	N/A	
		Moomin @ Moomin Plains (418070)	>20 ML/day		120 days per year (or 25 days per year in very dry years)			
	BF2	Moomin @ Combadello (418048)	>30 ML/day	September to March	150 days per year (40 days per year in very dry years)	5–10 years in 10 (75%)	2 years	
		Moomin @ Moomin Plains (418070)	>20 ML/day		80 days per year (5 days per year in very dry years)			
Small fresh	SF1	Moomin @ Combadello (418048)	>80 ML/day	October to April (can occur any time)	10 days	Annual (100%)	1 year	These EWRs may be partially met with current volumes of HEW under current constraints in addition to irrigation deliveries and

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

Flow category[63]		Gauge[63]	Flow rate / volume[63]	Timing[63]	Minimum duration[63]	Frequency (LTA frequency)[63]	Maximum inter-event period[63]	Additional requirements and comments[63]
	SF2	Moomin @ Combadello (418048)	80–500 ML/day	September to April	14 days	5–10 years in 10 (75%)	2 years	PEW at flows <1,500 ML/day. Remaining natural flows must be protected to ensure the higher range of flows can occur in the system.
Large fresh	LF1	Moomin @ Combadello (418048)	>500 ML/day	July to September (can occur any time)	5 days	5–10 years in 10 (75%)	2 years	
	LF2	Moomin @ Combadello (418048)	>500 ML/day	October to April	5 days	3–5 years in 10 (40%)	4 years	
Small overbank	OB3	Moomin @ Combadello (418048)	>3,000 ML/day	August to February (can occur any time)	1–3 days (2–3 months of asset inundation)	3–5 years in 10 (40%)	4 years	These EWRs cannot be met by HEW. Flows >3,000 ML/day at Mehi @ Moree are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs. These overbanks will also result in large overbank events in downstream planning units.
Large overbank	OB5	Mehi @ Moree (418002)	>20,000–30,000 ML/day	Any time	1–2 days (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 years	

PU17: Mallowa Creek



Priority environmental assets and values			
Mallowa Creek, associated in-channel habitat, and fringing and floodplain wetland vegetation communities Wetland areas potentially capable of supporting colonial waterbird breeding			
Native fish[64]	• freshwater catfish (P) • Murray-Darling rainbowfish (P) • Australian smelt (P)	• spangled perch • golden perch (P) • bony herring • carp gudgeon (P)	• Murray cod (P) • olive perchlet (P) • silver perch (P)
Birds	42 water-dependent bird species recorded, including the listed[65] waterbird species: • Australian painted snipe	• cattle egret	• eastern great egret
Native vegetation	Six water-dependent PCTs, including: • river red gum woodlands • water couch marshlands • river cooba wetland	• coolibah woodlands and coolibah wetland woodlands	• Lignum shrublands • Spike rush mixed marshlands
Registered cultural assets	• Modified trees		
Other species	• eastern sign-bearing froglet	• broad-palmed frog	• spotted grass frog
Unregulated WALs	The total volume of unregulated entitlements in the planning unit is 3888 ML. There are two unregulated WALs for production are between 500-1000 ML, and one is >2500 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[66] • Consider protection of water for the environment to protect connectivity between the Mallowa and Moomin planning units in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years		

[64] 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)

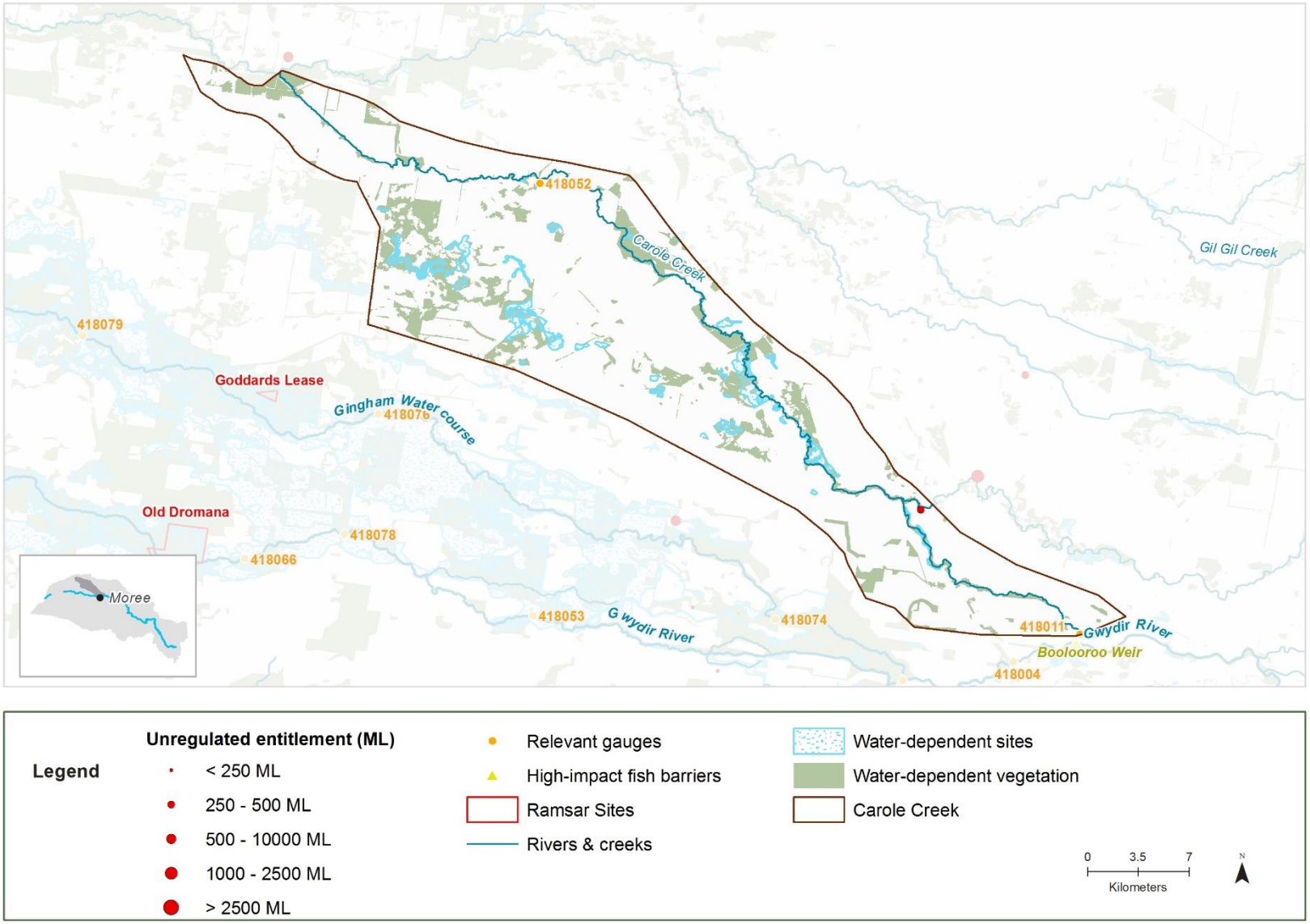
[65] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

[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[67]	Flow rate / volume[67]	Timing[67]	Minimum duration[67]	Frequency (LTA frequency)[67]	Maximum inter-event period[67]	Additional requirements and comments[67]
Cease-to-flow	CF1	Mallowa @ Regulator (418049)	0 ML/day	In line with historical low flow season, typically April to June	Events should not persist longer than 24 months	CF event durations of 24 months should only occur once in 10 years	N/A	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.
Small wetland inundation	WL1	Mallowa @ Regulator (418049)	>3,000 ML event	Any time	2–3 months	9–10 years in 10 (95%)	18 months	These EWRs may not be able to be met by HEW alone with the current volumes that are available and under current constraints. Flows >300 ML/day are dependent on the remaining natural events. Constraints need to be relaxed and remaining natural flows must be protected to meet these flows
	WL2	Mallowa @ Regulator (418049)	>8,000 ML event	September to March (can occur any time)	2–4 months (2–8 months of asset inundation)	7–9 years in 10 (80%)	2 years	
Large wetland inundation	WL3	Mallowa @ Regulator (418049)	>15,000 ML event	October to April	2–4 months (2–6 months of asset inundation)	5–7 years in 10 (60%)	3 years	
	WL4	Mallowa @ Regulator (418049)	>22,000 ML event	August to February (can occur any time)	2–6 months (2–3 months of asset inundation)	3–5 years in 10 (40%)	5 years	
Large overbank	OB5	Mehi @ Moree (418002)	>20,000–30,000 ML/day	Any time	1–2 days (1–6 months of asset inundation)	1 year in 10 (10%)	10-15 years	These EWRs cannot be met by HEW with the current volumes that are available and under current constraints. Flows >3,000 ML/day are dependent on the remaining natural events. Constraints need to be relaxed and remaining natural flows must be protected to meet these EWRs.

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

PU18: Carole Creek



Priority environmental assets and values			
Carole Creek, associated in-channel habitat, and fringing and floodplain wetland vegetation communities, and water-dependent assets including, but not limited to: • Boonoona Waterhole • Critical fish refuge		• Moorina Waterhole • Moorah Waterhole	
Native fish[68]	• unspecked hardyhead (P) • Murray-Darling rainbowfish • freshwater catfish (P)	• bony herring • Australian smelt • spangled perch	• golden perch • Murray cod • carp gudgeon
Birds	39 water-dependent bird species recorded, including the listed[69] waterbird species: • black-necked stork • brolga	• gull-billed tern	• cattle egret • eastern great egret
Native vegetation	Sixteen water-dependent PCTs, including: • river red gum woodlands • black box floodplain woodlands	• coolibah woodlands and coolibah wetland woodlands • lignum shrubland wetlands	• water couch marsh grasslands
Registered cultural assets	• Modified trees		
Other species	• eastern snake-necked turtle		

[68] 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)

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

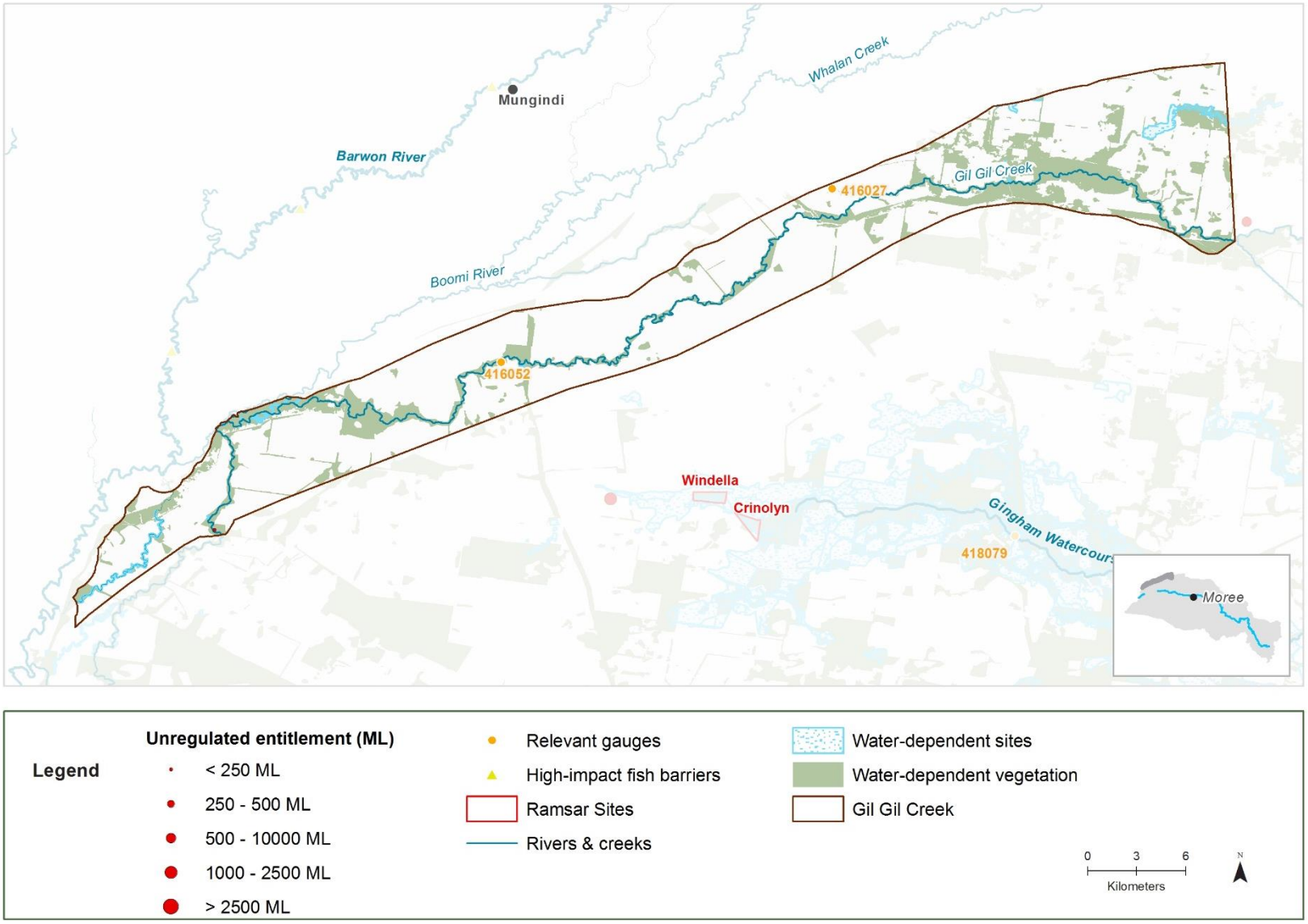
Flow category[70]		Gauge[70]	Flow rate / volume[70]	Timing[70]	Minimum duration[70]	Frequency (LTA frequency)[70]	Maximum inter-event period[70]	Additional requirements and comments[70]
Cease-to-flow[71]	CF1	Carole DS Regulator (418011)	0 ML/day	In line with historical low flow season, typically April to June	Maximum of 40–60 days (hot conditions) or 60–80 days maximum (cooler conditions)	CF event durations of more than 80 days should never be exceeded	N/A	When restarting flows, ensure a slow rate of rise and fall (in line with natural) to reduce 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[71]	VF1	Carole DS Regulator (418011)	20 ML/day	Any time	230 days per year (80 days per year in very dry years)	N/A	N/A	
Baseflow[71]	BF1	Carole near Garah (418052)	>70 ML/day	Any time	130 days per year (40 days per year in very dry years)	N/A	N/A	
	BF2	Carole near Garah (418052)	>70 ML/day	September to March	100 days per year (20 days per year in very dry years)	5–10 years in 10 (75%)	2 years	
Small fresh[71]	SF1	Carole near Garah (418052)	>200 ML/day	October to April (can occur any time)	10 days	Annual (100%)	1 year	These EWRs can be met with current volumes of HEW under current constraints in addition to irrigation deliveries and PEW at flows <1,500 ML/day. Remaining natural flows must be protected to ensure the higher range of flows can occur in the system.
	SF2	Carole near Garah (418052)	200-900 ML/day	September to April	14 days	5–10 years in 10 (75%)	2 years	
Large fresh[71]	LF1	Carole near Garah (418052)	>900 ML/day	July to September (can occur any time)	5 days	5–10 years in 10 (75%)	2 years	These EWRs may not be able to be met by HEW alone with the current volumes that are available and under current

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

[71] These EWRs are based on the current conditions of the Mehi, and not attempting to reinstate natural conditions as the environment has changed to adapt to river regulation

Flow category[70]		Gauge[70]	Flow rate / volume[70]	Timing[70]	Minimum duration[70]	Frequency (LTA frequency)[70]	Maximum inter-event period[70]	Additional requirements and comments[70]
	LF2	Carole near Garah (418052)	>900 ML/day	October to April	5 days	3–5 years in 10 (40%)	4 years	constraints. Flows >1,500 ML/day are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs.
Small overbank[71]	OB1	Carole near Garah (418052)	>2,000 ML/day	September to March (can occur any time)	1–2 days 2–8 months of asset inundation	7–8 years in 10 (75%)	2 years	These EWRs cannot be met by HEW with the current volumes that are available and under current constraints. Flows >1,500 ML/day are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs.
	OB2	Carole near Garah (418052)	>3,000 ML/day	October to April	10 days (6 months of asset inundation)	4–7 years in 10 (55%)	3 years	
	OB3	Carole near Garah (418052)	>5,000 ML/day	August to February (can occur any time)	5 days (2–3 months of asset inundation)	3–5 years in 10 (40%)	4 years	
Large overbank[71]	OB4	Carole near Garah (418052)	6,000 ML/day	September to May (can occur any time)	1–2 days (3–8 months of asset inundation)	2–3 years in 10 (25%)	5 years	
	OB5	Carole near Garah (418052)	160,000 ML event	Any time	3 months (1–6 months of asset inundation)	1 year in 10 (10%)	10–15 years	

PU19: Gil Gil Creek



Priority environmental assets and values			
Gil Gil Creek, associated in-channel habitat, and fringing and floodplain wetland vegetation communities, and water-dependent assets including, but not limited to: • Bengerang Waterhole • Gunnyanna Waterhole • Wadden Wadden Waterhole			
Native fish[72]	• carp gudgeon • Murray–Darling rainbowfish (P) • silver perch (P) • purple spotted gudgeon (P)	• spangled perch • golden perch • Australian smelt (P)	• Murray cod (P) • bony herring • freshwater catfish (P) • olive perchlet (P)
Birds	54 water-dependent bird species recorded, including the listed[73] waterbird species: • black-necked stork • brolga	• eastern great egret	• Latham's snipe
Native vegetation	18 water-dependent PCTs, including: • river red gum woodlands • lignum shrublands	• coolibah woodlands and coolibah wetland woodlands • black box woodland	• water couch marsh grasslands
Registered cultural assets	• Modified trees	• Fishing areas	• Ceremonial ring
Other species	None recorded		
Unregulated WALs	There is one unregulated water access licences (WALs) for production of 160 ML in the planning unit. The WAL is located on Ballone Creek, which eventually flows into the Gwydir watercourse and into Barwon 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 entering unregulated streams and off-channel pools (wetlands).[74] • Consider protection of water for the environment from the Carole Creek planning unit into the Gil Gil Creek planning unit to reduce impact on cease-to-flow and low flows and protect ecologically important flows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years		

[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)

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

[74] 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[75]		Gauge[75]	Flow rate / volume[75]	Timing[75]	Minimum duration[75]	Frequency (LTA frequency)[75]	Maximum inter-event period[75]	Additional requirements and comments[75]
Cease-to-flow	CF1	Gil Gil @ Galloway (416052)	0 ML/day	In line with historical low flow season, typically April to June	Events should not persist longer than 100 days	CF events durations of more than 100 days should occur in no more than 5% of years	N/A	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	BF1	Gil Gil @ Galloway (416052)	>25 ML/day	Any time	150 days per year (30 days per year in very dry years)	N/A	N/A	
	BF2	Gil Gil @ Galloway (416052)	>25 ML/day	September to March	115 days per year (25 days per year in very dry years)	5–10 years in 10 (75%)	2 years	
Small fresh	SF1	Gil Gil @ Weemalah (416027)	>160 ML/day	October to April (can occur any time)	10 days	Annual (100%)	1 year	These EWRs can be met with current volumes of HEW under current constraints in addition to irrigation deliveries and PEW at flows <1,000 ML/day at Gil Gil @ Weemalah gauge and <750 ML/day at Gil Gil @ Galloway. Remaining natural flows must be protected to ensure the higher range of flows can occur in the system.
	SF2	Gil Gil @ Weemalah (416027)	160–1,900 ML/day	September to April	14 days	5–10 years in 10 (75%)	2 years	
	SF3	Gil Gil @ Galloway (416052)	>45 ML/day	October to April (can occur any time)	10 days	Within 12 months following LF5	4 years	
Large fresh	LF1	Gil Gil @ Weemalah (416027)	>1,900 ML/day	July to September	5 days minimum	5–10 years in 10 (75%)	2 years	These EWRs cannot be met by HEW with the current volumes that are available

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

Flow category[75]		Gauge[75]	Flow rate / volume[75]	Timing[75]	Minimum duration[75]	Frequency (LTA frequency)[75]	Maximum inter-event period[75]	Additional requirements and comments[75]
				(can occur any time)				and under current constraints. Flows >1,000 ML/day at Gil Gil @ Weemalah gauge, >750 ML/day at Gil Gil @ Galloway, and >1,500 ML/day at Carole Creek DS Regulator are dependent on the remaining natural events. Remaining natural flows must be protected to meet these EWRs.
	LF2	Gil Gil @ Weemalah (416027)	>1,900 ML/day	October to April	5 days minimum	3–5 years in 10 (40%)	4 years	
	LF5	Gil Gil @ Galloway (416052)	>750 ML/day	July to September (can occur any time)	5 days minimum	Triggered when LF1 at Barwon @ Collarenebri is detected within 18 months of LF2 at Darling @ Wilcannia	4 years	
Small overbank	OB2	Gil Gil @ Weemalah (416027)	>3,700 ML/day	September to March (can occur any time)	1–4 days (2–8 months of asset inundation)	4–7 years in 10 (45%)	3 years	
	OB3	Gil Gil @ Weemalah (416027)	>10,000 ML/day	October to April	1–4 days (2–6 months of asset inundation)	3–5 years in 10 (33%)	4 years	
Large overbank	OB5	Gil Gil @ Weemalah (416027)	>20,000 ML/day	August to February (can occur any time)	1–5 days (2–3 months of asset inundation)	1 year in 10 (10%)	10 years	

3. Zone B planning units

Zone B PUs (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, and flows from upstream planning units to meet the water needs of the priority assets and functions they support.

Rules in the *Gwydir Unregulated River Water Sharing Plan* 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 *Gwydir Unregulated River Water Sharing Plan.*

3.1 Quantifying hydrological alteration and strategies for protecting ecologically significant flows

For each Zone B PU, information is presented on the hydrology[76] and the degree of alteration, as determined by DPIE–Water in their *Risk assessment for the Gwydir water resource plan area*, by comparing flows under near natural conditions (with no dams or water extractions) and flows under current conditions[77]. Table 1 describes how the hydrology changes are presented for each PU.

Recommendations have been suggested for each PU[78] to ensure important ecological flows are protected to maintain or improve priority assets and functions.[79]

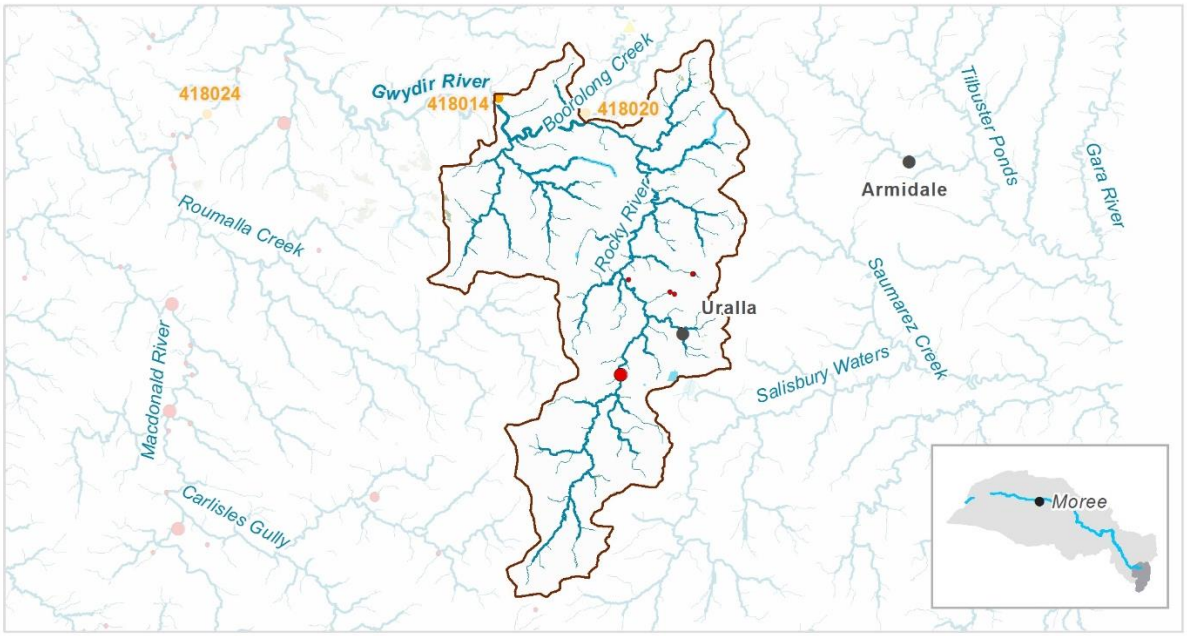
Table 1 Key to the degree of hydrological alteration used in this section.

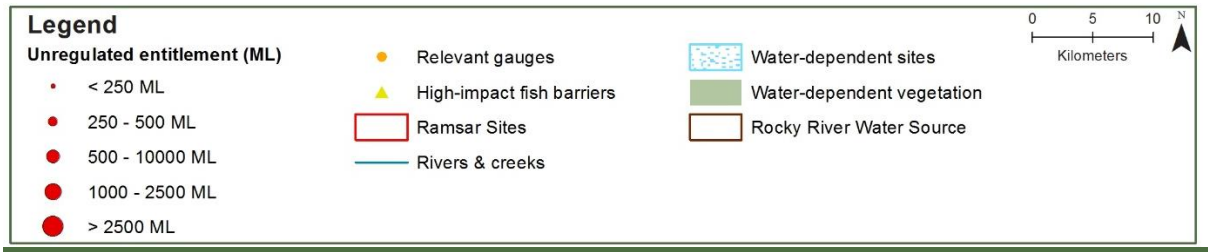
Key to hydrological alteration from *Risk assessment for the Gwydir water resource plan area* (NSW DPIE–Water 2019)
L= Low: less than 20% departure (+/-) from the base case for each hydrologic metric
M = Medium: 20-50% departure (+/-); from the base case for each hydrologic metric
H = High: greater than 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

[76] The hydrology is presented as percentiles and ARIs as determined by pre-development modelling.
[77] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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.
[78] 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.
[79] 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.

Figure 4 **Racecourse Lagoon near Glendarah in the Rocky River water source planning unit**
Photo: T. Cooke

PU20: Rocky River water source





Priority environmental assets and values

Rocky River and its associated in-channel habitat and fringing vegetation communities, and water-dependent assets including, but not limited to:

- Wilsons Creek
- Tolleys Gully
- Racecourse Lagoon
- Tributaries to Rocky River

Native fish[80]	• carp gudgeon • mountain galaxias • golden perch • river blackfish • Murray cod • freshwater catfish • purple spotted gudgeon (P) • Darling River hardyhead
Birds	73 water-dependent bird species recorded, including the listed[81] waterbird species: • sharp-tailed sandpiper • Latham's snipe • blue-billed duck • common greenshank • marsh sandpiper • cattle egret • eastern great egret
Native vegetation	Five water-dependent PCTs, including: river red gum woodlands, sedgeland fens wetlands and upland wetlands

[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	• eastern sign-bearing froglet • eastern snake-necked turtle • yellow-bellied sheathtail-bat • broad-palmed frog • Peron's tree frog • spotted grass frog • platypus • Bell's turtle

Hydrology[82]

Gauge: 418014 *Gwydir River at Yarrowick*	**80th percentile:** 1.9ML/day	**50th percentile:** 16.8ML/day	**20th percentile:** 98ML/day
	1.5 ARI: 6054.2ML/day	**2.5 ARI:** 9576.9ML/day	**5 ARI:** 22516.6ML/day

Summary of hydrological alteration

Cease-to-flow periods and low flows are moderately altered as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). 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 662.5 ML, of which 28 ML are unregulated water access licences (WALs) for production. There is one large (621 ML) stock and domestic WAL that exists on Kentucky Creek and three WALs for production <250 ML that are dispersed in the upper part of this planning unit.

The area is characterised by very low flows, and water is mainly diverted when the rainfall has been inadequate. This means that lower flows may be impacted by extraction (as confirmed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area*).

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[83]	M^+	M^-	L^-	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

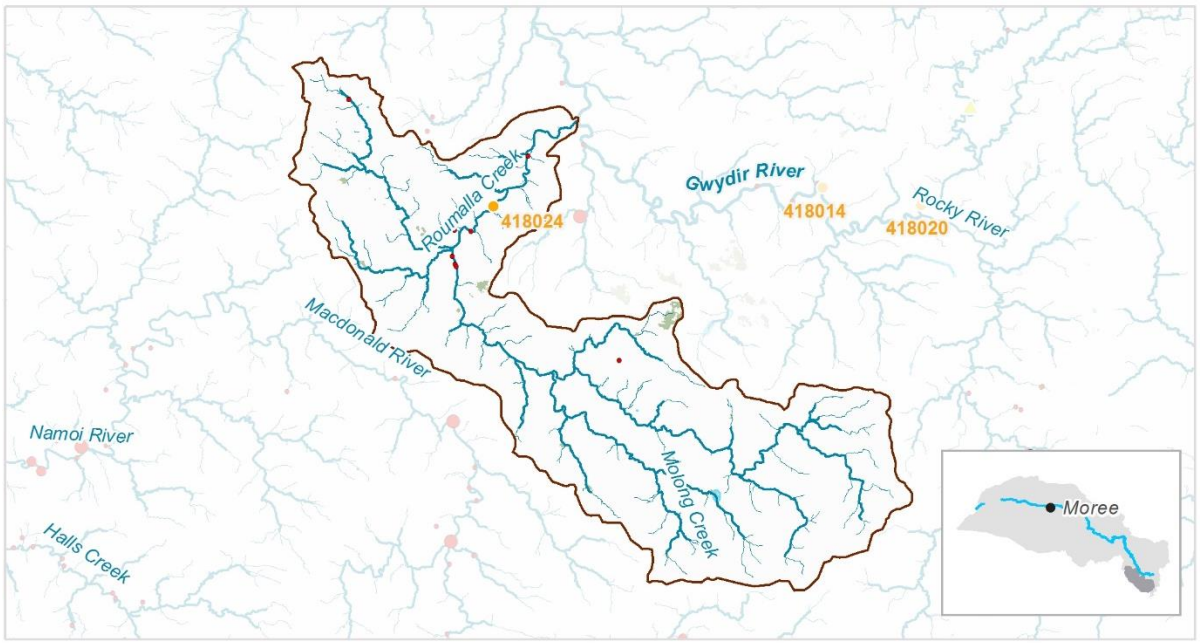
Recommendations

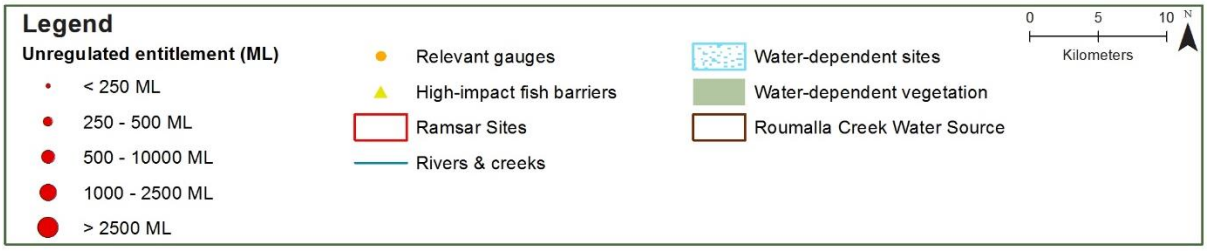
- Investigate opportunities to reduce length of cease-to-flow periods and extraction pressure on baseflows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years.
    - Consider rostering landholder water access during dry summer months.
    - Consider reviewing cease-to-pump rules to better protect low flows, especially during dry times or ecologically important months.
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[82] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[83] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU21: Roumalla Creek water source





Priority environmental assets and values		
Roumalla Creek and its associated in-channel habitat and fringing vegetation communities		
Native fish[84]	• carp gudgeon (P) • river blackfish (P)	• freshwater catfish (P) • purple spotted gudgeon (P)
Birds	32 water-dependent bird species recorded	
Native vegetation	Four water-dependent PCTs, including river red gum woodlands, sedgeland–forbland wetlands & sedgeland fens wetlands	
Registered cultural assets	None registered	
Other species	• eastern snake-necked turtle	• Bell's turtle

[84] 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)

Hydrology[85]			
Gauge: 418024 *Roumalla Creek at Kingstown*	**80th percentile:** 0.8ML/day	**50th percentile:** 14.3ML/day	**20th percentile:** 98.3ML/day
	1.5 ARI: 3427.2ML/day	**2.5 ARI:** 6171.6ML/day	**5 ARI:** 8362.7ML/day

Summary of hydrological alteration

Cease-to-flow periods are highly altered and low flows are moderately altered as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). 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 254 ML, of which 242 ML are unregulated water access licences (WALs) for production. There are eight WALs for production <250 ML that are distributed along Roumalla Creek.

The area is characterised by very low flows, and water is mainly diverted when the rainfall has been inadequate. This means that lower flows may be substantially impacted by extraction (as confirmed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area*).

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[86]	H^+	M^-	L^0	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

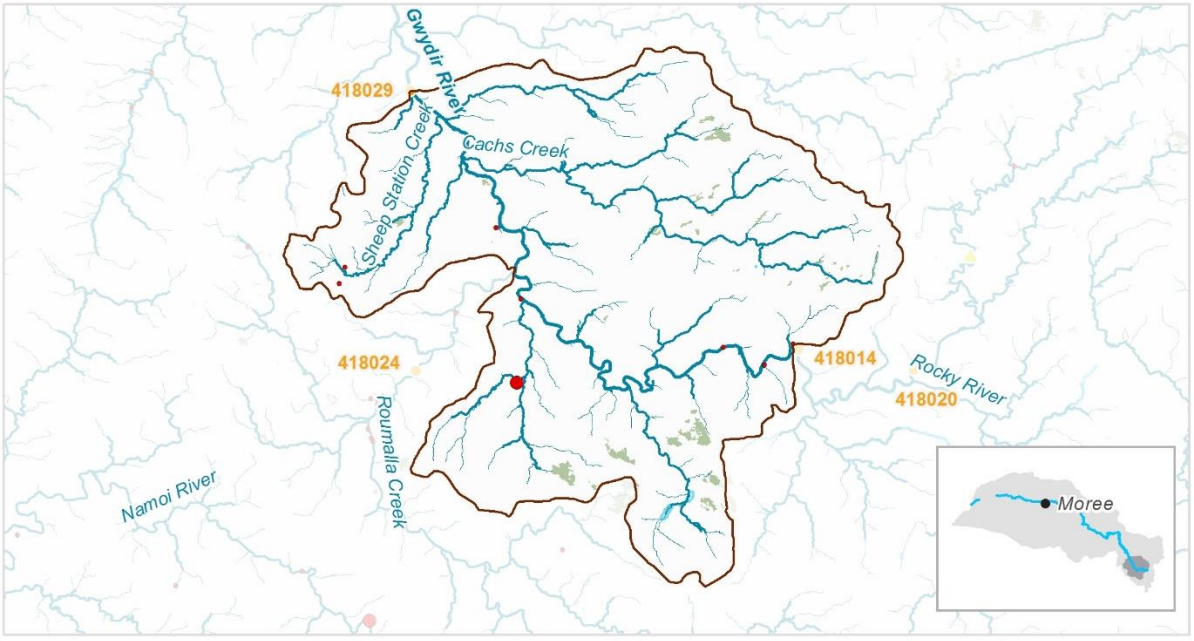
Recommendations

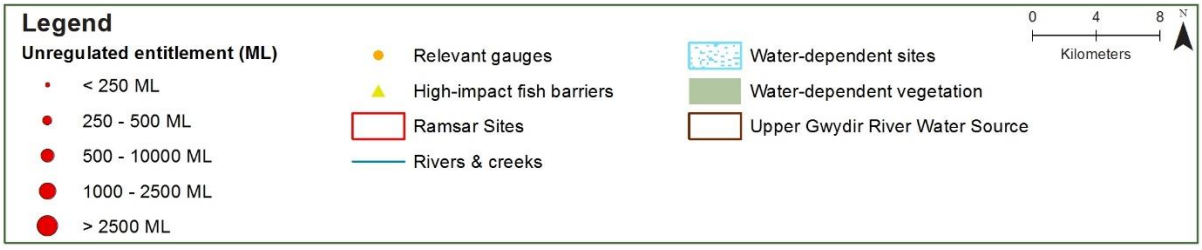
- Investigate opportunities to reduce length of cease-to-flow periods and extraction pressure on baseflows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years.
    - Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
    - Consider reviewing the cease-to-pump threshold
    - Consider rostering landholder water access
    - Consider Individual and/or Total Daily Extraction Limits (IDELS / TDELS)
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values
- Ensure compliance with water access licence conditions including through metering of all licensed extraction
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[85] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[86] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU22: Upper Gwydir River water source





Priority environmental assets and values

Gwydir River and its associated in-channel habitat and fringing vegetation communities, and water-dependent assets including, but not limited to:

- Tributaries to the Gwydir River

Native fish[87]	• Murray cod • carp–gudgeon • river blackfish (P)	• golden perch • freshwater catfish	• Australian smelt (P) • purple spotted gudgeon (P)
Birds	52 water-dependent bird species recorded, including the listed[88] waterbird species: blue-billed duck, Latham's snipe & eastern great egret		
Native vegetation	Three water-dependent PCTs, including river red gum woodlands & sedgeland fens wetlands		
Registered cultural assets	None registered		
Other species	• eastern sign-bearing froglet • eastern snake-necked turtle	• broad-palmed frog • water rat	• platypus • Bell's turtle

[87] 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)

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

Hydrology[89]			
Gauge: 418029 *Gwydir River at Stonybatter*	**80th percentile**: 4.6ML/day	**50th percentile**: 44.6ML/day	**20th percentile**: 285.3ML/day
	1.5 ARI: 12303.1ML/day	**2.5 ARI**: 23619.3ML/day	**5 ARI**: 40725.5ML/day

Summary of hydrological alteration

Cease-to-flow periods and low flows are highly altered as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). 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 1338.5 ML, of which 1311 ML are unregulated water access licences (WALs) for production. There are seven WALs for production <250 ML distributed throughout the Upper Gwydir River and one 1000ML WAL on Head Station Creek.

The area is characterised by low flows, and water is mainly diverted when the rainfall has been inadequate. This means that lower flows may be substantially impacted by extraction (as confirmed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area*).

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[90]	H+	H-	L-	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

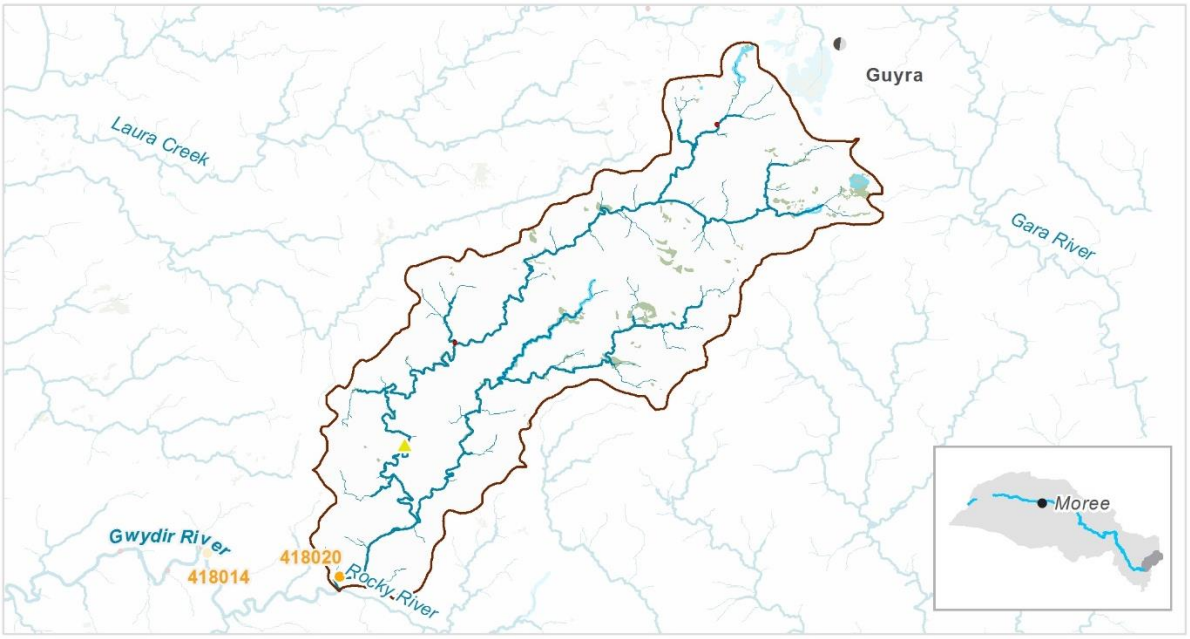
Recommendations

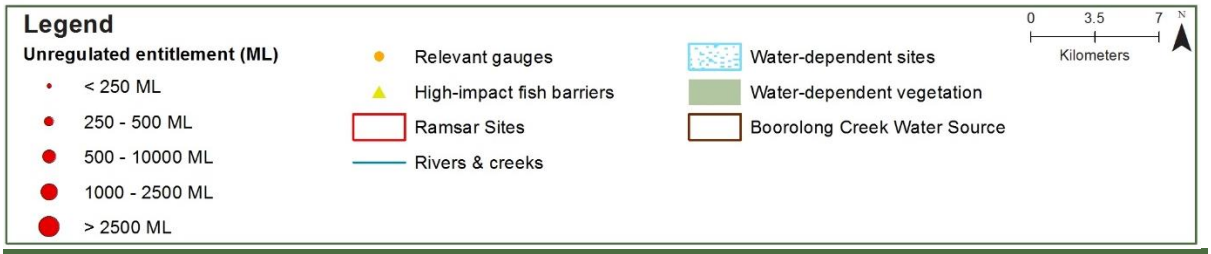
- Investigate opportunities to reduce length of cease-to-flow periods and extraction pressure on baseflows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years
  - Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
  - Consider reviewing the cease-to-pump threshold
  - Consider installing water level gauges at or near extraction sites
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[89] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[90] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU23: Boorolong Creek water source





Priority environmental assets and values

Boorolong Creek and its associated in-channel habitat and fringing vegetation communities, and water-dependent assets including, but not limited to:

- Toms Creek
- Tributaries to Boorolong Creek

Native fish[91]	• carp gudgeon (P) • mountain galaxias • freshwater catfish (P) • northern river blackfish • Murray cod (P) • purple spotted gudgeon (P) • Darling River hardyhead (P)
Birds	28 water-dependent bird species recorded, including the listed[92] magpie goose
Native vegetation	Five water-dependent PCTs, including: • river red gum woodlands • heath swamps • sedgeland fens wetlands • upland wetlands
Registered cultural assets	None registered
Other species	• spotted grass frog

[91] 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)

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

Hydrology[93]			
Gauge: 418020 *Boorolong Creek*	**80th percentile**: 0ML/day	**50th percentile**: 6.3ML/day	**20th percentile**: 59ML/day
	1.5 ARI: 3328.8ML/day	**2.5 ARI**: 4235.1ML/day	**5 ARI**: 5526ML/day

Summary of hydrological alteration

Baseflows are moderately altered, as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–WATER 2019). They currently occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 231 ML, of which 225 ML are unregulated water access licences (WALs) for production. There are three unregulated WALs for production <250 ML distributed along Boorolong Creek.

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

	Cease-to-flow	**Low flow and Baseflow**	**Freshes**	**High and infrequent flows**		
				1.5 ARI	**2.5 ARI**	**5 ARI**
Hydrological alteration[94]	L^0	M^-	L^-	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

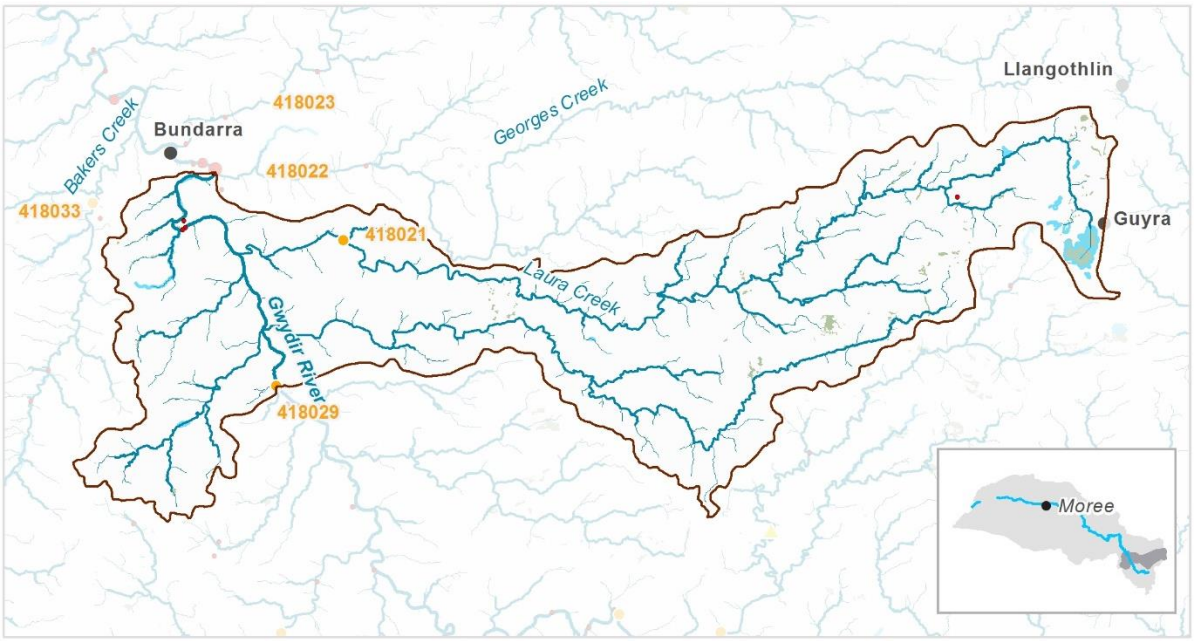
Recommendations

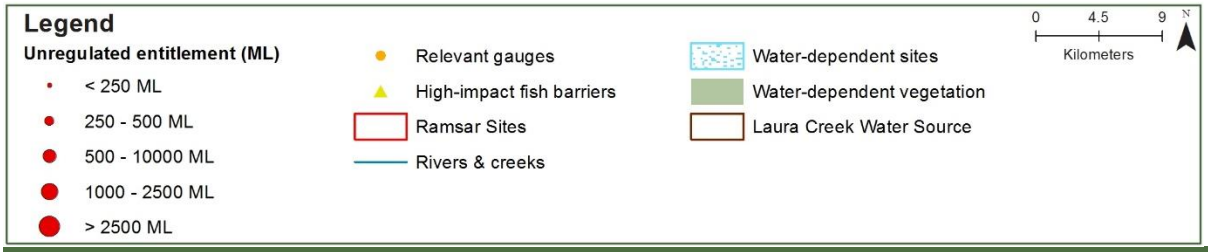
- Investigate opportunities to reduce impact on baseflows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years.
  - Consider reviewing the cease-to-pump threshold
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[93] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[94] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU24: Laura Creek water source





Priority environmental assets and values

Laura Creek and its associated in-channel habitat and fringing vegetation communities, and water-dependent assets including, but not limited to:

- Mother of Ducks Lagoon in-channel
- New England Wetlands

Native fish[95]	• golden perch • Murray cod • golden perch • Murray cod	• unspecked hardyhead • northern river blackfish • mountain galaxias • purple spotted gudgeon (P)	• carp gudgeon • freshwater catfish • Australian smelt (P)
Birds	85 water-dependent bird species recorded, including the listed[96] waterbird species:		
	• blue-billed duck • cattle egret • eastern great egret • curlew sandpiper • brolga	• comb-crested jacana • white-winged black tern • gull-billed tern • pacific golden plover	• Australian painted snipe • sharp-tailed sandpiper • red-necked phalarope • marsh sandpiper
Native vegetation	Seven water-dependent PCTs, including:		
	• river red gum woodlands • sedgeland–forbland wetlands	• montane bogs • heath swamps	• sedgeland fens wetlands • upland wetlands

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

Registered cultural assets	• Aboriginal ceremony and dreaming sites		
Other species	• eastern sign-bearing froglet • eastern snake-necked turtle	• broad-palmed frog • spotted grass frog	• platypus • Bell's turtle

Hydrology[97]

Gauge: 418021 *Laura Creek at Laura*	**80th percentile**: 0.2ML/day	**50th percentile**: 9.9ML/day	**20th percentile**: 69.7ML/day
	1.5 ARI: 3640.6ML/day	**2.5 ARI**: 4458.2ML/day	**5 ARI**: 6020.4ML/day

Summary of hydrological alteration

Flows do not seem to be altered by more than 20% compared to the 'without development' model scenario as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019).

The total volume of unregulated entitlements in the planning unit is 510.5 ML, of which 494 ML are unregulated water access licences (WALs) for production. There are four unregulated WALs for production <250 ML distributed along Laura Creek.

This planning unit has very low flows, and water is mainly diverted when the rainfall has been inadequate. This means that lower flows could be substantially impacted by extraction.

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[98]	L^0	L^-	L^-	L^-	L^-	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

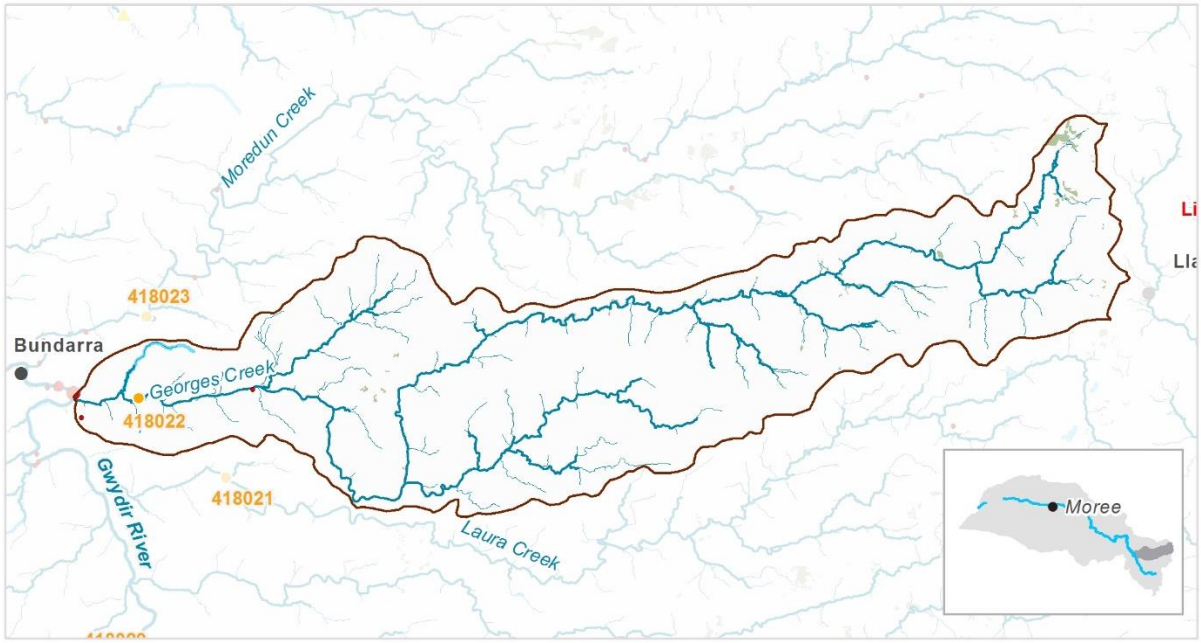
Recommendations

- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[97] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[98] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU25: Georges Creek water source



Priority environmental assets and values

Georges Creek and its associated in-channel habitat and fringing vegetation communities, and water-dependent assets including, but not limited to:

- Winter Station Creek

Native fish[99]	• carp gudgeon • Murray cod	• northern river blackfish (P) • purple spotted gudgeon (P)	• freshwater catfish • Australian smelt (P)
Birds	28 water-dependent bird species recorded		
Native vegetation	Five water-dependent PCTs, including:		
	• river red gum woodlands	• sedgeland fens wetlands	• upland wetlands • heath swamps
Registered cultural assets	None registered		
Other species	• eastern sign-bearing froglet • eastern snake-necked turtle	• Peron's tree frog • Spotted grass frog	• platypus • Bell's turtle

[99] 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)

Hydrology[100]			
Gauge: 418022 *Georges Creek at Clerkness*	**80th percentile**: 0.1ML/day	**50th percentile**: 8.8ML/day	**20th percentile**: 91.4ML/day
	1.5 ARI: 4802.9ML/day	**2.5 ARI**: 7514.2ML/day	**5 ARI**: 8963.2ML/day

Summary of hydrological alteration

Cease-to-flow periods are highly altered, as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). Cease-to-flows currently occur more frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 144 ML, all of which are unregulated water access licences (WALs) for production. There are two WALs <250 ML that are located on Georges Creek.

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

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[101]	H^+	L^-	L^-	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

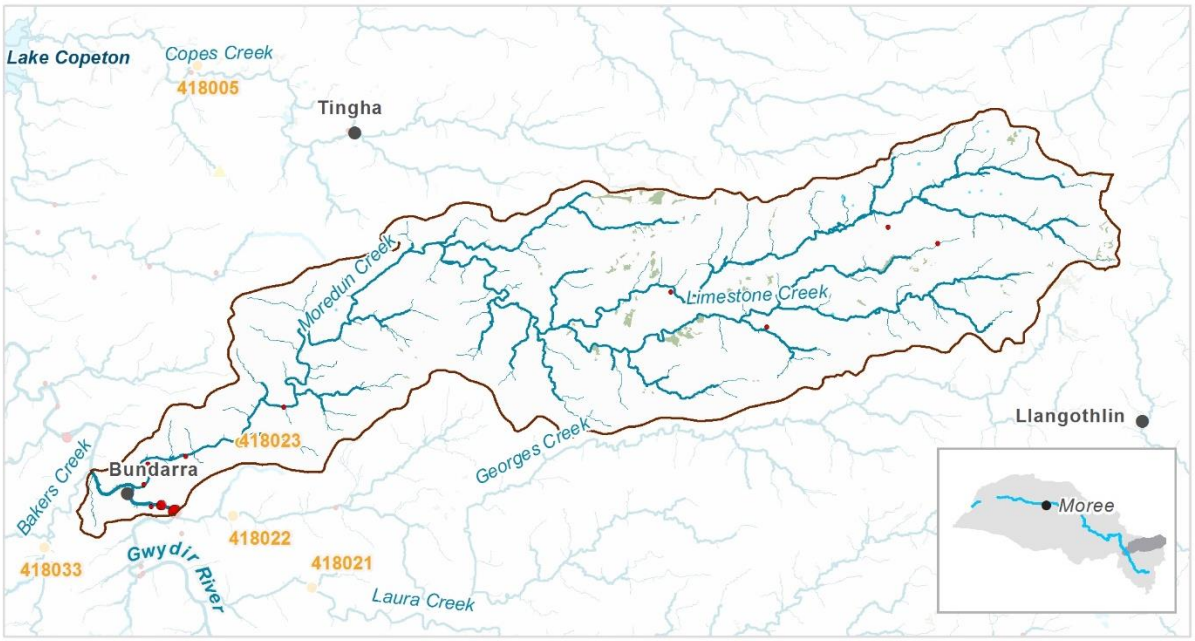
Recommendations

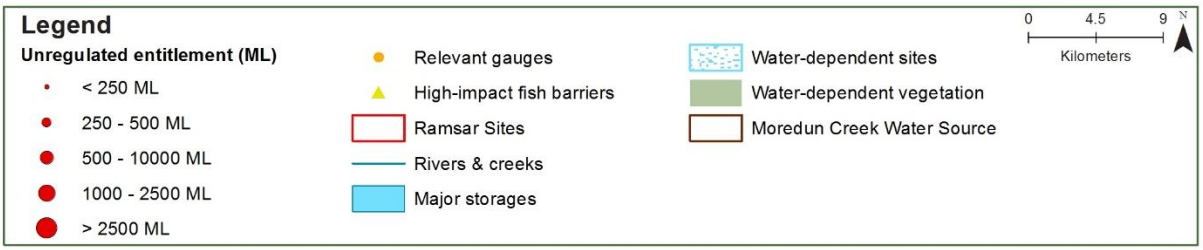
- Investigate opportunities to reduce length of cease-to-flow periods in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years
  - Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
  - Consider reviewing the cease-to-pump threshold
  - Consider installing water level gauges at or near extraction sites
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values
- Ensure compliance with water access licence conditions including through metering of all licensed extraction
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes

[100] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[101] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU26: Moredun Creek water source





Priority environmental assets and values

Moredun Creek and its associated in-channel habitat and fringing vegetation communities

Native fish[102]	• mountain galaxias • Australian smelt (P) • freshwater catfish	• golden perch • river blackfish • Murray cod	• carp gudgeon • purple spotted gudgeon (P)
Birds	47 water-dependent bird species recorded, including the listed[103] waterbird species: • blue-billed duck • eastern great egret • Latham's snipe		
Native vegetation	Seven water-dependent PCTs, including: • river red gum woodlands • sedgeland–forbland wetlands	• sedgeland fens wetlands	• heath swamps • upland wetlands
Registered cultural assets	None registered		
Other species	• eastern sign-bearing froglet	• broad-palmed frog	• little pied bat

[102] 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)

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

- eastern snake-necked turtle
- yellow-bellied sheathtail-bat
- greater broad-nosed bat
- Peron's tree frog
- eastern bentwing-bat
- Bell's turtle
- platypus

Hydrology[104]

Gauge: 418023 *Moredun Creek at Bundarra*	**80th percentile**: 1.5ML/day	**50th percentile**: 20.6ML/day	**20th percentile**: 134.3ML/day
	1.5 ARI: 6958.8ML/day	**2.5 ARI**: 12472ML/day	**5 ARI**: 14152.7ML/day

Summary of hydrological alteration

Cease-to-flow periods and low flows are highly altered, as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). 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 2230 ML, of which 2127 ML are for production. There are 11 unregulated WALs for production <250 ML, one between 250-500 ML, and one between 500-1000 ML. They are all distributed along Moredun Creek.

Water is most likely diverted when the rainfall has been inadequate. This means that lower flows may be substantially impacted by extraction (as confirmed by the Gwydir Risk Assessment).

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[105]	H^+	H^-	L^0	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

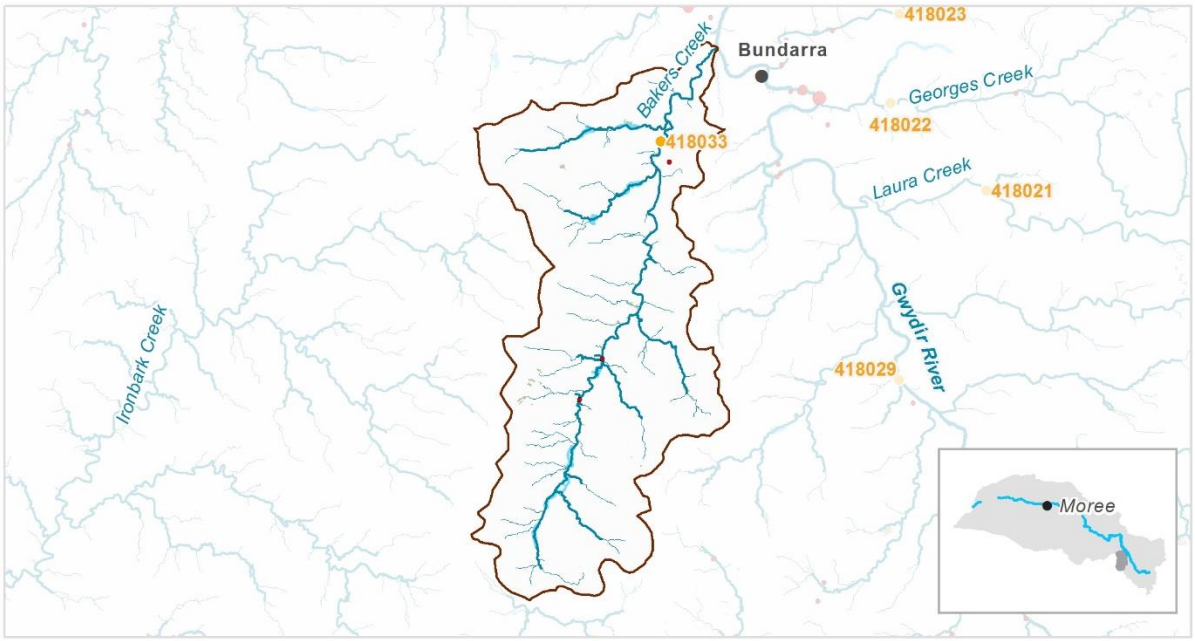
Recommendations

- Investigate opportunities to reduce length of cease-to-flow periods in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* 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 installing water level gauges at or near extraction sites
  - Consider rostering landholder water access
  - Consider Individual and/or Total Daily Extraction Limits (IDELS / TDELS)
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[104] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[105] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU27: Bakers Creek water source



Priority environmental assets and values

Bakers Creek and its associated in-channel habitat and fringing vegetation communities

Native fish[106]	• carp gudgeon (P) • Australian smelt (P)	• freshwater catfish (P) • northern river blackfish (P)	• purple spotted gudgeon (P) • Murray cod (P)
Birds	20 water-dependent birds recorded		
Native vegetation	Five water-dependent PCTs, including river red gum woodlands, montane bogs & sedgeland fens wetlands		
Registered cultural assets	None registered		
Other species			

[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)

Hydrology[107]			
Gauge: 418033 *Bakers Creek at Bundarra*	**80th percentile**: 1.1ML/day	**50th percentile**: 6.5ML/day	**20th percentile**: 32.8ML/day
	1.5 ARI: 1474.6ML/day	**2.5 ARI**: 2544.9ML/day	**5 ARI**: 4513ML/day

Summary of hydrological alteration

Cease-to-flow periods are highly altered, as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). They currently occur more frequently compared to the 'without development' model scenario.

There are three unregulated water access licences (WALs) for production in this water source with a total volume of 35 ML. These small WALs <250 ML are all distributed along Bakers Creek.

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

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[108]	H^+	L^-	L^-	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

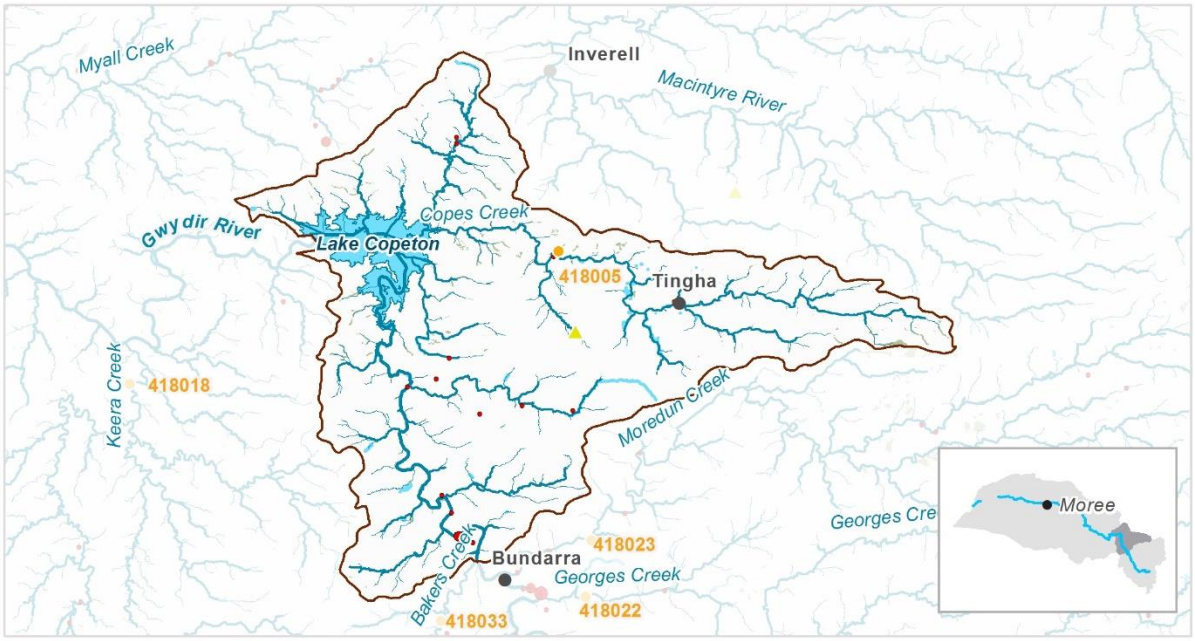
Recommendations

- Investigate opportunities to reduce length of cease-to-flow periods in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* 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 installing water level gauges at or near extraction sites
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[107] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[108] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU28: Copeton Dam water source



Priority environmental assets and values

Copes Creek and its associated in-channel habitat and fringing vegetation communities, and water-dependent assets including, but not limited to:

- Murray Waters

Native fish[109]	• northern river blackfish (P) • Murray cod	• carp gudgeon • freshwater catfish • Australian smelt (P)	• Darling River hardyhead (P) • purple spotted gudgeon (P) • purple spotted gudgeon (P)
Birds	53 water-dependent bird species recorded, including the listed[110] eastern great egret		
Native vegetation	Nine water-dependent PCTs, including: • river red gum woodlands • montane bogs	• sedgeland–forbland wetlands	• sedgeland fens wetlands
Registered cultural assets	• Modified trees		

[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)

Other species	• eastern sign-bearing froglet • yellow-bellied sheathtail-bat • eastern snake-necked turtle • Corben's long-eared bat	• spotted grass frog • broad-palmed frog • eastern bentwing-bat • Macquarie River turtle	• Bell's turtle • platypus • little pied bat • Peron's tree frog

Hydrology[111]

Gauge: 418005 *Copes Creek at Kimberley*	**80th percentile**: 0.4ML/day	**50th percentile**: 3.1ML/day	**20th percentile**: 16.2ML/day
	1.5 ARI: 582.9ML/day	**2.5 ARI**: 1187.4ML/day	**5 ARI**: 1995.44ML/day

Summary of hydrological alteration

Cease-to-flow periods and low flows are highly altered, and freshes are moderately altered as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). 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 1045.5 ML, of which 1024 ML are water access licences (WALs) for production. There are 14 unregulated WALs for production <250 ML and one between 250-500 ML. They are all distributed throughout the planning unit, upstream of Copeton Dam.

Water is mainly diverted when the rainfall has been inadequate. This means that lower flows may be substantially impacted by extraction and some of the larger licences may be impacting on freshes (as confirmed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area*).

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[112]	H^+	H^-	M^-	L^0	L^-	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

Recommendations

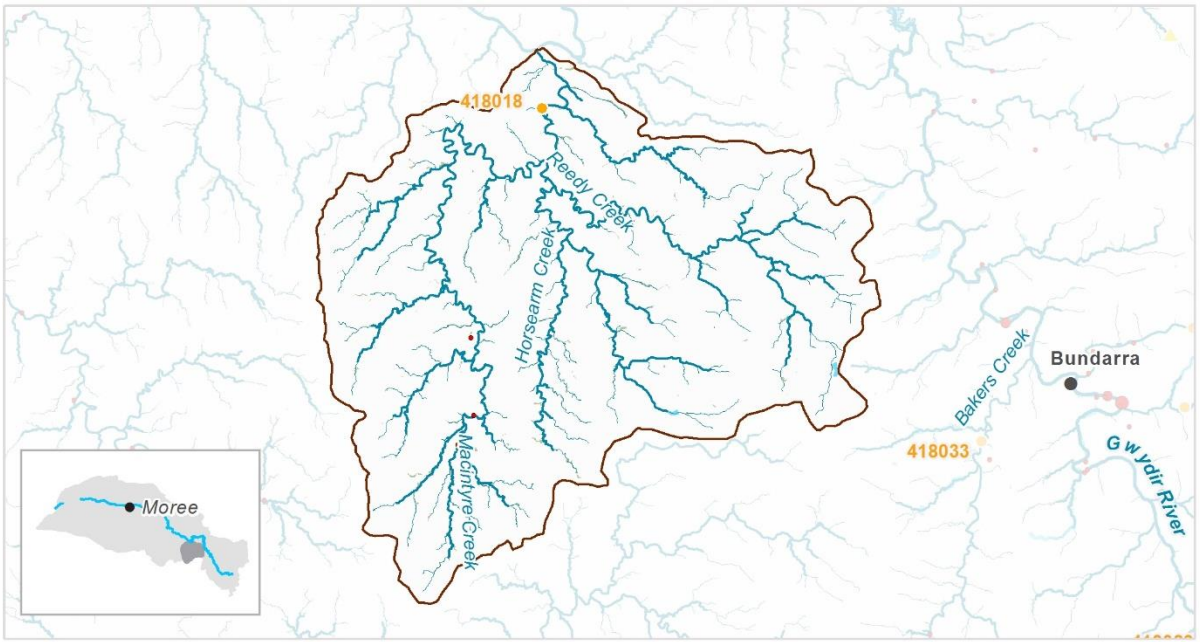
- Investigate opportunities to reduce length of cease-to-flow periods and extraction pressure on baseflows and freshes in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years.
    - Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
    - Consider reviewing the cease-to-pump threshold
    - Consider implementing a commence-to-pump threshold that is higher than cease-to-pump threshold
    - Consider installing water level gauges at or near extraction sites
    - Consider installing a river flow gauge
    - Consider rostering landholder water access
    - Consider Individual and/or Total Daily Extraction Limits (IDELS / TDELS)
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.

[111] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[112] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

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

PU29: Keera Creek water source



Priority environmental assets and values

Keera Creek and its associated in-channel habitat and fringing vegetation communities		Tributaries to Keera Creek	
Native fish[113]	• unspecked hardyhead • Murray-Darling rainbowfish (P) • purple spotted gudgeon • Darling River hardyhead	• golden perch (P) • Murray cod • carp gudgeon (P) • bony herring (P)	• freshwater catfish • Australian smelt • spangled perch (P)
Birds	51 water-dependent bird species recorded, including the listed[114] Australian painted snipe		
Native vegetation	Seven water-dependent PCTs, including river red gum forests and woodlands, and sedgeland fens wetlands		

[113] 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)
[114] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Registered cultural assets	• Burial sites		
Other species	• eastern snake-necked turtle	• broad-palmed frog • Peron's tree frog	• spotted grass frog

Hydrology[115]			
Gauge: 418018 *Keera Creek at Keera*	**80th percentile**: 1.6 ML/day	**50th percentile**: 11.9 ML/day	**20th percentile**: 66.2 ML/day
	1.5 ARI: 2383ML/day	**2.5 ARI**: 7582.4ML/day	**5 ARI**: 14385.5ML/day

Summary of hydrological alteration

Cease-to-flow periods and low flows are highly altered, as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). Cease-to-flows 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 102 ML, which is made up of water access licences (WALs) for production. There are three unregulated WALs for production <250 ML distributed along Keera Creek.

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

	Cease-to-flow	**Low flow and Baseflow**	**Freshes**	**High and infrequent flows**		
				1.5 ARI	**2.5 ARI**	**5 ARI**
Hydrological alteration[116]	H^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

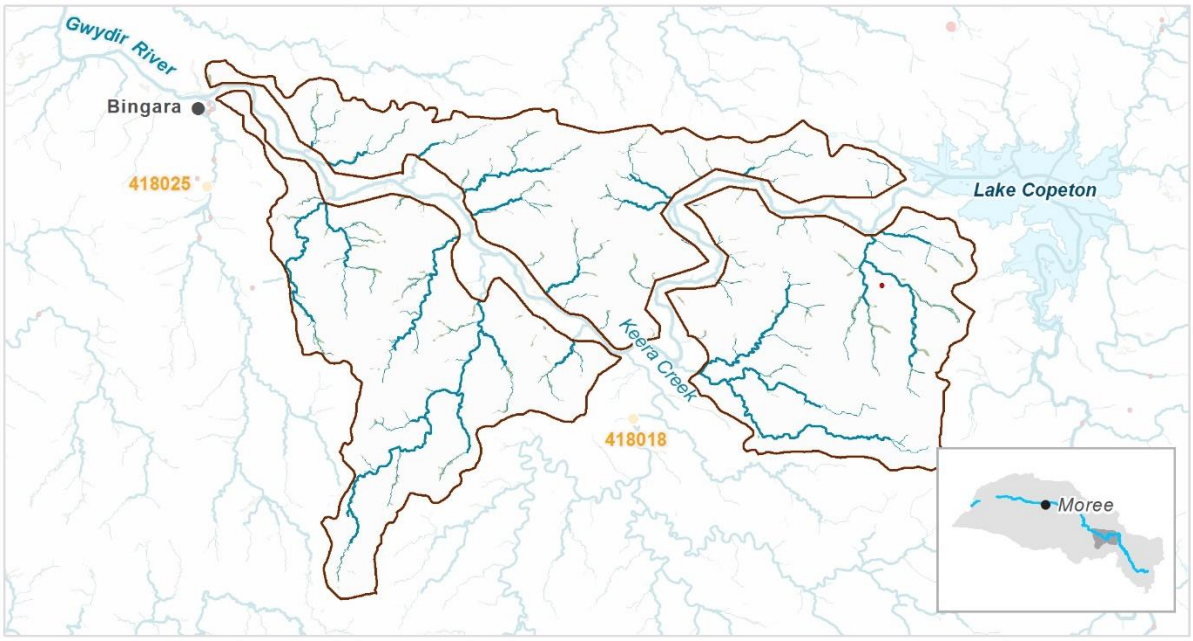
Recommendations

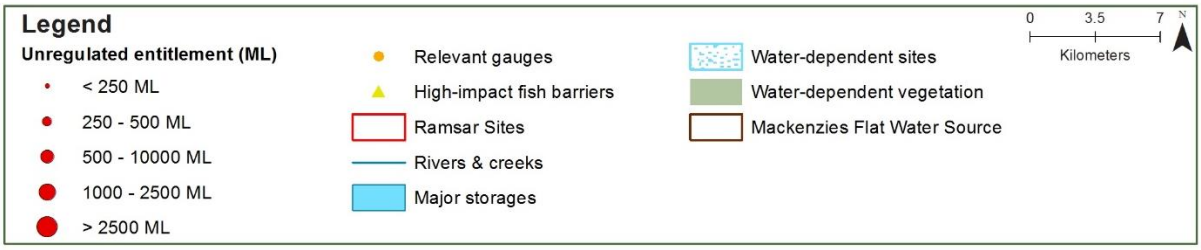
- Investigate opportunities to reduce length of cease-to-flow periods and extraction pressure on baseflows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years.
  - Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
  - Consider reviewing the cease-to-pump threshold
  - Consider installing water level gauges at or near extraction sites
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[115] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[116] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU30: Mackenzies Flat water source





Priority environmental assets and values

Tributaries to the Gwydir River and its associated in-channel habitat and fringing vegetation communities

Native fish[117]	• unspecked hardyhead (P) • carp gudgeon (P)	• spangled perch (P) • purple spotted gudgeon (P)	• freshwater catfish (P) • Darling River hardyhead (P)
Birds	40 water-dependent bird species recorded, including the listed[118] eastern great egret		
Native vegetation	Eight water-dependent PCTs, including river red gum woodlands & sedgeland fens wetlands		
Registered cultural assets	None registered		
Other species	• broad-palmed frog • Peron's tree frog	• eastern sign-bearing froglet • eastern snake-necked turtle	• Spotted grass frog • water rat

[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)

- Little pied bat

Hydrology[119]			
No gauge in water source: 418025 *Halls Creek at Bingara*	**80th percentile**: 2.4ML/day	**50th percentile**: 4.3ML/day	**20th percentile**: 8.7ML/day
	1.5 ARI: 306.2ML/day	**2.5 ARI**: 627.4ML/day	**5 ARI**: 1095ML/day

Summary of hydrological alteration

Flows do not seem to be altered by more than 20% compared to the 'without development' model scenario as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019).

There is only one small water access licence (WAL) for production of 27 ML in the Mackenzies Flat planning unit, which likely minimally impacts flows.

	Cease-to-flow	**Low flow and Baseflow**	**Freshes**	**High and infrequent flows**		
				1.5 ARI	**2.5 ARI**	**5 ARI**
Hydrological alteration[120]	L^0	L^0	L^0	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

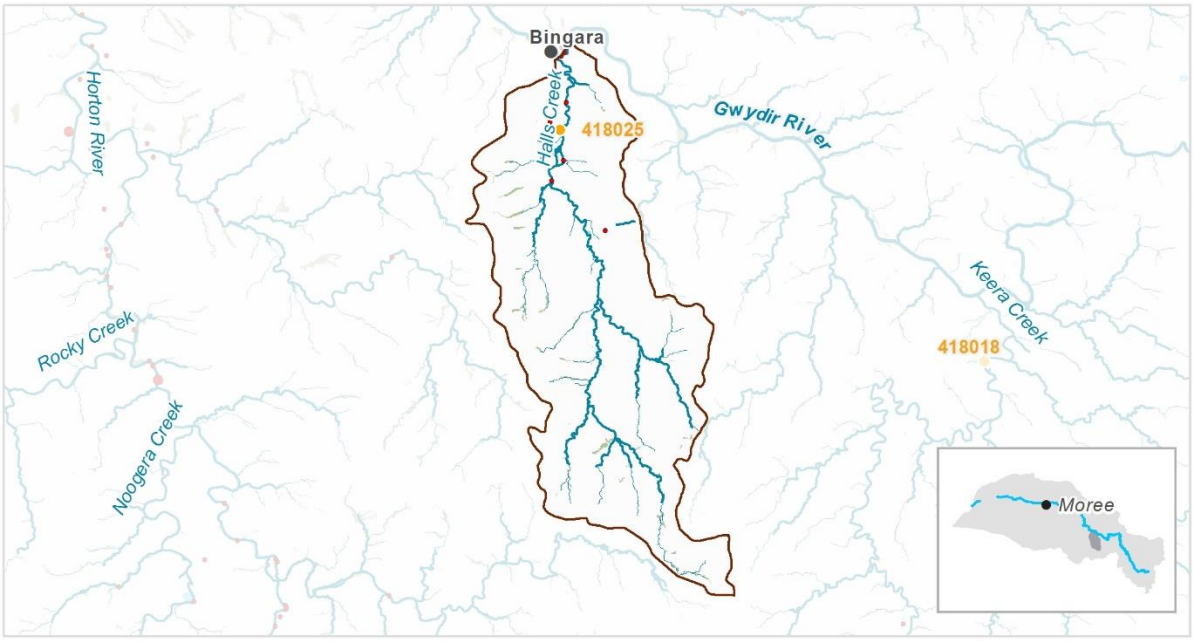
Recommendations

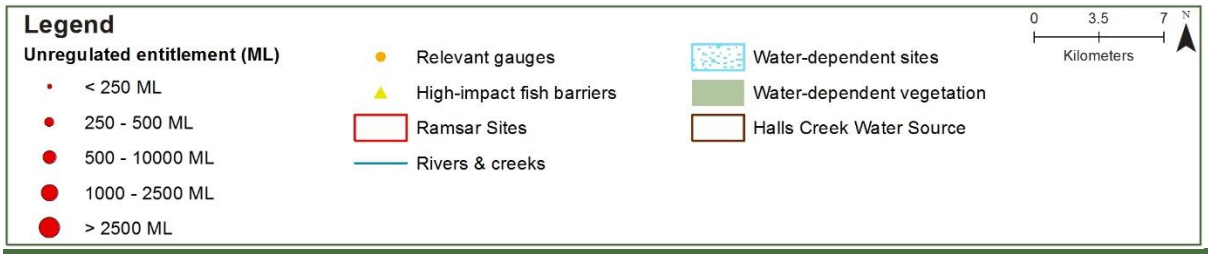
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[119] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[120] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU31: Halls Creek water source





Priority environmental assets and values

Halls Creek and its associated in-channel habitat and fringing vegetation communities

Native fish[121]	• carp gudgeon • Murray-Darling rainbowfish • unspecked hardyhead • golden perch • spangled perch • freshwater catfish • purple spotted gudgeon • Darling River hardyhead
Birds	59 water-dependent bird species recorded, including the listed[122] waterbird species: • Australasian bittern • eastern great egret
Native vegetation	Six water-dependent PCTs, including river red gum woodlands
Registered cultural assets	None registered
Other species	• eastern bentwing-bat

[121] 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)

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

Hydrology[123]			
Gauge: 418025 *Halls Creek at Bingara*	**80th percentile**: 4ML/day	**50th percentile**: 7.3ML/day	**20th percentile**: 14.8ML/day
	1.5 ARI: 518.7ML/day	**2.5 ARI**: 1062.9ML/day	**5 ARI**: 1855.1ML/day

Summary of hydrological alteration

Cease-to-flow periods are highly altered and low flows are moderately altered, as assessed by the Gwydir WRPA Risk Assessment. Cease-to-flows 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 441 ML. There are nine unregulated WALs for production <250 ML. They are all distributed along Halls Creek.

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

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[124]	H^+	M^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source					
	Halls Creek Tributaries MZ Cease to pump when there is no visible flow		**Halls Creek MZ** Cease to pump when there is no visible flow at Halls Creek at Bingara gauge (418025)			

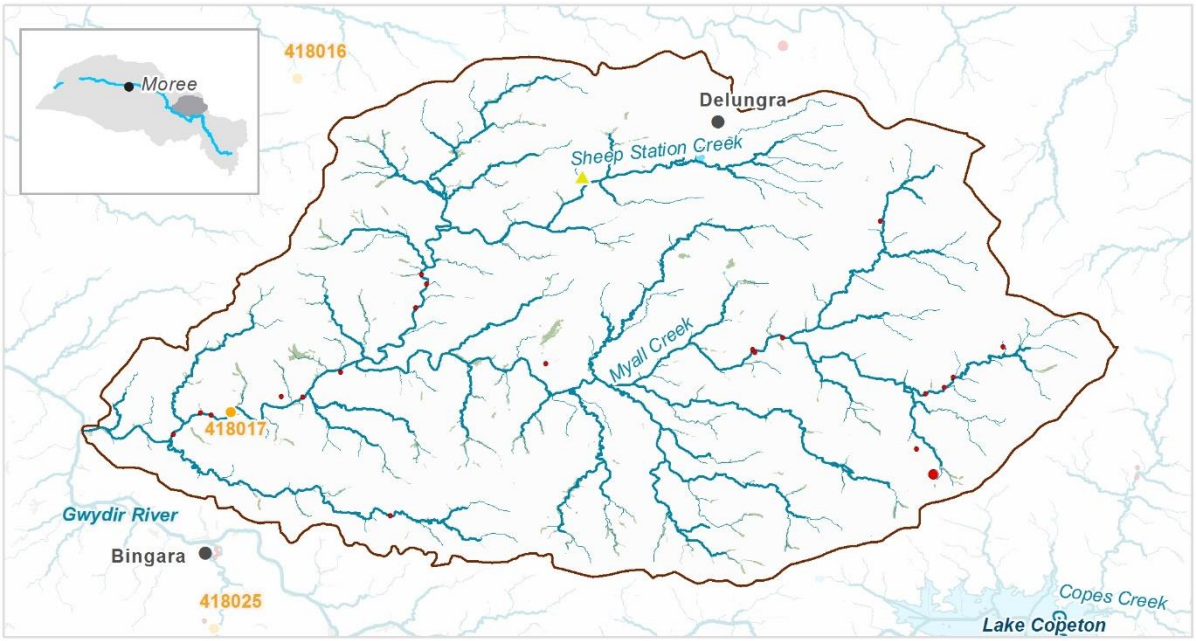
Recommendations

- Investigate opportunities to reduce length of cease-to-flow periods and extraction pressure on baseflows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* 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 installing water level gauges at or near extraction sites
    - Consider rostering landholder water access
    - Consider Individual and/or Total Daily Extraction Limits (IDELS / TDELS)
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[123] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[124] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU32: Myall Creek water source



Priority environmental assets and values

Myall Creek and its associated in-channel habitat and fringing vegetation communities, and water-dependent assets including, but not limited to:

- Areas of high biodiversity
- Tributaries to Myall Creek in-channel
- Lowland Darling River endangered ecological community

Native fish[125]	• carp gudgeon • Murray-Darling rainbowfish • bony herring (P)	• Australian smelt • spangled perch (P) • golden perch (P) • Murray cod	• freshwater catfish • purple spotted gudgeon (P) • Darling River hardyhead (P) • unspecked hardyhead
Birds	47 water-dependent bird species recorded, including the listed[126]eastern great egret		
Native vegetation	Nine water-dependent PCTs, including river red gum woodlands and sedgeland fens wetlands		
Registered cultural assets	None registered		
Other species	• eastern snake-necked turtle	• Peron's tree frog	• platypus

[125] 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)
[126] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

- broad-palmed frog

Hydrology[127]			
Gauge: 418017 *Myall Creek at Molroy*	**80th percentile**: 2.2ML/day	**50th percentile**: 11.6ML/day	**20th percentile**: 43.7ML/day
	1.5 ARI: 4841.6ML/day	**2.5 ARI**: 7793.8ML/day	**5 ARI**: 15569.7ML/day

Summary of hydrological alteration

Cease-to-flow periods and low flows are highly altered as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). 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 1412.5 ML, of which 1388 ML are for production. There are 21 unregulated WALs for production <250 ML, one between 250-500 ML. They are all distributed along Myall Creek.

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

	Cease-to-flow	**Low flow and Baseflow**	**Freshes**	**High and infrequent flows**		
				1.5 ARI	**2.5 ARI**	**5 ARI**
Hydrological alteration[128]	H^+	H^-	L^-	L^-	L^-	L^-
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

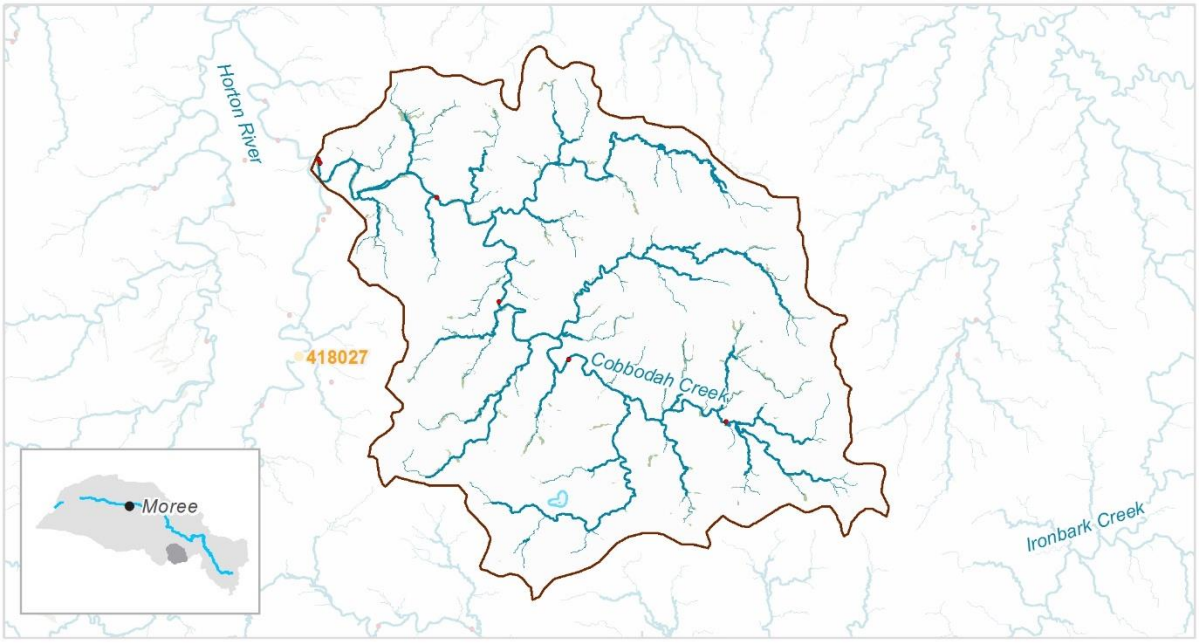
Recommendations

- Investigate opportunities to reduce length of cease-to-flow periods and extraction pressure on baseflows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* 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 installing water level gauges at or near extraction sites
    - Consider rostering landholder water access
    - Consider Individual and/or Total Daily Extraction Limits (IDELS / TDELS)
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[127] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[128] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU33: Cobbodah Creek water source



Priority environmental assets and values			
Cobbadah Creek and its associated in-channel habitat and fringing vegetation communities including, but not limited to	Chain of Ponds Creek		
Native fish[129]	• unspecked hardyhead • Murray-Darling rainbowfish (P) • Murray cod	• spangled perch (P) • golden perch (P) • carp gudgeon • bony herring (P)	• freshwater catfish • purple spotted gudgeon (P) • Darling River hardyhead • Australian smelt (P)
Birds	48 water-dependent bird species recorded, including the listed[130] eastern great egret		
Native vegetation	Seven water-dependent PCTs, including river red gum woodlands		
Registered cultural assets	None registered		
Other species	• Peron's tree frog		

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

Hydrology[131]			
No gauge in water source: 418018 *Keera Creek at Keera*	**80th percentile**: 1.1ML/day	**50th percentile**: 8.5ML/day	**20th percentile**: 47.4ML/day
	1.5 ARI: 1706ML/day	**2.5 ARI**: 5428ML/day	**5 ARI**: 10298.2ML/day

Summary of hydrological alteration

Cease-to-flow periods and baseflows are highly altered, as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). Cease-to-flows currently occur more frequently and baseflows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 332 ML. There are six unregulated WALs for production <250 ML. They are all distributed along Cobbodah Creek.

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

Cobbodah Creek is a priority planning unit to investigate since low flows are highly impacted and there is potential to achieve significant environmental benefits with improved protection of critical flows.

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[132]	H^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

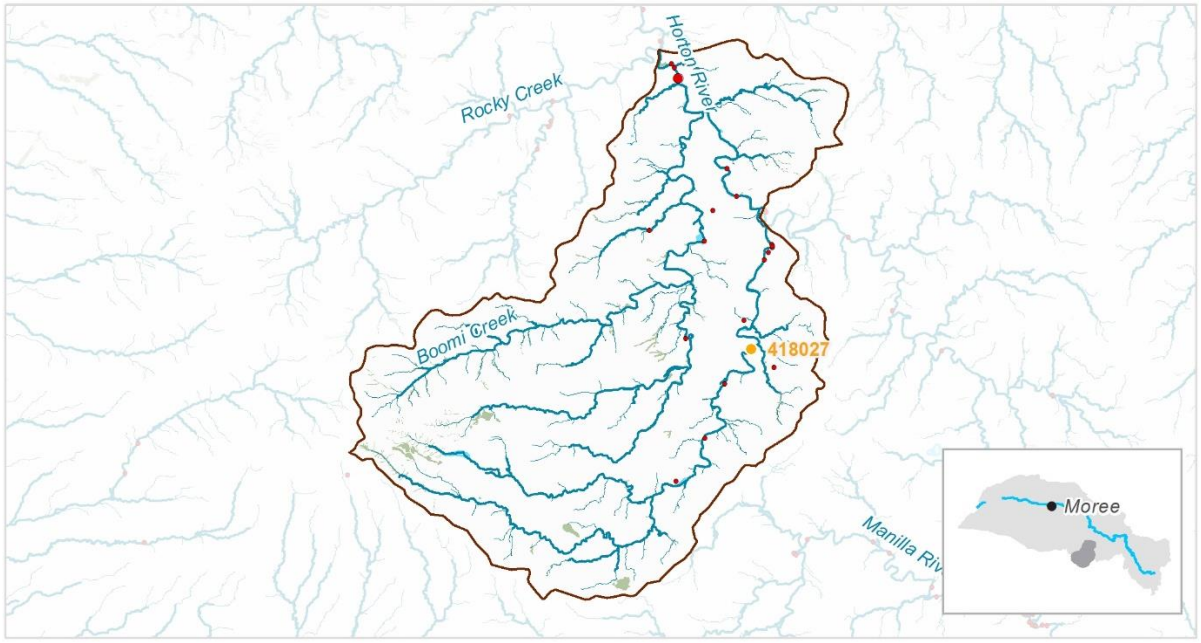
Recommendations

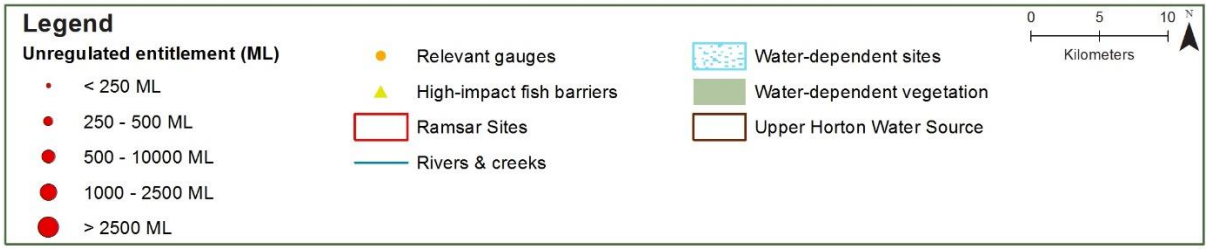
- Investigate opportunities to reduce length of cease-to-flow periods and extraction pressure on baseflows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years.
    - Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
    - Consider reviewing the cease-to-pump threshold
    - Consider installing water level gauges at or near extraction sites
    - Consider rostering landholder water access
    - Consider Individual and/or Total Daily Extraction Limits (IDELS / TDELS)
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[131] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[132] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU34: Upper Horton water source





Priority environmental assets and values

Horton River and its associated in-channel habitat and fringing vegetation communities

Native fish[133]	• carp gudgeon • bony herring • river blackfish (P) • mountain galaxias	• Australian smelt • spangled perch • golden perch (P) • Murray cod	• freshwater catfish • purple spotted gudgeon (P) • unspecked hardyhead • Murray-Darling rainbowfish
Birds	52 water-dependent bird species recorded, including the listed[134] waterbird species: • Latham's snipe • eastern great egret		
Native vegetation	Eight water-dependent PCTs, including river red gum woodlands and sedgeland fens wetlands		
Registered cultural assets	• Modified trees		

[133] 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)

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

Other species	• yellow-bellied sheathtail-bat • eastern snake-necked turtle • Corben's long-eared bat	• Peron's tree frog • spotted grass frog • water rat	• large-eared pied bat • greater broad-nosed bat • broad-palmed frog

Hydrology[135]

Gauge: 418027 *Horton River at Horton Dam*	**80th percentile**: 18.5ML/day	**50th percentile**: 66.4ML/day	**20th percentile**: 252.9ML/day
	1.5 ARI: 21314.9ML/day	**2.5 ARI**: 36253.3ML/day	**5 ARI**: 47856.6ML/day

Summary of hydrological alteration

Cease-to-flow periods and low flows are highly altered as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). Cease-to-flows 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 1346 ML, of which 1328 ML are for production. There are 19 unregulated WALs for production <250 ML and one between 250-500 ML. They are all distributed along the Upper Horton River.

Water is mainly diverted when the rainfall has been inadequate. This means that lower flows may be substantially impacted by extraction (as confirmed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area*).

	Cease-to-flow	**Low flow and Baseflow**	**Freshes**	**High and infrequent flows**		
				1.5 ARI	**2.5 ARI**	**5 ARI**
Hydrological alteration[136]	H^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

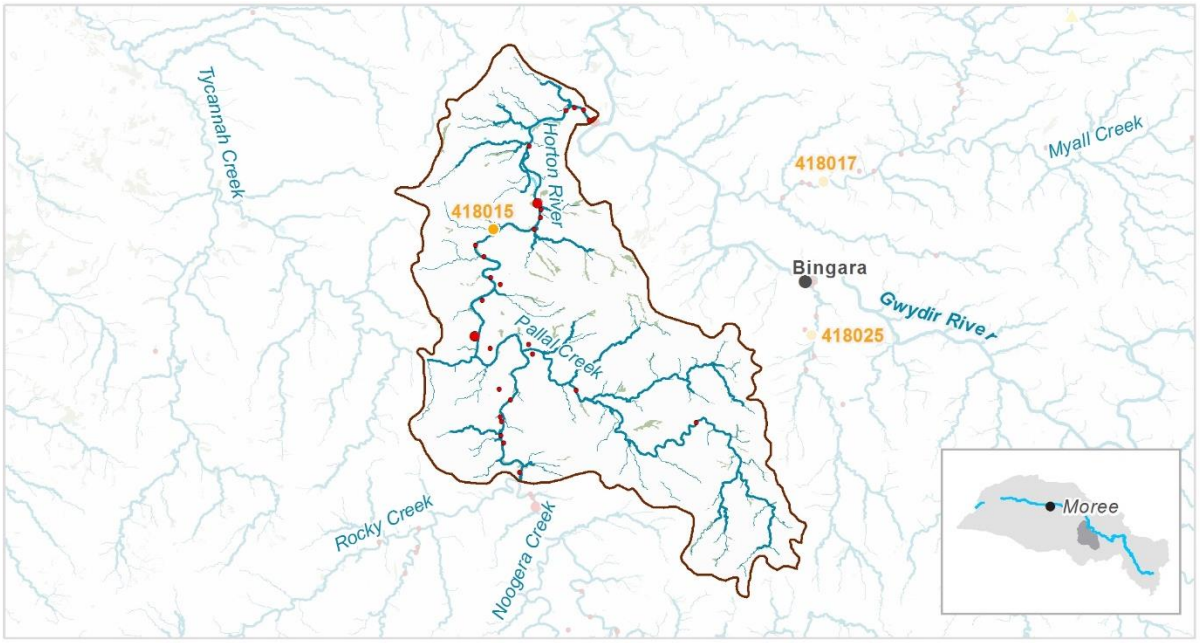
Recommendations

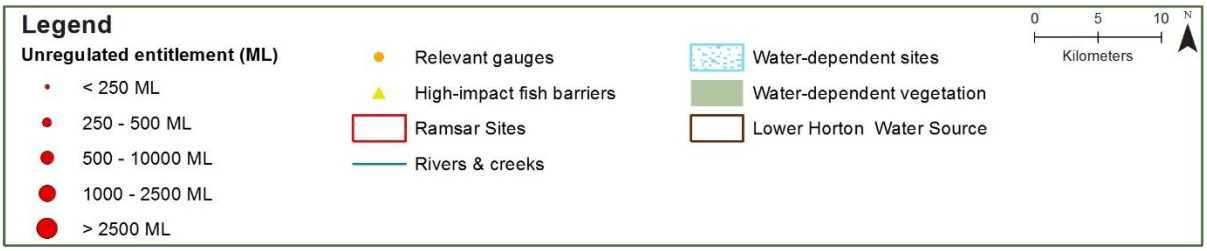
- Investigate opportunities to reduce length of cease-to-flow periods in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years.
  - Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points.
  - Consider reviewing the cease-to-pump threshold
  - Consider installing water level gauges at or near extraction sites
  - Consider rostering landholder water access
  - Consider Individual and/or Total Daily Extraction Limits (IDELS / TDELS)
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Rivers water sources* (DOI-Water 2019) that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[135] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[136] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU35: Lower Horton water source





Priority environmental assets and values

Areas of Lowland Darling River endangered ecological community		Horton River and its associated in-channel habitat and fringing vegetation communities	
Native fish[137]	• unspecked hardyhead • carp gudgeon • Murray-Darling rainbowfish • purple spotted gudgeon (P)	• Australian smelt • spangled perch • golden perch • freshwater catfish	• Murray cod • bony herring • silver perch (P)
Birds	64 water-dependent bird species recorded including the listed[138] waterbird species: • common greenshank • eastern great egret	• comb-crested jacana	• brolga
Native vegetation	Eight water-dependent PCTs, including river red gum woodlands		
Registered cultural assets	None registered		
Other species	• eastern snake-necked turtle	• Peron's tree frog • spotted grass frog	• platypus

[137] 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)
[138] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Hydrology[139]			
Gauge: 418015 *Horton River at Rider Gauge*	**80th percentile**: 18.5ML/day	**50th percentile**: 66.4ML/day	**20th percentile**: 252.9ML/day
	1.5 ARI: ML/day	**2.5 ARI**: ML/day	**5 ARI**: ML/day

Summary of hydrological alteration

The Horton River is one of the main unregulated tributaries of the Gwydir River. The confluence of the Horton and Gwydir Rivers is approximately 15km downstream of Bingara. Low flows are highly altered, as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). Low flows occur less frequently compared to the 'without development' model scenario.

The total volume of unregulated entitlements in the planning unit is 3266 ML, of which 3264 ML are for production. There are 25 unregulated WALs for production <250 ML and three between 250-500 ML. They are all distributed along the Lower River.

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

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[140]	L^0	H^-	L^-	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Cease to pump at 4ML/day at Horton River at Rider Gauge (418015) Trade not permitted into the water source					

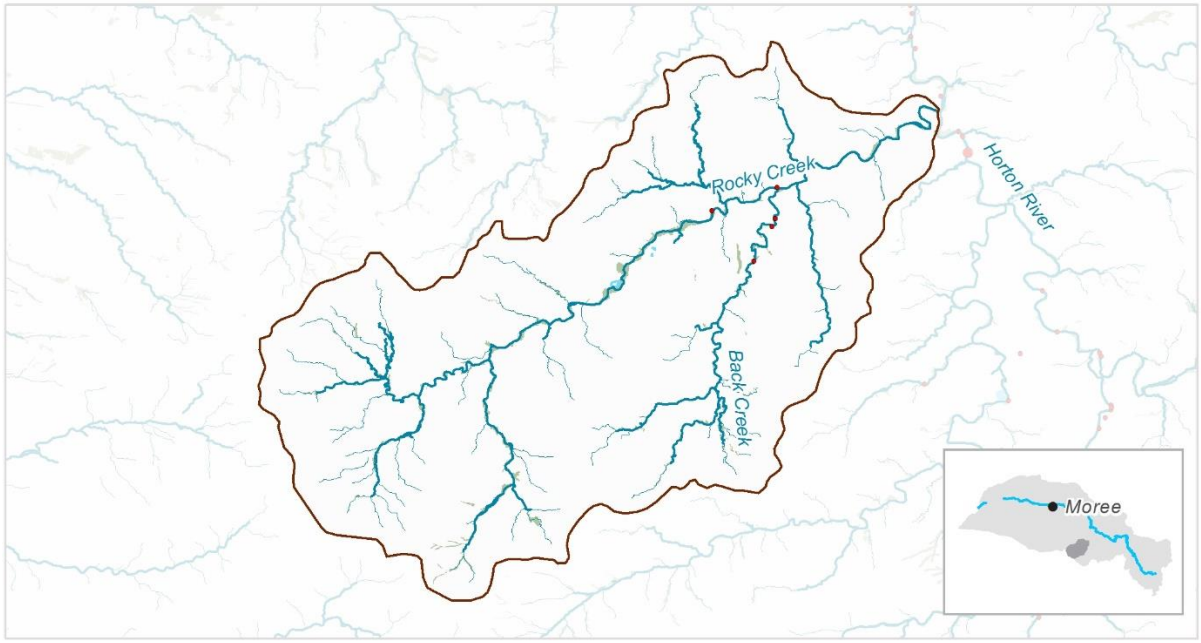
Recommendations

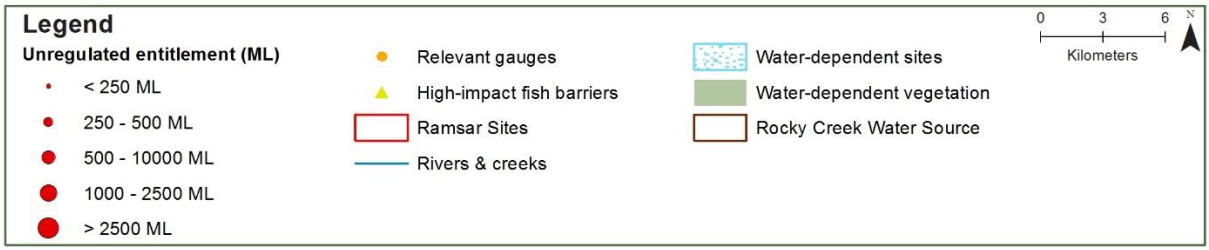
- Investigate opportunities to reduce extraction pressure on low flows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years.
  - Consider reviewing the cease-to-pump threshold
    - Cease-to-pump at 10 ML/day at Horton River at Rider Gauge (418015)
  - Consider installing water level gauges at or near extraction sites
  - Consider rostering landholder water access
  - Consider Individual and/or Total Daily Extraction Limits (IDELS / TDELS)
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[139] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[140] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU36: Rocky Creek water source





Priority environmental assets and values

Rocky and Back Creek and their associated in-channel habitat and fringing vegetation communities

Native fish[141]	• freshwater catfish • mountain galaxias • Murray-Darling rainbowfish • spangled perch	• bony herring (P) • golden perch (P) • Murray cod • carp gudgeon	• purple spotted gudgeon (P) • Australian smelt • unspecked hardyhead • Darling River hardyhead (P)
Birds	34 water-dependent bird species recorded		
Native vegetation	Six water-dependent PCTs, including river red gum woodlands		
Registered cultural assets	None registered		
Other species	• broad-palmed frog • Peron's tree frog	• Corben's long-eared bat	• spotted grass frog

[141] 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)

Hydrology[142]			
No gauge in water source: 418027 *Horton River at Horton Dam*	**80th percentile**: 0.5ML/day	**50th percentile**: 9.6ML/day	**20th percentile**: 75.9ML/day
	1.5 ARI: 9333.7ML/day	**2.5 ARI**: 10658.4ML/day	**5 ARI**: 21669.8ML/day

Summary of hydrological alteration

Cease-to-flow periods and low flows are highly altered as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). 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 291 ML, of which 284 ML are for production. There are five unregulated WALs for production <250 ML. They are all distributed along Rocky Creek.

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

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[143]	H^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

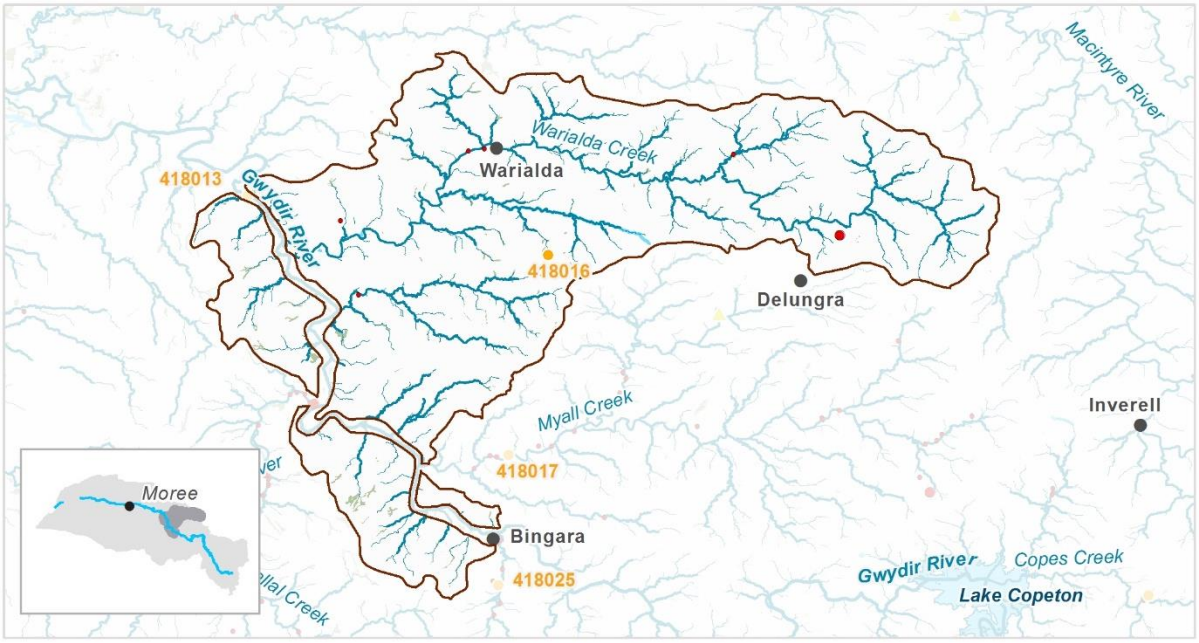
Recommendations

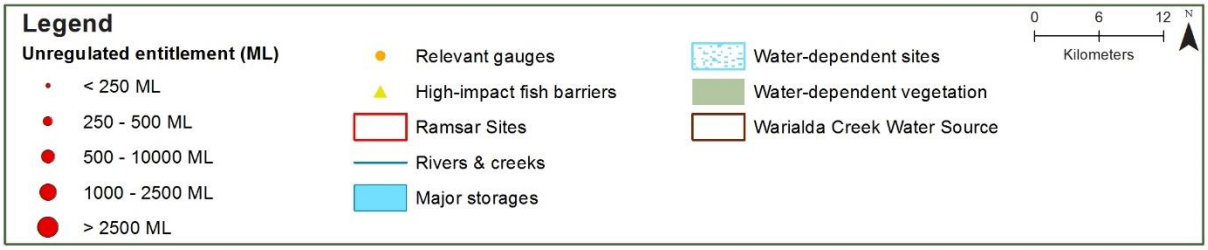
- Investigate opportunities to reduce length of cease-to-flow periods and extraction pressure on baseflows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years.
    - Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
    - Consider reviewing the cease-to-pump threshold
    - Consider installing water level gauges at or near extraction sites
    - Consider installing a river flow gauge
    - Consider rostering landholder water access
    - Consider Individual and/or Total Daily Extraction Limits (IDELS / TDELS)
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[142] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[143] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU37: Warialda Creek water source





Priority environmental assets and values

	Warialda Creek and its associated in-channel habitat and fringing vegetation communities		Tributaries to Warialda Creek and the Gwydir River	
Native fish[144]	• carp gudgeon • Murray-Darling rainbowfish (P) • bony herring (P)	• Australian smelt (P) • spangled perch • golden perch (P)	• Murray cod (P) • freshwater catfish • purple spotted gudgeon (P) • unspecked hardyhead (P)	
Birds	69 water-dependent bird species recorded, including the listed[145] eastern great egret			
Native vegetation	12 water-dependent PCTs, including: • river red gum woodlands	• river cooba wetlands	• sedgeland fens wetlands	
Registered cultural assets	None registered			

[144] 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)

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

Other species	• Corben's long-eared bat • yellow-bellied sheathtail-bat • eastern sign-bearing froglet • eastern snake-necked turtle	• Peron's tree frog • platypus • Macquarie turtle • little pied bat	• eastern cave bat • broad-palmed frog • spotted grass frog • large-eared pied bat

Hydrology[146]

Gauge: 418016 *Warialda Creek at Bundarra*	**80th percentile**: 0.5ML/day	**50th percentile**: 4.6ML/day	**20th percentile**: 27.5ML/day
	1.5 ARI: 4324.9ML/day	**2.5 ARI**: 6526.1ML/day	**5 ARI**: 9460.8ML/day

Summary of hydrological alteration

Cease-to-flow periods are highly altered and low flows are moderately altered, as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). Cease-to-flows 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 602 ML. There are six unregulated WALs for production <250 ML and one between 250-500 ML. They are all distributed along Warialda Creek.

Water is mainly diverted when the rainfall has been inadequate. This means that lower flows may be substantially impacted by extraction (as confirmed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area*).

	Cease-to-flow	**Low flow and Baseflow**	**Freshes**	**High and infrequent flows**		
				1.5 ARI	**2.5 ARI**	**5 ARI**
Hydrological alteration[147]	H^+	M^-	L^-	L^-	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

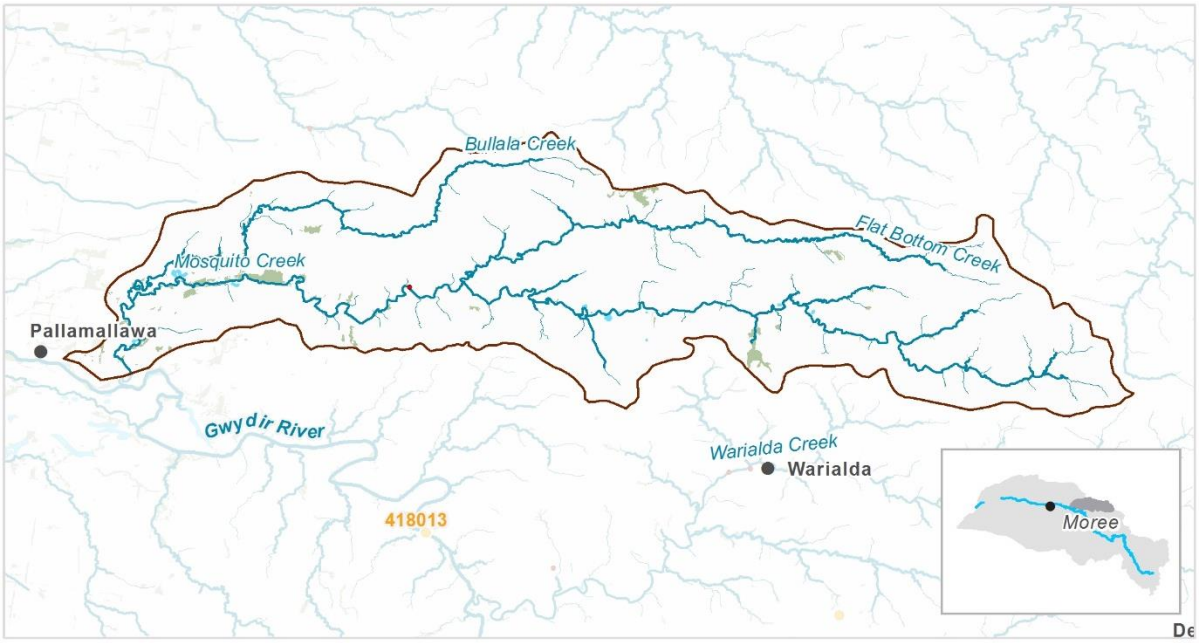
Recommendations

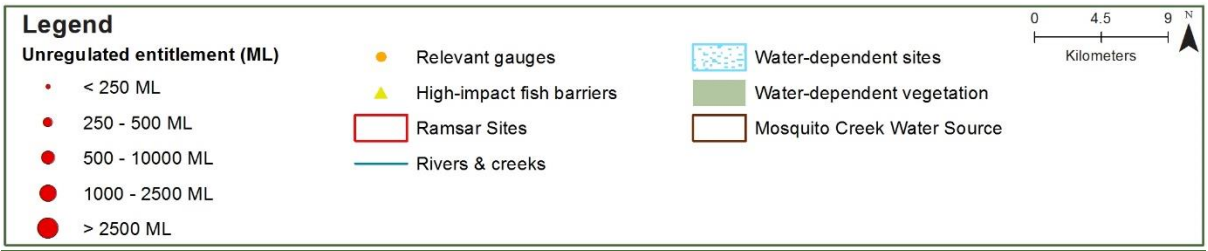
- Investigate opportunities to reduce length of cease-to-flow periods and extraction pressure on low flows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years.
  - Consider reviewing existing rules to ensure that visible flow is maintained downstream of extraction points
  - Consider reviewing the cease-to-pump threshold
  - Consider installing water level gauges at or near extraction sites
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[146] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[147] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU38: Mosquito Creek water source





Priority environmental assets and values			
Mosquito and Flat Bottom Creek and their associated in-channel habitat and fringing vegetation communities			
Native fish[148]	• unspecked hardyhead (P) • freshwater catfish (P) • Murray-Darling rainbowfish (P) • bony herring (P)	• Dwarf Flat-Headed Gudgeon (P) • Australian smelt (P) • spangled perch (P)	• purple spotted gudgeon (P) • Darling River hardyhead (P) • carp gudgeon (P)
Birds	39 water-dependent bird species recorded		
Native vegetation	14 water-dependent PCTs, including: • river red gum woodlands	• coolibah woodlands and coolibah wetland woodlands	• water couch marsh grasslands
Registered cultural assets	• Modified trees		
Other species	• eastern snake-necked turtle	• spotted grass frog	• Peron's tree frog

[148] 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)

Hydrology[149]

Summary of hydrological alteration

Low flows are moderately altered as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). Low flows and freshes occur less frequently compared to the 'without development' model scenario.

There is one small water access licence (WAL) for production with a volume of 38 ML located in Mosquito Creek. This may be having a small impact on low flows when there has been insufficient rain in the water source.

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[150]	L^0	M^-	L^-	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

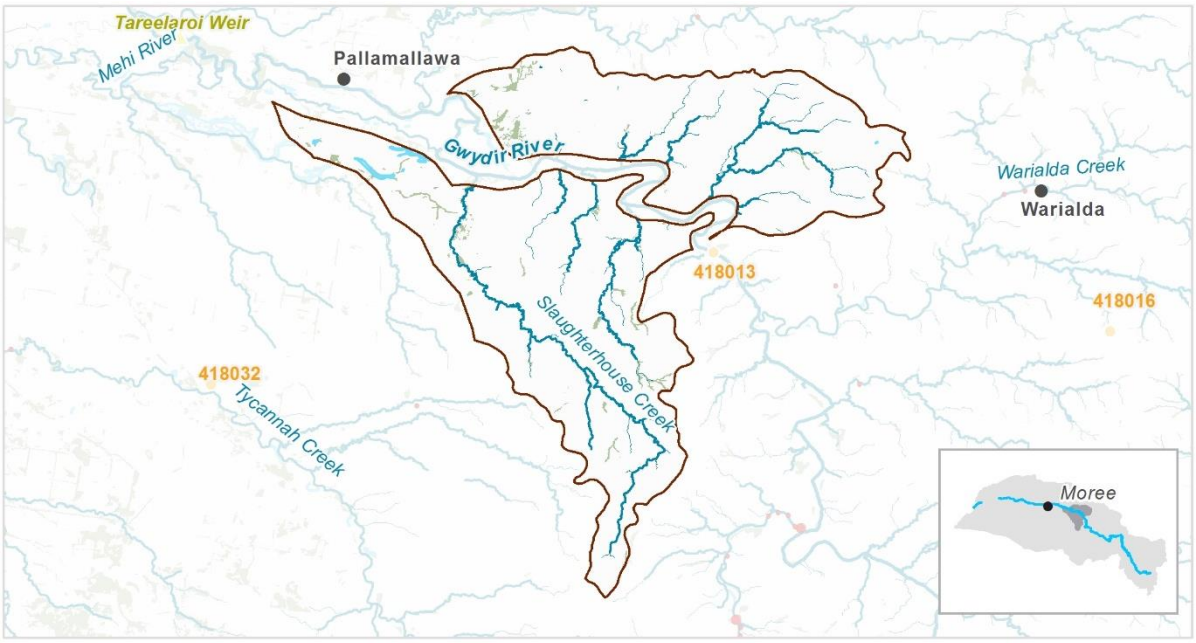
Recommendations

- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[149] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[150] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU39: Slaughterhouse Creek water source



Priority environmental assets and values

- Slaughterhouse Creek and its associated in-channel habitat and fringing vegetation communities
- Tributaries to the Gwydir River

Native fish[151]	• unspecked hardyhead (P) • carp gudgeon (P)	• spangled perch (P) • purple spotted gudgeon (P)
Birds	50 water-dependent bird species recorded, including the listed[152] eastern great egret	
Native vegetation	16 water-dependent PCTs, including: • river red gum woodlands • common reed grasslands	• coolibah woodlands and coolibah wetland woodlands • shallow freshwater wetland sedgelands • tall rushlands, reedlands and sedgelands
Registered cultural assets	• Modified trees	
Other species	None recorded	

[151] 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)

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

Hydrology[153]			
No gauge in water source: 418032 *Tycannah Creek at Horseshoe Lagoon*	**80th percentile**: 0ML/day	**50th percentile**: 0.3ML/day	**20th percentile:** 1.7ML/day
	1.5 ARI: N/A	**2.5 ARI**: N/A	**5 ARI**: N/A

Summary of hydrological alteration

Flows do not seem to be altered by more than 20% as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019).

There are no extraction licences in this planning unit.

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[154]	L^0	L^0	L^0	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

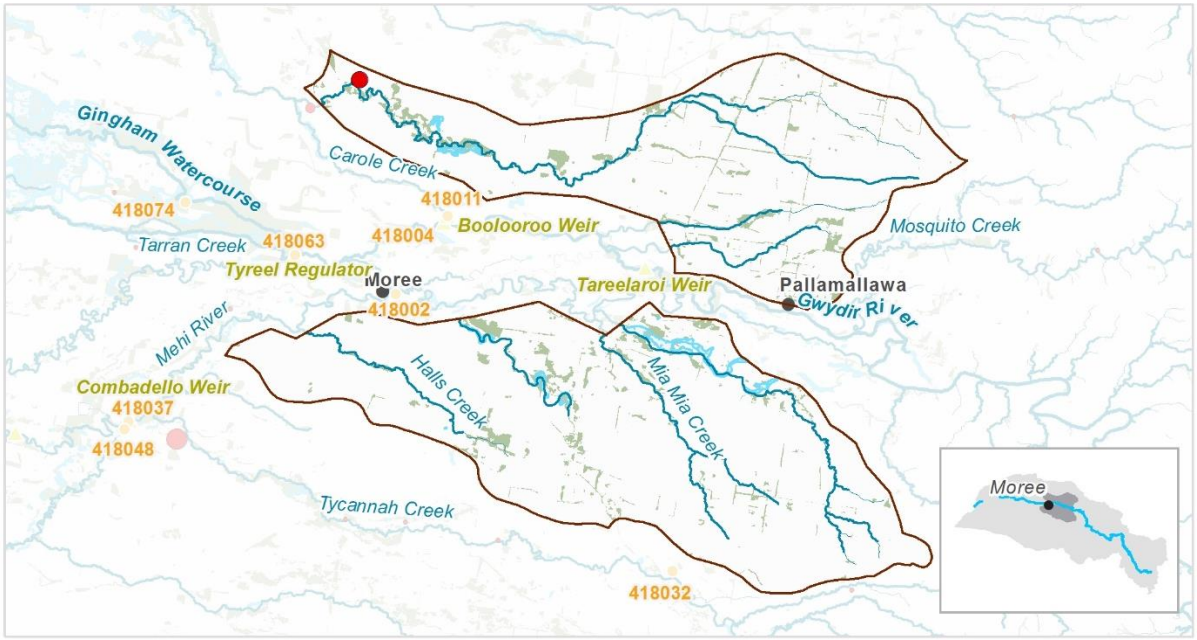
Recommendations

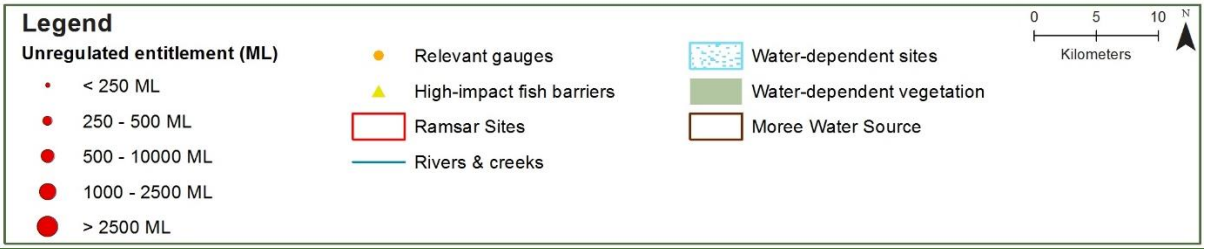
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[153] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[154] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU40: Moree water source





Priority environmental assets and values

In-channel habitat and fringing vegetation communities associated with Marshall's Pond and other tributaries to Gwydir River, Mehi River, and Carole Creek	Mia Mia Lagoon		
Native fish[155]	• carp gudgeon (P) • bony herring (P)	• Australian smelt (P)	• spangled perch (P)
Birds	70 water-dependent bird species recorded, including the listed[156] waterbird species:		
	• eastern great egret	• little curlew	• magpie goose
Native vegetation	14 water-dependent PCTs, including:		
	• river red gum woodlands • river cooba wetlands	• coolibah woodlands and coolibah wetland woodlands • shallow freshwater wetland sedgelands	• water couch marsh grasslands
Registered cultural assets	• Modified trees		

[155] 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)
[156] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

Other species	• spotted grass frog	• yellow-bellied sheathtail bat

Hydrology[157]

No gauge in water source: 418032 *Tycannah Creek at Horseshoe Lagoon*	**80th percentile**: 0ML/day	**50th percentile**: 0ML/day	**20th percentile**: 0.6ML/day
	1.5 ARI: 1876.5ML/day	**2.5 ARI**: 4066.4ML/day	**5 ARI**: 5441.47ML/day

Summary of hydrological alteration

Cease-to-flow periods and low flows are highly altered, and freshes are moderately altered as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). Cease-to-flow periods currently occur more frequently, and low flows and freshes occur less frequently compared to the 'without development' model scenario.

There are two unregulated water access licences (WALs) for production in this water source with a total volume of 1700 ML. One very large WAL for production (1340 ML) is at the bottom of Marshalls Ponds Creek and may increase downstream zero flow periods and reduce baseflows and freshes. The other WAL for production is 360 ML. The principle impact of these WALs may be on connectivity with Carole Creek during low flow and fresh events.

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[158]	H^+	H^-	M^-	L^0	L^0	L^0
Relevant rule	Cease to pump when there is no visible flow Trade not permitted into the water source					

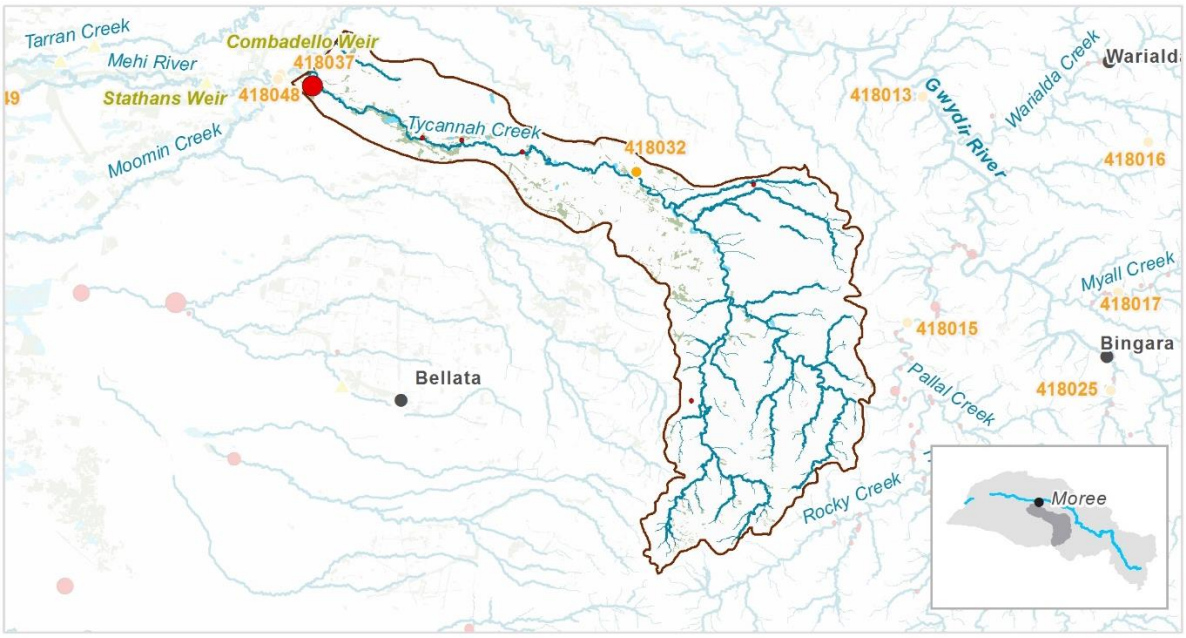
Recommendations

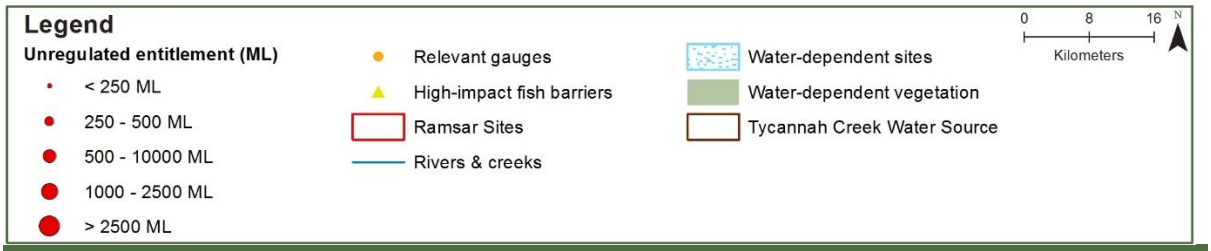
- Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within five years
  - Consider installing water level gauges at or near extraction sites
  - Consider Individual and/or Total Daily Extraction Limits (IDELS / TDELS)
- Investigate opportunities to reduce length of cease-to-flow periods and extraction pressure on baseflows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* 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
- Investigate opportunities to protect higher flows that provide connectivity with Carole Creek in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within next 5 years
  - Consider implementing a commence-to-pump threshold that is higher than cease-to-pump threshold
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[157] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[158] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU41: Tycannah Creek water source





Priority environmental assets and values

Tycannah Creek and its associated in-channel habitat and fringing vegetation communities, and water-dependent assets including, but not limited to:

- Horseshoe Lagoon
- Dirty Lagoon
- Menadool Lagoon
- Mill-Bullah Waterholes
- Gyan Waterhole

Native fish[159]	• unspecked hardyhead • Murray-Darling rainbowfish • freshwater catfish • purple spotted gudgeon	• Australian smelt (P) • spangled perch (P) • golden perch (P)	• Murray cod (P) • carp gudgeon • bony herring (P)
Birds	52 water-dependent bird species recorded, including the listed[160] eastern great egret		
Native vegetation	22 water-dependent PCTs, including: • river red gum woodlands • sedgelands fens wetlands	• river cooba wetlands • coolibah woodlands and coolibah wetland woodlands	• shallow freshwater wetland sedgelands • water couch marsh grasslands

[159] 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)
[160] 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	• Burial sites	
Other species	• eastern sign-bearing froglet • yellow-bellied sheathtail-bat • Corben's long-eared bat • large-eared pied bat	• broad-palmed frog • Peron's tree frog • salmon striped frog	• spotted grass frog • water rat • little pied bat

Hydrology[161]

Gauge: 418032 *Tycannah Creek at Horseshoe Lagoon*	**80th percentile**: 0.1ML/day	**50th percentile**: 5.4ML/day	**20th percentile**: 28ML/day
	1.5 ARI: 5955.3ML/day	**2.5 ARI**: 14386.3ML/day	**5 ARI**: 19251.1ML/day

Summary of hydrological alteration

Cease-to-flow periods and low flows are highly altered as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). 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 2780 ML, of which 2768 ML are for production. There are five unregulated WALs for production <250 ML that are distributed throughout Tycannah Creek planning unit. This means that lower flows may be substantially impacted by extraction (as confirmed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area*).

In addition, there is one large unregulated WAL for production >2500 ML (2592 ML) that is located at the bottom of Tycannah Creek. It may have a significant impact on connectivity with the Mehi River during low flow and fresh events and may also increase downstream cease-to-flow periods and reduce baseflows and freshes.

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[162]	H^+	H^-	L^-	L^-	L^-	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

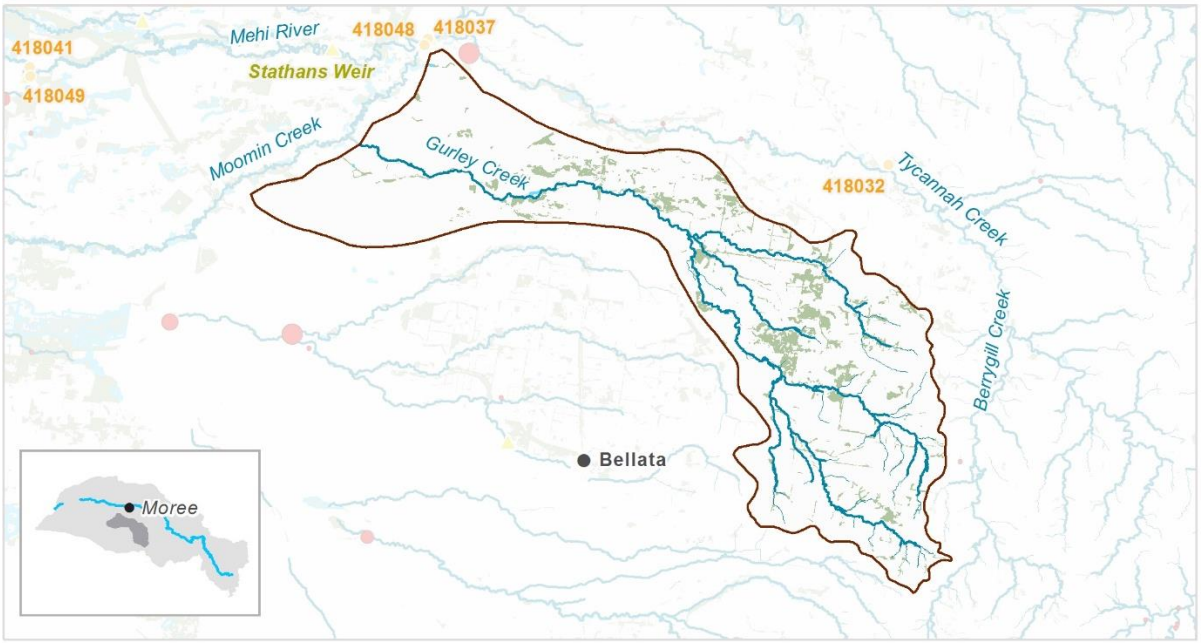
Recommendations

- Investigate opportunities to reduce length of cease-to-flow periods and extraction pressure on baseflows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* 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 installing water level gauges at or near extraction sites
  - Consider rostering landholder water access
  - Consider Individual and/or Total Daily Extraction Limits (IDELS / TDELS)
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.

[161] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.
[162] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

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

PU42: Gurley Creek water source



Priority environmental assets and values			
Gurley Creek and its associated in-channel habitat and fringing vegetation communities			
Native fish[163]	• unspecked hardyhead (P) • carp gudgeon (P)	• Australian smelt (P) • spangled perch (P) • bony herring (P)	• freshwater catfish (P) • purple spotted gudgeon (P)
Birds	34 water-dependent bird species recorded, including the listed[164] eastern great egret		

[163] 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)

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

Native vegetation	20 water-dependent PCTs, including:		
	• river red gum woodlands • river cooba wetlands	• coolibah woodlands and coolibah wetland woodlands • shallow freshwater wetland sedgelands	• water couch marsh grasslands
Registered cultural assets	• Modified trees		
Other species	• broad-palmed frog • Peron's tree frog	• eastern snake-necked turtle	• little pied bat

Hydrology[165]

No gauge in water source: 418032 *Tycannah Creek at Horseshoe Lagoon*	**80th percentile**: 0.1ML/day	**50th percentile**: 2ML/day	**20th percentile**: 10.2ML/day
	1.5 ARI: 2390.1ML/day	**2.5 ARI**: 5259.1ML/day	**5 ARI**: 7037.7ML/day

Summary of hydrological alteration

Flows do not seem to be altered by more than 20% as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019).

There are no extraction licences in this planning unit.

	Cease-to-flow	**Low flow and Baseflow**	**Freshes**	**High and infrequent flows**		
				1.5 ARI	**2.5 ARI**	**5 ARI**
Hydrological alteration[166]	L^0	L^0	L^0	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

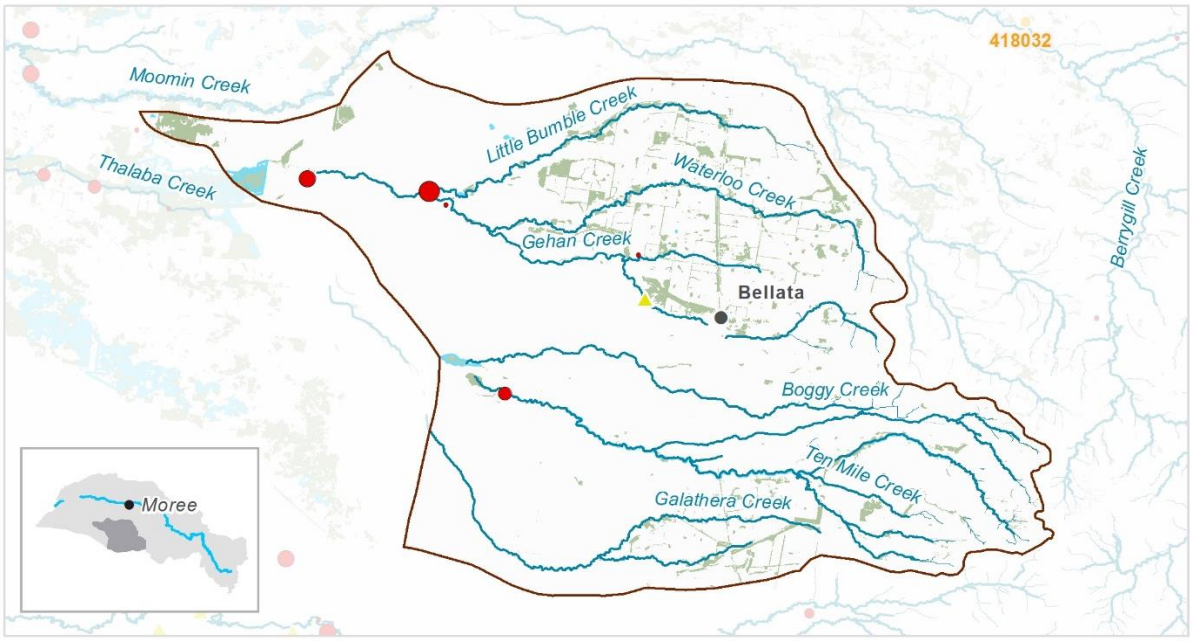
Recommendations

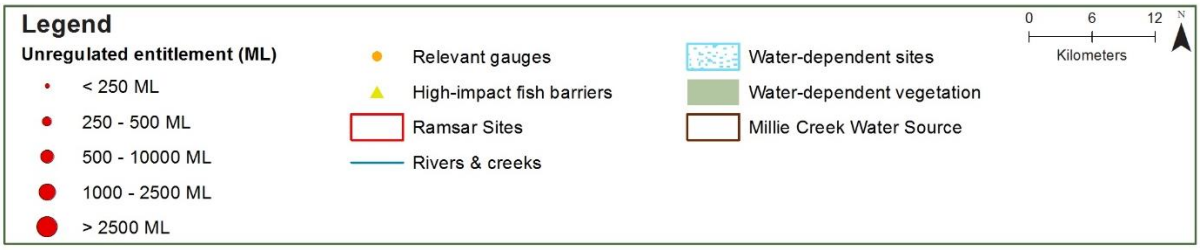
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[165] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[166] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU43: Millie Creek water source





Priority environmental assets and values

Numerous small creeks including, but not limited to Millie Creek, Little Bumbie Creek, Waterloo Creek, Gehan Creek, Boggy Creek, Ten Mile Creek and Galathera Creek

Multiple creeks associated in-channel habitat and fringing vegetation communities

Native fish[167]	• unspecked hardyhead (P) • freshwater catfish (P) • Murray-Darling rainbowfish (P)	• spangled perch (P) • golden perch (P) • bony herring (P) • Murray cod (P)	• purple spotted gudgeon (P) • Australian smelt (P) • carp gudgeon (P)
Birds	44 water-dependent bird species recorded		
Native vegetation	20 water-dependent PCTs, including: • coolibah woodlands and coolibah wetland woodlands • sedgeland fens wetlands	• river red gum woodlands • lignum shrubland wetlands	• water couch marsh grasslands • shallow freshwater wetland sedgelands
Registered cultural assets	• Modified trees	• Burial sites	• Camping sites
Other species	• salmon striped frog	• spotted grass frog	

[167] 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)

Hydrology[168]			
No gauge in water source: 418032 *Tycannah Creek at Horseshoe Lagoon*	**80th percentile**: 0.1ML/day	**50th percentile**: 3.8ML/day	**20th percentile**: 019.4ML/day
	1.5 ARI: 4117.4ML/day	**2.5 ARI**: 9947.6ML/day	**5 ARI**: 13311.8ML/day

Summary of hydrological alteration

Cease-to-flow periods and low flows are highly altered, as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). 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 6281 ML, of which 6247 ML are for production. There are two unregulated WALs for production <250 ML, one between 500-1000 ML, one between 1000-2500 ML, and one >2500 ML (4099 ML).

Two large, unregulated WALs for production (1458 ML and 4099 ML) are located at the bottom of Millie Creek, which may increase downstream cease-to-flow periods and reduce baseflows and freshes (as confirmed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area*). The principle impact may be on connectivity with Moomin Creek during fresh events.

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[169]	H^+	H^-	L^-	L^-	L^-	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

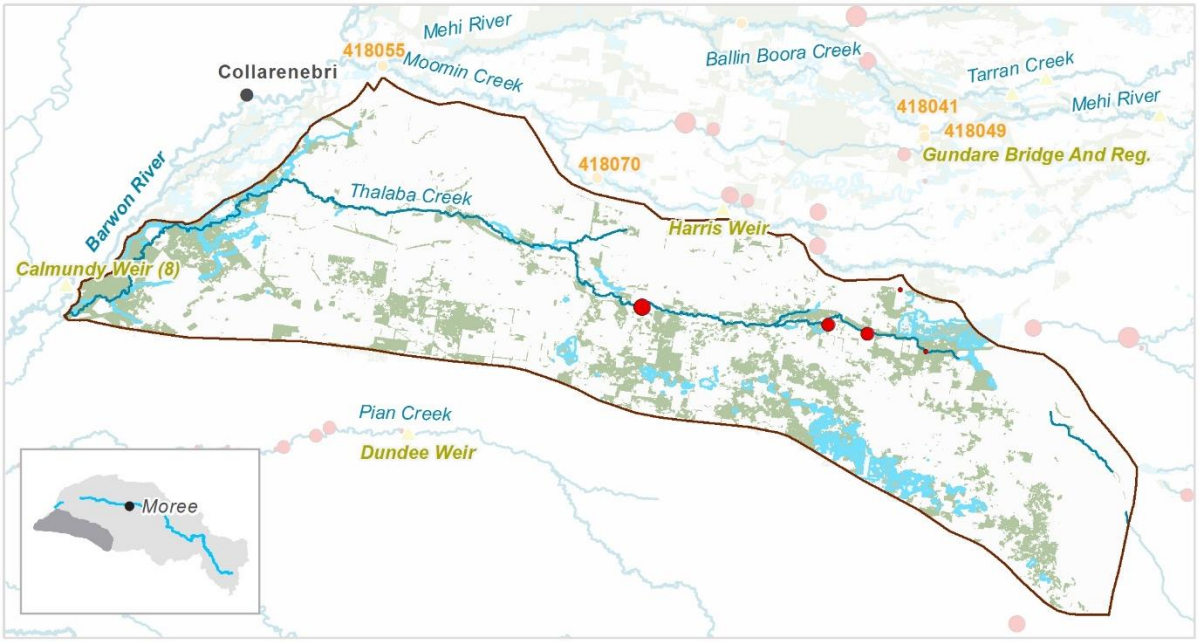
Recommendations

- Investigate opportunities to reduce length of cease-to-flow periods and extraction pressure on baseflows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* 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 installing water level gauges at or near extraction sites
    - Consider Individual and/or Total Daily Extraction Limits (IDELS / TDELS)
- Investigate opportunities to protect flows that provide connectivity with the Moomin Creek planning unit in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within next five years
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.
- Monitor floodplain harvesting take and review access rules if impacts on the environment are present

[168] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[169] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU44: Thalaba Creek water source



Priority environmental assets and values

Thalaba Creek and its associated in-channel habitat and fringing vegetation communities, and water-dependent assets including, but not limited to:

- Jews Lagoon
- Camp Lagoon
- Mallarum Waterholes
- Pidgee Waterhole
- Collytootela Lagoon
- Brigalow Tree Waterhole

Native fish[170]	• unspecked hardyhead (P) • Murray-Darling rainbowfish (P) • purple spotted gudgeon (P)	• Australian smelt (P) • spangled perch • golden perch • silver perch (P)	• Murray cod (P) • olive perchlet (P) • bony herring • carp gudgeon (P)
Birds	46 water-dependent bird species recorded, including the listed[171] waterbird species		
	• cattle egret	• eastern great egret	• brolga
Native vegetation	18 water-dependent PCTs, including:		
	• black box woodland wetlands • coolibah woodlands and coolibah wetland woodlands	• shallow freshwater wetland sedgelands	• water couch marsh grasslands

[170] 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)

[171] 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	• eastern sign-bearing froglet • yellow-bellied sheathtail-bat • eastern snake-necked turtle	• broad-palmed frog • Peron's tree frog	• salmon striped frog • spotted grass frog

Hydrology[172]

Summary of hydrological alteration

No hydrological modelling data is available for this water source due to the effluent nature of the watercourse. Streams are connected by overland flows.

The total volume of unregulated entitlements in the planning unit is 3805 ML, of which 3788 ML are for production. There are two unregulated WALs for production between 500-1000 ML, and two between 1000-2500 ML.

The unregulated WALs for production, especially the two larger ones, may impact on wetland inundating flows in the Lower Gwydir planning unit and reduce connectivity with the Barwon River.

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[173]	N/A	N/A	N/A	N/A	N/A	N/A
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

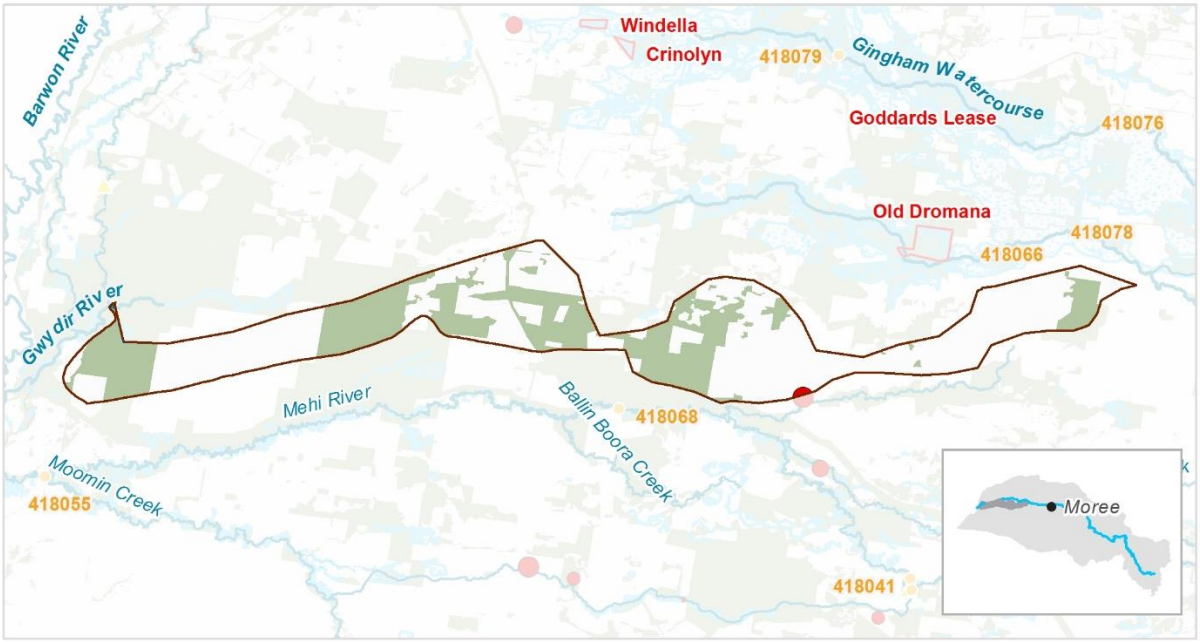
Recommendations

- Investigate opportunities to reduce extraction pressure on in-channel and floodplain wetland inundating 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 a commence-to-pump threshold that is higher than cease-to-pump threshold
  - Consider installing water level gauges at or near extraction sites
  - Consider rostering landholder water access
  - Consider Individual and/or Total Daily Extraction Limits (IDELS / TDELS)
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.
- Monitor floodplain harvesting take and review access rules if impacts on the environment are present

[172] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[173] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU45: Gwydir water source



Priority environmental assets and values

Outer floodplain vegetation communities associated with the Gwydir watercourse

Native fish[174]	• carp gudgeon • Murray-Darling rainbowfish • bony herring • Australian smelt (P)	• golden perch • spangled perch • silver perch (P)	• Murray cod (P) • olive perchlet (P) • purple spotted gudgeon (P)
Birds	27 water-dependent bird species recorded, including the listed[175] waterbird species: • magpie goose • eastern great egret • brolga		
Native vegetation	Seven water-dependent PCTs, including: • black box woodland wetlands • coolibah wetland woodlands • river cooba wetlands		
Registered cultural assets	• Modified trees	• Resources and gathering sites	

[174] 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)

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

Other species	• salmon striped frog • spotted grass frog • eastern snake-necked turtle

Hydrology[176]

Summary of hydrological alteration

Freshes and overbank flows are highly altered as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). Freshes and overbank flows occur less frequently compared to the 'without development' model scenario, which may be mostly influenced by planned and held environmental water from the regulated river.

The total volume of unregulated entitlements in the planning unit is 86.5 ML, of which 82 ML are for production. There is one unregulated WAL for production <250 ML (82 ML).

Water captured by Copeton Dam and water extracted upstream of the planning unit for production are most likely the main reasons for the high degree of hydrological alteration in high and infrequent flows.

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[177]	L^0	L^0	H^-	H^-	H^-	H^-
Relevant rules	Trade not permitted into the water source Very low flow – cease to pump when flows at Gwydir River at Millewa (418066) are ≤ 250ML/day A Class – access when flows at Gwydir River at Millewa (418066) are ≥250ML/day Access when the flow is greater than the announced environmental water flow in ML/day					

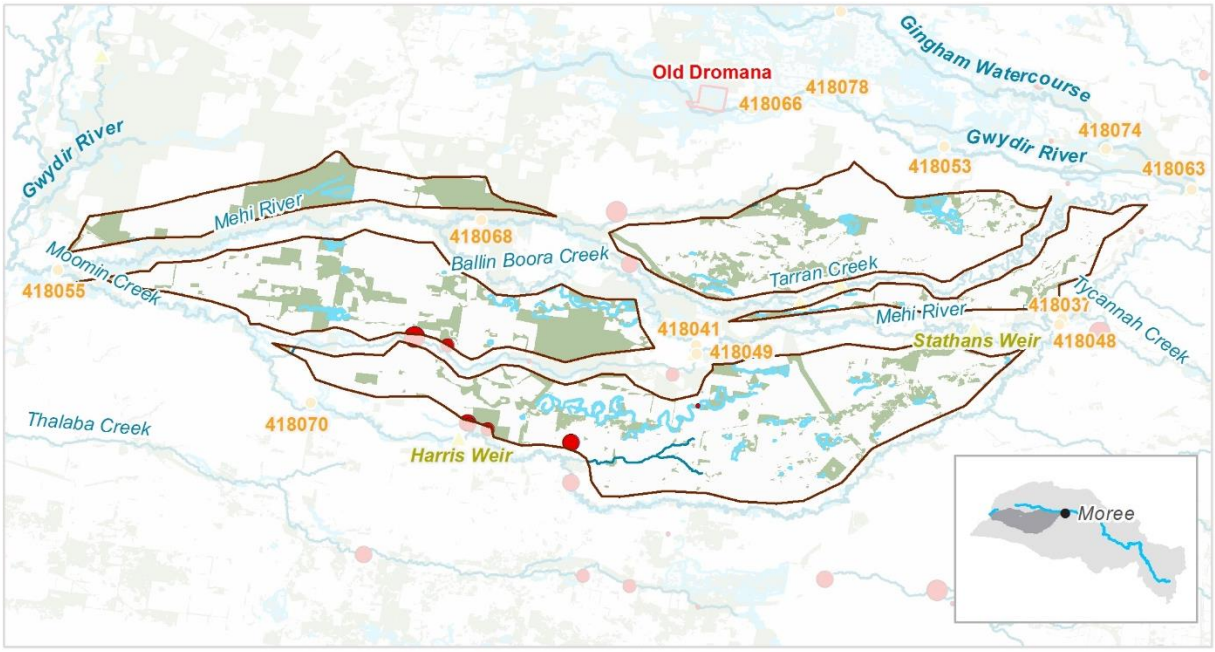
Recommendations

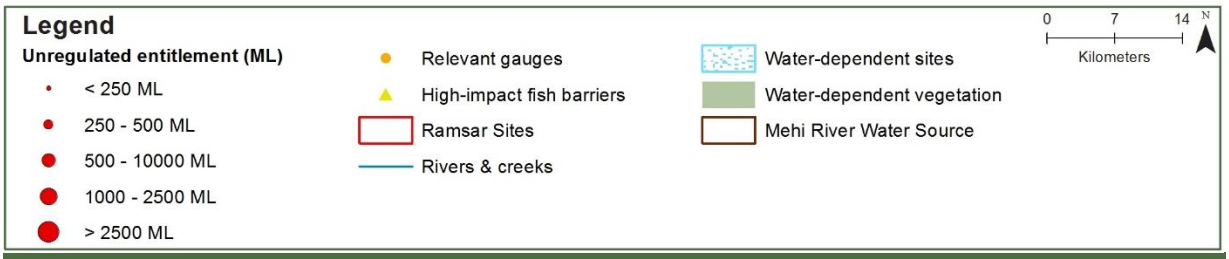
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[176] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[177] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU46: Mehi water source





Priority environmental assets and values

Outer floodplains associated with the Mehi River, and Mallowa and Moomin Creek and water-dependent assets including, but not limited to:

- Wolongimba Creek
- Mogo Watercourse

Native fish[178]	• carp gudgeon • Murray-Darling rainbowfish • Australian smelt	• spangled perch • golden perch (P) • silver perch (P) • bony herring	• Murray cod • olive perchlet (P) • purple spotted gudgeon (P)
Birds	70 water-dependent bird species recorded, including the listed[179] waterbird species		
	• black-necked stork • Australian painted snipe • eastern great egret	• brolga • Latham's snipe • cattle egret	• wood sandpiper • marsh sandpiper • Caspian tern
Native vegetation	17 water-dependent PCTs, including:		
	• river red gum woodlands	• coolibah woodlands and coolibah wetland woodlands • black box woodland wetlands	• water couch marsh grasslands

[178] 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)
[179] Listed as Commonwealth or NSW threatened (Vulnerable, Endangered or Critically Endangered) or under international migratory bird agreements (JAMBA, CAMBA, ROKAMBA)

	• lignum shrubland wetlands	
Registered cultural assets	• Modified trees	
Other species	• spotted grass frog	• eastern snake-necked turtle

Hydrology[180]

Summary of hydrological alteration

Flows do not seem to be altered by more than 20% compared to the 'without development' model scenario as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019).

There are 13 unregulated WALs in this water source with a total volume of 14,791 ML, of which 14,742 ML are general security. Several very large licences (between 1,000 ML and 5,000 ML) are located throughout the planning unit, which may impact on connectivity with the Mehi River during low flows or fresh events.

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[181]	L^0	L^0	L^0	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

Recommendations

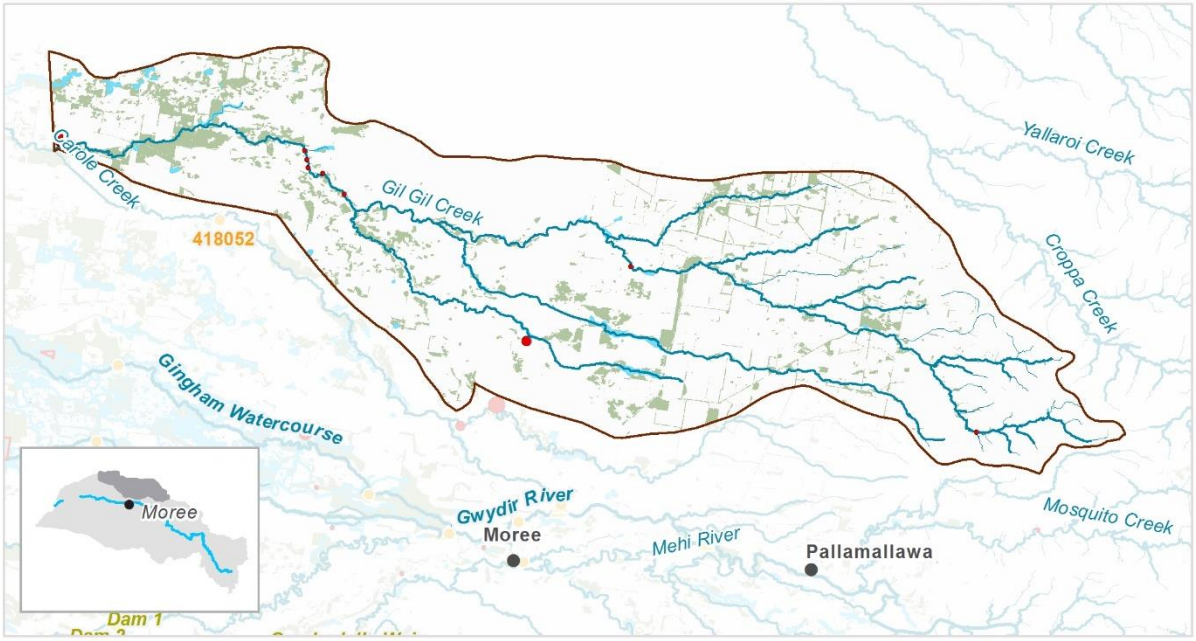
- Investigate introducing cease-to-pump and commence-to-pump rules (and any associated required amendments to WAL conditions) that protect held and planned environmental water entering unregulated streams and off-channel pools (wetlands).[182]
    - Consider protection of water for the environment from the Lower Gwydir and Zone A Mehi planning units into the Mehi water source planning unit to reduce impact on freshes and overbank flows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* within five years
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.
- Monitor floodplain harvesting take and review access rules if impacts on the environment are present

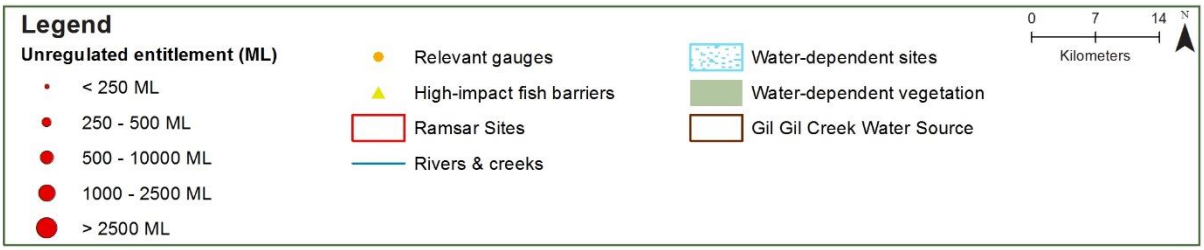
[180] There are limitations to the flow data available in the unregulated water sources of the Gwydir catchment. The flow statistics used were mainly generated from measured data and vary in duration and cover different climatic periods. In addition, some flow sequences had gaps that were filled using correlations with nearby gauges.

[181] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

[182] 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).

PU47: Gil Gil Creek water source





Priority environmental assets and values

Gil Gil Creek and its associated in-channel habitat and fringing vegetation communities, and water-dependent assets including, but not limited to:

- Gunnyanna Waterhole
- Wadden Wadden Waterhole
- Bengerang Waterhole
- Wallon Creek
- Bengerang Waterhole

Native fish[183]

- freshwater catfish (P)
- Murray-Darling rainbowfish (P)
- purple spotted gudgeon (P)
- bony herring
- golden perch
- silver perch (P)
- Murray cod (P)
- olive perchlet (P)
- carp gudgeon
- spangled perch
- Australian smelt (P)

Birds

54 water-dependent bird species recorded, including the listed[184] waterbird species:

- black-necked stork
- eastern great egret
- brolga

[183] 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)

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

Native vegetation	18 water-dependent PCTs, including: • river red gum woodlands • lignum shrubland wetlands • coolibah woodlands and coolibah wetland woodlands • black box woodland wetlands • water couch marsh grasslands
Registered cultural assets	• Fishing areas
Other species	• eastern sign-bearing froglet • large-eared pied bat • spotted grass frog • water rat • little pied bat • eastern cave bat

Hydrology[185]

Summary of hydrological alteration

Cease-to-flow periods are moderately altered, and low flows are highly altered, as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). Cease-to-flows currently occur more frequently and low flows occur less frequently compared to the 'without development' model scenario.

There are ten unregulated WALs in this water source with a total volume of 1502.5 ML, of which 1421 ML are general security. These small to medium licences are distributed along Gil Gil Creek. One large licence (648 ML) exists at the bottom of the unregulated section of Gil Gil Creek, which may impact on connectivity with the downstream regulated section.

	Cease-to-flow	**Low flow and Baseflow**	**Freshes**	**High and infrequent flows**		
				1.5 ARI	**2.5 ARI**	**5 ARI**
Hydrological alteration[186]	M^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

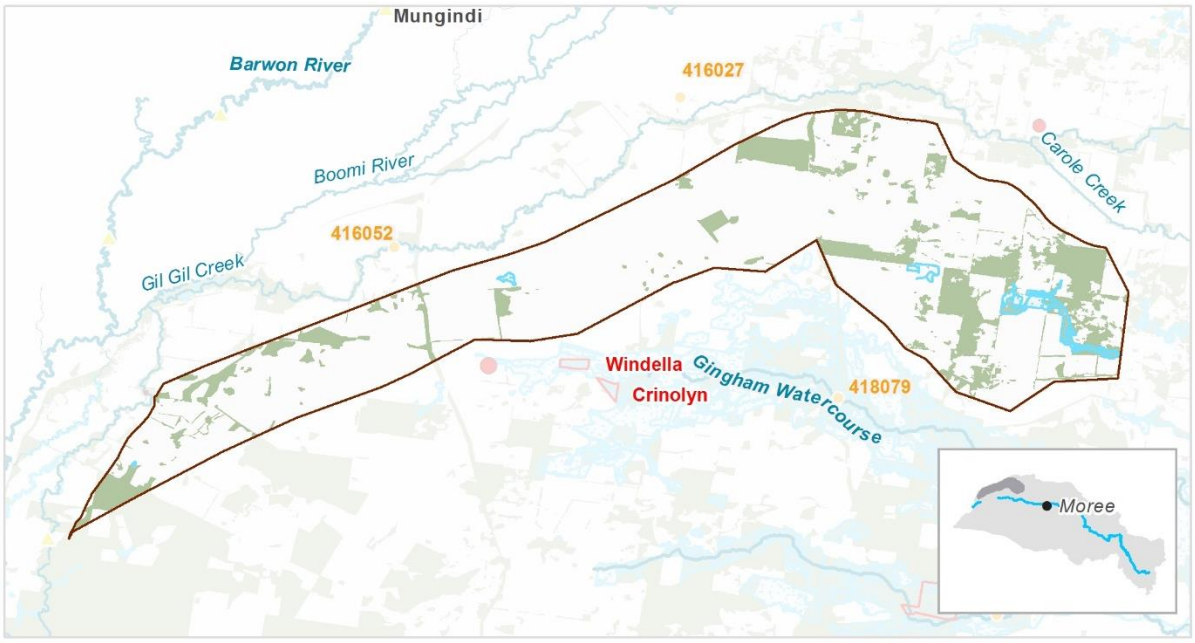
Recommendations

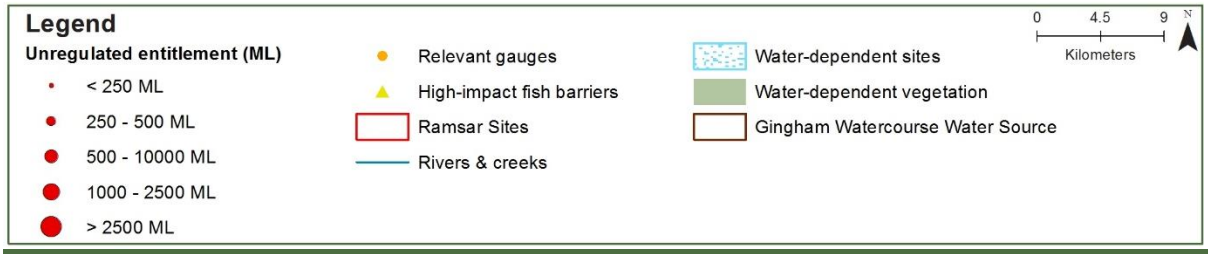
- Investigate potential impact of extraction pressure on ability to meet EWRs in the Gil Gil planning unit within five years.
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.

[185] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[186] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU48: Gingham water source





Priority environmental assets and values

Outer floodplain vegetation communities associated with the Gingham watercourse	
Native fish[187]	• carp gudgeon (P) • Murray-Darling rainbowfish (P) • bony herring (P) • spangled perch (P) • golden perch (P) • Murray cod (P)
Birds	8 water-dependent bird species recorded including the listed[188]eastern great egret
Native vegetation	13 water-dependent PCTs, including: • black box woodland wetlands • coolibah woodlands and coolibah wetland woodlands • water couch marsh grasslands
Registered cultural assets	None registered
Other species	None recorded

[187] 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)

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

Hydrology[189]

Summary of hydrological alteration

Freshes and overbank flows are highly altered as assessed by the *Risk assessment for the Gwydir Surface Water Resource Plan Area* (DPIE–Water 2019). Freshes and overbank flows occur less frequently compared to the 'without development' model scenario, which may be mostly influenced by planned and held environmental water from the regulated river.

There are two unregulated WALs in this water source with a total volume of 2265 ML, of which 2260 ML are general security. One very large licence (1612 ML) exists within the Gingham water source planning unit.

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[190]	L^0	L^0	H^-	H^-	H^-	H^-
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source Access when the flow is greater than the announced environmental water flow in ML/day					
	Upper Gingham Watercourse MZ Cease to pump when flows at Tillaloo (418076) is≤250ML/day A Class – access when flow at Tillaloo (418076) is ≥250ML/day		**Lower Gingham Watercourse MZ** Very low flows – access when the flow depth at Gingham Bridge (418079) is >1m and <4000ML/day and there is visible flow at the Gingham Watercourse at Morialta Road A Class – cease to pump when the flow depth at Gingham Bridge (418079) is <1m and <4000ML/day and there is no visible flow at the Gingham Watercourse at Morialta Road			

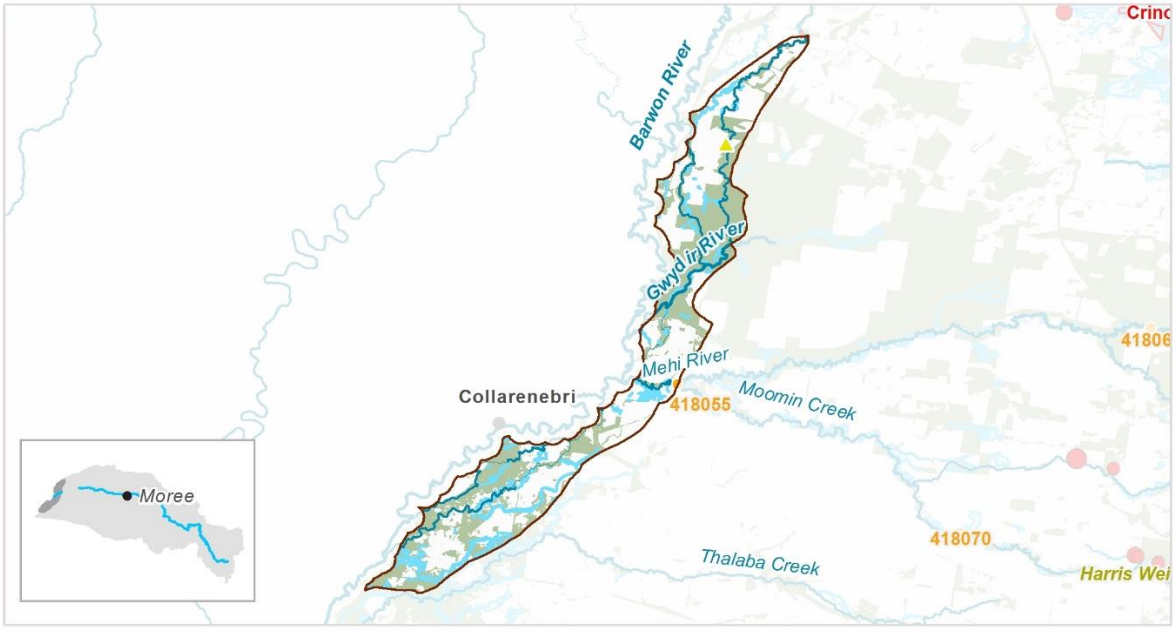
Recommendations

- Consider protection of water for the environment from the Gingham Watercourse planning unit into the Northern Gingham Floodplain planning unit to reduce impact on freshes and overbank flows in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* and the Gwydir WRPA WSP within five years.
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* that protect environmental assets and values.
- Ensure compliance with water access licence conditions including through metering of all licensed extraction.
- Monitor for changes in water demand and review access rules if current usage is high or if the pattern of use changes.
- Monitor floodplain harvesting take and review access rules if impacts on the environment are present

[189] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[190] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

PU49: Barwon water source



Priority environmental assets and values

Floodplain and wetland vegetation communities associated with Barwon River, and water-dependent assets including, but not limited to:

- Collymongle Lagoon
- The Big Waterhole
- First Lagoon
- Second Lagoon
- Butti Lagoon

Native fish[191]	• carp gudgeon (P) • Murray-Darling rainbowfish (P) • Australian smelt (P)	• spangled perch (P) • golden perch (P) • silver perch (P) • bony herring (P)	• Murray cod (P) • olive perchlet (P) • purple spotted gudgeon (P)
Birds	24 water-dependent birds recorded		
Native vegetation	10 water-dependent PCTs, including: • river red gum woodlands • black box woodlands	• coolibah woodlands and coolibah wetland woodlands	• lignum shrubland wetlands
Registered cultural assets	• Modified trees	• Resource and gathering sites	
Other species	• spotted grass frog		

[191] 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)

Hydrology[192]

Summary of hydrological alteration

No extraction licences in this planning unit

	Cease-to-flow	Low flow and Baseflow	Freshes	High and infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration[193]	N/A	N/A	N/A	N/A	N/A	N/A
Relevant rules	Cease to pump when there is no visible flow Trade not permitted into the water source					

Recommendations

- Investigate opportunities to protect flows from the Lower Mehi and Gil Gil Creek planning units that provide connectivity with the Barwon River during ecologically relevant times in the *Water Sharing Plan for the Gwydir Unregulated Water Sources* and the *Gwydir Regulated River Water Sharing Plan* within five years[194]
- As a minimum, maintain existing rules in the *Water Sharing Plan for the Gwydir 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.

[192] There are limitations to the flow data available in the unregulated water sources of the Gwydir 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 had gaps that were filled using correlations with nearby gauges.

[193] See Table 1 for explanatory text on how to interpret the degree of hydrological alteration.

[194] 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).

References

NSW DPIE–Water 2019, *Risk Assessment for the Gwydir Water Resource Plan Area (SW15)*, NSW Department of Planning, Industry and Environment.

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.