

Murray–Darling Basin Authority’s submission to the New South Wales Natural Resources Commission review of the 2012 Barwon–Darling Water Sharing Plan

Introduction

The recent events in the Barwon–Darling emphasise the need for water management arrangements across the entire Basin that reflect contemporary best practice. Best practice actively manages flows to appropriately share between consumptive, environmental and other users, is adaptable to allow for significant climate variability, is based on best available information, and considers and provides for Traditional Owner, community and stakeholder expectations.

Since 2012, when the current Barwon–Darling water sharing plan (WSP) was put in place, a significant body of work has been carried out to better understand water systems in the northern Basin. The Murray–Darling Basin Authority’s (MDBA) [Northern Basin Review](#) was undertaken over 2013 – 2016, during which time the MDBA heard significant community concerns with the operating arrangements in the 2012 Barwon–Darling WSP.

Changes introduced to the WSP in 2012 significantly altered past access rules and usage patterns. These changes are broadly considered to have had an overall negative effect on environmental outcomes, with these concerns raised by Ken Matthews as part of his [review](#) into water management and compliance, and also through two independent expert reviews into the 2018/19 fish deaths ([Australian Academy of Science](#) and the Professor Vertessy led [Independent assessment of the 2018-19 fish deaths in the Lower Darling](#)).

All of the reviews recommended actions to improve water management in the Barwon–Darling, including the introduction of an active management framework for extractions, rules to improve connectivity and placing limits on daily extractions. Many recommendations were specifically targeted at managing low flows. The Barwon–Darling is an ephemeral river system, a natural result of the climate and river morphology across the northern Basin. Dry periods are an inherent characteristic of the region. The importance of low flows, and their degradation over recent years, is a consistent message received by the MDBA from scientists, community members and cultural custodians. This is further reinforced by the MDBA’s 2018 [studies](#) into the low flow needs of the Barwon–Darling system, and observed changes in flow character since the early 2000s.

The 2012 WSP has now been in operation for more than six years. This review presents an opportunity to consider its settings in the context of current best practice for Basin water management, both through a body of work that considers what can be done now, and also what is needed over the longer term to fully implement event based, active management. This transition will underpin a well-managed, sustainable and working river system into the future.

In the following sections we will set out:

- the imperative to **move towards full active, event based management for the Barwon–Darling system (section 1)**
- **tools and capabilities required to support full active, event based management (section 2)**
- **interim steps** that can be logically taken in the current **Barwon Darling WSP review (section 3)**
- the process that might be used to **progressively strengthen active, event based management as stakeholder and community confidence is built (section 4).**

Section 1 – Active, event-based management - critical for northern Basin catchments.

The northern Basin is characterised by a very flat landscape, hot and highly variable climate and limited capacity to store water. The volumes of water involved in maintaining river health are small – almost to the point of being immaterial in overall take. However, these flows are critical to maintaining ecological health.

Under the Basin Plan water extractions are regulated against a long term average, known as the sustainable diversion limit (SDL). The SDL is necessary to limit the amount of take to a sustainable level but is insufficient as a management tool to ensure the sustainable stewardship of water resources, particularly in the unregulated rivers of the north. Equally critical to the level of take in these catchments is the active management of flows when and where they occur. For example:

- in drier times, i.e. periods of lower flows, the protection of base and freshing flows is essential to maintain the ecological function and health of the river – both within the catchment and downstream
- in times of flood water spills over onto the floodplain, providing plentiful access for both consumptive and environmental entitlement holders, and an adequate supply to downstream users
- in periods of medium-intermediate flows, the task of balancing management objectives becomes more nuanced – focussed on equitably sharing available water between all users, consumptive and environmental and also upstream and downstream.

As a result of the scientific analysis undertaken and community feedback received in the MDBA's [Northern Basin Review](#), the final recommendations placed an emphasis on the improved management of flows. A series of 'toolkit measures' was proposed, which aim to more effectively target water management arrangements to deliver balanced outcomes in a highly variable environment.

Currently, access is managed through passive tools, including regulation of pump sizes, pumping thresholds, daily extraction limits, carryover provisions, first flush rules and shepherding arrangements for held environmental water. The MDBA submits that on first/best policy principles, a full shift from passive operating rules to active event based management is a fundamental long-term requirement to safeguard Barwon–Darling water dependent ecosystems and Aboriginal cultural and heritage values, ensure all users have certainty of access against their entitlements, and to achieve community confidence that the resource is being shared and managed equitably.

The principles of active management mirror those of the southern system where water is called from an independent operator. Management, in the complex context of highly variable flows, is appropriately shifted to an independent operator who is guided by a clear set of operating principles. These include requirements to:

- allow consumptive users to take water as per their share of entitlements under the annual permitted take set under the Basin Plan
- protect both planned and held environmental water
- maintain connectivity within and between catchments
- protect low flows and freshing flows after extended dry periods.

The independent operator would announce each users' share of the water volume anticipated from a rainfall/flow event, and determine the timing and volume of take. User reliability is underpinned by the operator's requirement to fairly distribute against the Basin Plan SDL for the catchment over time. The timing for when users are able to pump to storages, and the volume of water allowed, would be tightly regulated. Actions such as metering and secondary verification from remote sensing data are required to support this process for the purposes of compliance.

It is not possible to optimise and enforce the required rules under passive management. Passive controls, or a 'set and forget' approach based on water licence rules, do not allow for the required management actions to be fully codified or implemented. Active controls are required for systems with high levels of uncertainty, in this case amplified by the impacts of climate change that include more frequent occurrences of dry periods and days of extreme heat, both factors being preconditions for ecological stress.

Since the Northern Basin Review, much work has been done across relevant Basin governments to ensure active management requirements in the toolkit measures are implemented. For example, NSW has made amendments to the Barwon–Darling WSP through the *NSW Water Management Amendment Act 2000*, which allow changes to access rules to implement active management in the system. This will allow for a transition to management arrangements consistent with the above principles.

There is a strong imperative to initiate active management in the Barwon–Darling as an urgent priority, preferably in the 2019/20 water year. This imperative has multiple drivers, including the current drought across the northern Basin and the need for the next flow through the system to be well-managed (and for the community to see that it is well-managed). The MDBA recognises, however, that fully transitioning the Barwon–Darling to an actively managed system will require time.

The policy shift away from the passive management of take through long-term averages to more active, event-based management is a fundamental change in management philosophy. Reforms of this kind are a long-term endeavour, and existing arrangements need to evolve rather than undergo sudden alteration. Work is required to understand, consult communities and negotiate the required changes. The changes are likely to be more labour-intensive for NSW operators, and it is also expected that the accuracy for the announced volume extraction system will, at first, have greater uncertainty compared to other areas with similar arrangements. However, knowledge will increase, and methods will be refined, to give consumptive users confidence that they can reliably access water in ways that support their businesses and give downstream and environmental users better management of water demands, particularly in drought conditions, to ensure appropriate sharing of intermediate flows.

In the interim, the MDBA recommends a combination of active management supplemented by passive controls to be embedded in the next version of the WSP, supported by a series of published operating protocols. This is a necessary first step that can be completed with existing knowledge and tools.

Section 2: Capabilities required to support active event-based management

Shifting the Barwon–Darling to an active management system has many challenges which fall into three categories: technical, system management, and community acceptance.

Listed below are the main capabilities required for changes in both the short and long term. Some capabilities are already present but may require additional refinements, and some do not yet exist and will require investment and resourcing to progress.

Technical challenges

Existing technology and forecasting tools provide the necessary essential technical elements to support active management, albeit with some caveats (detailed below). This assessment is based on discussions with NSW officials and hydrology experts, combined with MDBA analysis during Basin Plan development and implementation. The tools are sometimes manual and have some uncertainty, and hence there will be a need for improvement through adaptive management principles. Overall, however, the essential elements exist.

The technical challenges include:

Ability to predict water volumes generated by individual rainfall events

Predicting flow in the northern Basin, and especially through the Barwon–Darling, is a complex undertaking. The period between rainfall and flow into the Barwon–Darling is long, typically a few weeks. Water transmission rates are dependent on water consumption volumes both through natural processes (such as seepage and evaporation) and via water extraction, some of which is currently not measured (floodplain harvesting). Natural consumption is highly dependent on antecedent conditions and the prevailing climate, and is therefore difficult to forecast.

These difficulties apply to the tributaries of the Barwon–Darling, many of which end in large distributary networks before water passes downstream. The floodplains consume large (and often uncertain) volumes of water through natural processes, and also often contain significant volumes of supplementary and unregulated extraction (also uncertain and sometimes unmeasured). Forecasting from a rainfall event to an end of system flow for the tributaries is therefore highly uncertain. Similar uncertainties also apply once the water passes into the Barwon–Darling — for example, in dry periods the river separates into a series of disconnected pools and requires large (but indeterminate) volumes to ‘restart’.

Despite these issues, it is the MDBA’s view that existing technology and forecasting tools provide the essential elements that will be necessary for the active management of flows through the Barwon–Darling system. The biggest impact of the forecast uncertainty will be a period of increased labour intensity for NSW operators during the first generation of adaptive management.

The MDBA expects that there will be ongoing investment to improve forecast capability over coming years. A detailed description of the requirements is given in section 4.

Ability to model and track flows within and between catchments

Effective water policy and management is built on good data. This includes a wide array of long-term measurements regarding river flow, losses, extraction, and climatic conditions. It also includes tools to allow managers and policy makers to capture and interrogate this data and make evidence-based decisions.

Hydrologic models are a crucial tool for water management. Based on experience gained through Basin Plan development and the Northern Basin Review, the MDBA found that the NSW Barwon–

Darling hydrologic model requires improvement. The [Podger et al. \(2010\)](#) report 'River System Modelling for the Basin Plan: Assessment of fitness for purpose' rated the Barwon–Darling model's ability to assist with water policy development as 'very poor'. The MDBA's experience using this model found that it was suitable to assist with long-term macro decisions (such as determining the SDL), but had a number of weaknesses which limited its utility on other fronts.

Improving this utility is a necessary step if the model is to assist with the development and implementation of (for example) toolkit measures. Specific weaknesses to be addressed are listed in section 4.

Over coming years active management will also require additional investment in gauge station data. This has two over-arching purposes: to provide improved day-to-day flow tracking data to support daily operations, and to provide a long-term dataset to support management and policy decisions. More detail on these requirements is provided in section 4.

Ability to measure and monitor water take

Accurate metering and measurement are fundamental for water management, compliance and community confidence. They are also vital for a successful active management framework. For these reasons, pumping in the Barwon–Darling should not occur without a meter. The Australian Standard (AS4747) requires meters to be accurate to within +5% to -5%. However, the standard is not mandated and most meters sold in Australia have not passed the required testing.

The MDBA has worked with Basin governments to produce the [Murray–Darling Basin Compliance Compact](#) (the Compact). It aims to restore public confidence in water resource management in the Basin by providing transparency and accountability of surface and groundwater management and regulation, and a consistent approach to compliance and enforcement practices by governments across the Basin.

As a result of its review into compliance across the Basin, the MDBA set a metering target of 95% per water resource area for meterable take to meet a 'no meter, no pump' principle, while avoiding undue cost burdens on small entitlement holders. The question of who should own the meter, government or the entitlement holder, has been strongly contested in recent times. The compliance review found that either approach can work – the more important matter is to ensure meters are of a suitable standard, installed correctly and audited for accuracy.

More detail on specific recommendations relating to metering accuracy and telemetry is provided in section 4.

Floodplain harvesting cannot be metered, but NSW have committed to bringing this form of take into the entitlement framework with all associated monitoring and compliance requirements. In this regard, storage level recorders calibrated by volumetric survey data of individual storages are an important source of data. This is important for updating policy and planning tools (such as the hydrologic model).

The development and use of remote sensing technology (i.e. satellite imagery) to assist with compliance responsibilities offers a significant opportunity to better target compliance activity and assist with enforcement. When used in conjunction with river flow data, it can reveal unexplained or unexpected wetting of irrigation channels or loss of river flows (including the complete loss of low flows) in a particular river reach at certain times. NSW are encouraged to co-develop improve this capacity with the MDBA and Geoscience Australia.

Ability to estimate long term sustainable yields (to set the SDL) and subsequently estimate annual permitted take based on actual annual climatic conditions

This capacity is established in NSW hydrological models that support long term allocations across the northern Basin.

Systems management

The MDBA has been involved in a series of meetings with NSW officials to work through the practical application of an active management framework. Based on these discussions, the MDBA understands that existing management systems can be modified or enhanced over the near-term (i.e. coming months) to support active management. As with the technical challenges, it is anticipated that the operating protocols will be refined through adaptive management over coming years.

The system management requirements include:

Clearly defined and transparent ecological criteria

An important role for the WSP, and hence for active management, is to preserve and enhance the ecology of the Barwon–Darling River. The WSP must therefore have clear criteria by which an ecologically sustainable flow regime can be defined and monitored. The MDBA anticipates that this need will be addressed through the Barwon–Darling long-term watering plan, which is under preparation by NSW and due to be completed this year.

Long-term watering plans are a requirement of the Basin Plan. Their immediate purpose is to provide the ecological basis for arrangements within the water resource plans currently under preparation by Basin states. They also fulfil a role as part of the environmental watering plan defined in Chapter 8 of the Basin Plan. They must define the environmental assets and functions, the objectives for these functions, and the associated environmental water requirements. They also define how these water requirements can be met, and if there are impediments to overcome.

The MDBA recommends/anticipates that the Barwon–Darling active management protocols in the WSP will specifically reference the environmental water requirements in the long-term watering plan.

Water accounting rules to shepherd environmental flows

The existing Barwon–Darling WSP rules do not explicitly recognise environmental water passing through the system. Instead, water that has been recovered upstream for the environment is available for extraction by downstream users. This applies to water recovered both in the tributaries and in the Barwon–Darling itself.

Current rules provide a long-term cap on diversions from the system. This ensures that diversions do not increase over the long-term, even if additional water is flowing through the system, providing a form of long-term protection for recovered environmental water. Under this approach, environmental water that is extracted from one event is balanced by less water extracted from the next event.

The overall result of this approach is a trade-off, such that environmental water provides less benefit from low flows and more from medium and high flows. Low-flows are particularly critical for the ecological condition of the Barwon–Darling, hence this result is inconsistent with the overall aims of the Basin Plan. Further, if environmental water holders release water from upstream storages to enhance Barwon–Darling conditions during zero-to-low flow periods (such as the 2018 Northern Connectivity Event), the current rules do not provide the necessary confidence that the released

water will be protected from extraction. NSW has recently instituted embargoes during the appropriate periods, but this is an *ad hoc* approach which does not provide long-term certainty for environmental water holders or other entitlement holders. The rules must be clear and consistently applied without the need for an embargo-style intervention.

The MDBA sees a key aim of active management is to recognise environmental water as it comes through the system on an event-by-event basis. Under this approach, environmental water is explicitly recognised in a flow event and kept aside from the consumptive pool. Losses through the system would be borne proportionally by all water types, hence the environmental portion would attenuate in line with the aggregate flow event.

The MDBA expects that the protocols under development by NSW for active management will be consistent with this concept, and that these protocols will be included in the next version of the WSP.

A crucial component of this system is individual daily extraction limits (discussed in section 3). Active management will ensure environmental water is protected over the long-term and within an event – daily extraction limits ensure that water is shared equitably between all users on a daily basis.

The current active management framework proposed by NSW includes these aspects, and the MDBA encourages NSW to continue this progress and maintain the momentum behind the work.

Community acceptance

The MDBA's stakeholder engagement suggests that there is broad support for an active management system from the community in general and water users in particular. There is, however, the need to demonstrate to water users that they will have the necessary certainty and reliability of access, which is tied to the technological and systems management challenges. There will be an ongoing need for transparency of active management — the community will need to see that decisions are evidence-based and that learning is occurring. The MDBA again acknowledges that NSW are working through these issues.

The community acceptance capabilities needed are:

Communication and phased implementation to build stakeholder confidence and support for the reform

All government initiatives are built on social licence. Stakeholders support a government action if it is perceived to be delivering benefit. Hence a successful government program must report to the community the benefits that have been achieved, but also be transparent about further improvements that can be made through better policy or better implementation.

The community's current perspective on Barwon–Darling water sharing arrangements is less than optimal. Events over recent years have increased community awareness of water issues, and it is clear that the community has expectations of water reform outcomes that are greater than currently achieved.

The introduction of active management is an opportunity to demonstrate water reform progress. It will inherently provide NSW river operators with a large volume of information regarding river losses, extraction, and environmental water patterns in each flow event. As NSW operators learn from each event, active management elements will improve and adapt in response to increased knowledge and better management tools. It is vital that this information, and its application for operating decisions, is both transparent and communicated.

Another key aim of active management will be to build trust with entitlement holders that the operational decisions are appropriate and equitable. Building trust in the early years may be difficult, because river operators will be making allocation decisions based on imperfect information. Initially, it is possible that some of the announced opportunities for extraction will over or underestimate the volume of available resource.

The MDBA see this as a natural part of the adaptive management cycle – to learn and improve – and regard the communication at the conclusion of each flow event as the primary vehicle for building stakeholder trust that best efforts are being made. The operating protocols for adaptive management must therefore include a responsive and robust public reporting structure as soon as possible after the conclusion of each flow event.

In the early years of active management, the MDBA will be looking to NSW to demonstrate best endeavours to make evidence-based operational decisions (with admittedly imperfect information); to be seeking to improve the information base; and to publicly communicate active management outcomes.

Section 3: Policies the MDBA recommends for immediate inclusion in the Barwon–Darling WSP

Over the long-term, the MDBA expects that active management will be embedded as the operational norm, similar to current standard river operations in regulated systems. However, as noted above, the capacity to have full active management supported by robust ecological understanding, management systems and stakeholder confidence is still some distance away. In the interim, there are a series of changes that should be initiated in the next iteration of the WSP to ensure water is more appropriately managed.

The MDBA acknowledges the significant efforts made by NSW thus far as part of its Water Reform Action Plan. In its *Better Management of Environmental Water* release (December 2018), NSW proposed four actions for public comment. These actions seek to:

- better understand northern connectivity
- actively management held environmental water in the system
- manage the resumption of flows in the Barwon–Darling after an extended dry period
- limit daily water take in the Barwon–Darling.

The actions proposed as part of this plan should improve water management arrangements in the Barwon–Darling and better allow recovered environmental water entitlements to be used for their intended purposes. The MDBA has been working collaboratively with NSW on these actions through an Interagency Working Group, and NSW committed to including the reforms in the next version of the Barwon–Darling WSP. Momentum must be maintained behind the proposed actions.

In February 2019 the Authority noted that its assessment of the Barwon–Darling water resource plan for accreditation will depend on the inclusion of these measures and expects to see these measures in the next iteration of the WSP. The Authority has also resolved that prior to making a recommendation to the Minister to accredit water resource plans it must be satisfied that they deliver on undertakings made following the Northern Basin Review. The Authority will also require Basin states to detail the mechanisms they will use to resolve the regulation and accounting of all water diversions, including floodplain harvesting.

The MDBA recommends that the specific changes listed below should appear in the next version of the Barwon–Darling WSP. Importantly, the MDBA encourages a multiple lines of evidence approach to assess the outcomes of the 2012 WSP and the changes required. This approach reflects the MDBA’s experience from the Northern Basin Review, in which model outputs were combined with observed data, ecological science, community feedback, and cultural heritage considerations.

Enable active management

Embed active management provisions in the revised WSP which include:

- **a system to forecast flows in the Barwon–Darling based on observed climate, extraction and upstream gauge flows**
- **a series of publicly available protocols which describe how this information will be used to determine extraction announcements on an event-by-event basis**
- **a framework by which extraction announcements from each event will be made**
- **a monitoring and evaluation framework through which an event is monitored as it passes through the system and an update is released publicly detailing the active management outcomes (i.e. forecasted versus observed flow at gauge stations,**

forecasted versus observed losses, metered extraction, and accounted environmental water)

- **an adaptive management system detailing how NSW will improve their active management capability over time.**

To facilitate this change, NSW have made amendments to the *NSW Water Management Amendment Act 2000* that allow access rules to be changed to implement active management in the Barwon–Darling (in addition to the other unregulated parts of the NSW northern Basin).

As described in section 2, MDBA envisions this first version of the active management framework will be relatively labour-intensive for NSW operators. It should meet the primary aim of recognising held environmental water, both from the tributaries and in the Barwon–Darling itself.

Manage and protect the first flow after a dry period

Include a first flush rule in the WSP to refresh, replenish and prime the river along the Barwon–Darling reach through to the Menindee Lakes. The rule must protect the first 30 to 50 GL of flow (measured at Bourke) after a dry period of greater than 50 to 100 days.

During no-flow periods aquatic fauna are restricted to waterholes, pools and reaches bounded by the weirs on the Barwon–Darling. There is little capacity to move longitudinally along the river channel, and therefore during these times local water quality conditions are of increased importance. No-flow periods are also associated with increased salinity levels in some reaches of the river, as a result of increased saline discharges from local groundwater.

The first flow after a dry period is critical to maintain habitats and refresh pools, improve water quality, provide conditions for fish and other animals to access key habitats, and water riparian vegetation. This flow is also important for the critical human water needs of the downstream communities that depend on the river.

The hydrology of the Barwon–Darling has been changing over recent years. An MDBA analysis ([MDBA 2018a, b](#)) indicated that no-flow periods have been increasing in length and frequency since around the year 2000 (Figure 1). Some of this can be attributed upstream factors — that is, climate and water sharing arrangements in upstream catchments ([MDBA 2018c](#)). However, when the water flows from these catchments to the Barwon–Darling, it is important that active management arrangements satisfy the critical needs associated with the first flow.

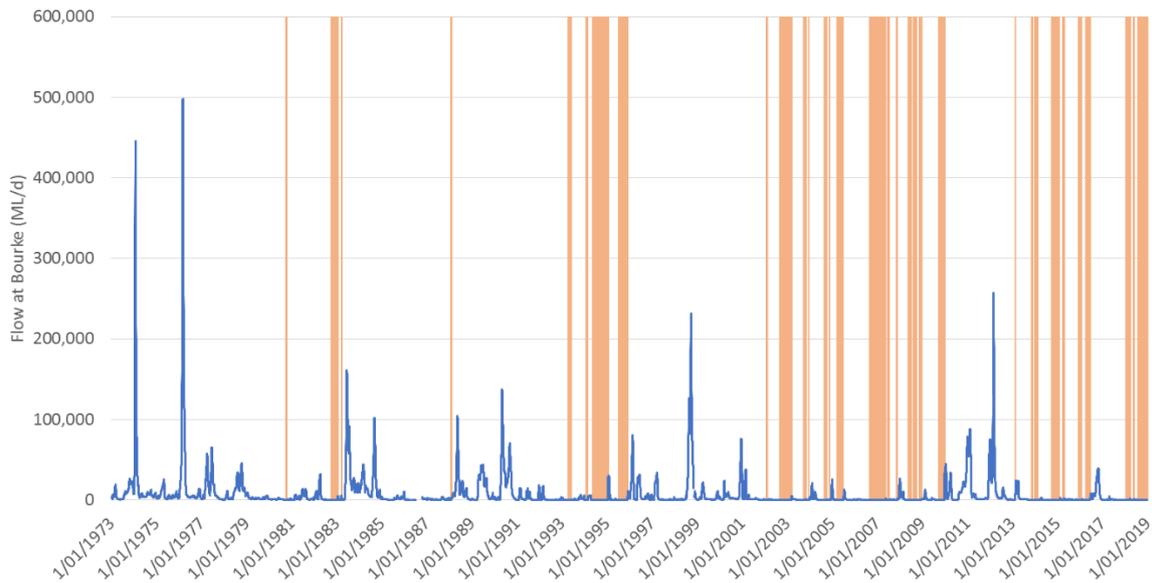


Figure 1: Observed flow at Bourke since 1973 (sourced from WaterNSW); the orange bars trace the periods without flow.

The MDBA recommends that the next version of the WSP include rules to protect the first parcel of water arriving in the system after an extended dry period, with the aim of refreshing the entire river through to Menindee Lakes. Cease-to-flow periods of around 50 days at Bourke and 100 days at Wilcannia have been tied to critical thresholds for ecological, water quality, and social/cultural outcomes towards the downstream end of the river (MDBA 2018a; Sheldon 2017). The specific cease-to-flow periods under which this rule is activated should be guided by the Barwon–Darling long-term watering plan currently under preparation by NSW. This rule should be straightforward, communicated, and tied to the best available science.

Include a rule in the WSP to protect small flow pulses (in the 1,000 to 3,000 ML/d range) on a regular basis.

Small flow pulses are vital for the maintenance of refugia habitat to reduce conductivity, destroy stratification and flush algal blooms. They are also vital for maintaining healthy populations of small bodied fish, which spawn and recruit during small in-channel flow events. Including a rule to protect these flushing events reduces the risks of poor water quality and maintains fish health.

The specific rule should be guided by the Barwon–Darling long-term watering plan currently under preparation by NSW.

Enable individual daily extraction components to be assigned between access licences in Barwon–Darling access licence provisions.

Enable information about assignment of individual daily extraction components to be included in the water allocation account for an access licence.

Historically, extraction rates in the Barwon–Darling were limited by irrigators’ pump size. The 2012 WSP removed this restriction, allowing entitlement holders to extract water at an increased rate.

The introduction of individual daily extraction limits (IDELs) can mitigate local and downstream impacts of extraction. When used in conjunction with active management, IDELs better manage environmental water by quantifying the individual daily volume of water from an unregulated held

environmental water licence that can be ‘used’ in-stream to achieve its intended downstream use. The overall aim of the IDELs is to ensure all users have equitable access to flows. IDELs also address the current impacts of trade between physical locations within the water source, as they allow this trade to occur, but limit any effects that may have been caused by a change in the extraction location.

The [Matthews investigation](#) and [MDBA Compliance Review](#) both recommended the introduction of IDELs in the Barwon–Darling. As part of their Water Reform Action Plan, NSW are proposing to introduce IDELs, and are currently working with the community on the details of this change. The current version of the Barwon–Darling WSP enables IDELs to be instated.

NSW has proposed, through implementation of its Water Reform Action Plan, to define the total daily extraction limit (TDEL) in each management zone to be the sum of the local IDELs. This bottom-up build approach is adequate for the next version of the WSP, however in the longer term the MDBA recommends a top-down approach in which TDELs are defined to ensure sustainable extraction from the river system. IDELs would then be an appropriate share of the TDEL in each management zone. The definition of a sustainable TDEL would need to be guided by the available science, but MDBA recommends that maintaining connectivity through the system and to Menindee Lakes is a guiding principle.

Carryover

Change the current rules on unlimited carryover to further enhance social, cultural and environmental outcomes in the Barwon–Darling. The proposed changes are not exclusive of each other, and could be adopted in combination:

- **introduce a ceiling for carryover accumulation (i.e. to replace unlimited carryover) — a ceiling of 300% is suggested**
- **introduce a multi-year ceiling for carryover use (i.e. to replace the 300% condition) — this could be as per the provision in the draft 2012 WSP which allowed 300% extraction in a single water year, but introduced a 150% average limit over three years (this second component was proposed but removed prior to WSP finalisation in 2012).**

Carryover is a standard provision in water sharing arrangements across the Basin. It provides an entitlement holder with the flexibility to access their allocation in a later year if they do not use their allocated volume of water. The carryover provision introduced in the 2012 Barwon–Darling WSP allowed unlimited accumulation, in contrast to other arrangements in the Basin. Over an extended multi-year dry period, a user can accumulate many times their annual limit. Furthermore, once flow resumes, Barwon–Darling users can access up to three times their annual limit in a given year (i.e. 300% access), far in excess of other users across the Basin, as long as they don’t exceed 100% of their entitlement over a three year period. Modelling by NSW and MDBA shows that these provisions allow a greater amount of extraction to occur from the first flows after a lengthy dry period, increasing the period before a replenishment flow passes through the system.

Implement a NSW system for northern Basin connectivity

Incorporate an operable set of rules to improve connectivity through the system in the WSP, based on the findings of the NSW review into current connectivity policies and rules.

Since making the Basin Plan, the MDBA has consistently highlighted the importance of managing the Basin as a whole, ensuring connected systems are managed together. The MDBA therefore

recommends that the next version of all NSW northern Basin WSPs include an operable set of rules to improve connectivity through the system.

Longitudinal connectivity is a vital component of riverine health. It supports social, environmental, cultural and economic health, and is especially important in the Barwon–Darling system, which receives almost all of its inflows from upstream tributaries (rather than local runoff). The need for connectivity in a river system, and for this connectivity to be supported through water management, is also an outcome of the recent reviews into the 2018/19 fish kills in the Lower Darling ([Australian Academy of Science](#) and [Fish Death Independent Panel](#)). Both reviews recommended improved connectivity to ensure waterholes can persist during dry periods, and to allow fish to move up and down the river system in line with their lifecycle requirements.

The 2012 Barwon–Darling WSP included a set of connectivity rules in the North-West NSW unregulated flow management plan. The rules covered a wide section of the flow regime and, if applied, would have substantially improved the connectivity of the Barwon–Darling. The main issue with these rules was the difficulty for them to be operated in practice — they require significant (and currently unrealistic) forecasting ability.

NSW is undertaking a review of current connectivity policy, and associated rules and measures in WSPs, as part of their Water Reform Action Plan. The timeframe for review recommendations is late 2019. MDBA recommends that active management protocols implemented in the Barwon–Darling include consideration of these findings, including the identification of specific flow requirements.

Better outcomes for Traditional Owners

Include culturally appropriate measures and outcomes identified during consultation with relevant Traditional Owners to gauge the success of objectives. Examples of these could include Traditional Owner waterway assessments and cultural flow assessments.

An objective of the current WSP is to “protect, preserve, maintain and enhance the Aboriginal, cultural and heritage values” in the identified area. The objectives are quite general and outcomes are not identified. Communities, including local Traditional Owner groups, have provided strong feedback through the NSW WRP consultation process that their lived experience with the river has changed as a result of altered flow conditions under the 2012 WSP. When consulted on key social, spiritual and cultural (and economic) matters relating to Basin water resources, Traditional Owners often identify and raise concerns about ongoing connections with, and access - including physical access - to water resources. In particular, there have been noticeable social impacts in recent years.

The WSP provides significant detail on access to take for supplementary water access licences and conditions on the rights of Traditional Owners and communities to use water. This is in line with water use under native title rights. However, the provision of access licences does not necessarily provide physical access to waterways for relevant water-based cultural activities, as part of enacting these licences.

The WSP also does not include specific compliance measures to ensure Traditional Owner objectives are being met; or discuss risks to Traditional Owner values and associated management strategies (as required under the Basin Plan). The WSP states that the performance measure for success is “the extent of recognition of spiritual, social and customary values of water to Aboriginal people”. This requirement does not provide a clear benchmark against which Traditional Owner objectives can be measured.

Section 4: Forward program for the phased implementation of full active management arrangements.

Improve measurement and monitoring of water take

Ensure all water meters comply with the national standard (AS4747) by 2025; ensure these meters have telemetry installed

The MDBA has worked with Basin governments to produce the Murray–Darling Basin Compliance Compact (the Compact). It is expected that, under the Compact, all water meters would comply with the national standard (AS4747) by 2025 unless the state has published a cost-benefit analysis of why this is not required. The Compact also includes a commitment to automate the reporting of all water take no later than 2025 – again, unless there is a published justification for not doing so. NSW has published a metering policy and implementation plan to achieve these commitments.

AS4747 meters are capable of having telemetry installed. Telemetry provides real-time, remote meter readings, and in this way is a powerful and efficient way of monitoring compliance. Increased use of telemetry is warranted in the Basin, particularly for larger entitlement holders and in more remote unregulated systems such as the Barwon–Darling. Telemetry will allow NSW operators to adjust their management of the system — announcements for downstream users will be influenced by the rate of extraction by upstream users. Furthermore, telemetry will allow the active management framework to be improved over the long-term by including more accurate data. The MDBA recommends telemetry as a key requirement for the ongoing improvement of active management over coming years.

Facilitate structural change to entitlements

Revise A-class licence arrangements through any or a combination of the following options:

- **recover sleeper A-class entitlements (around one-third of the total A-class pool are sleeper licences)**
- **recover all A-class entitlements**
- **transition A-class entitlements to B-class**
- **restore pre-2012 daily limits to A-class entitlements through either IDELs or pump size restrictions.**

The social, cultural and environmental condition of the Barwon–Darling is at its most stressed during and immediately after a dry period (MDBA 2017¹). Multiple environmental studies have emphasised the importance of low flows to maintain refuge habitats for fish and other biota, and the MDBA has received strong feedback relating a dry river to social issues (crime and health).

In 2017 the MDBA conducted a [study of the importance of low flows](#) in the Barwon–Darling to environmental outcomes, and examined historical changes to these flows. The study identified a number of ecological requirements that are critically dependent on low flows, including the maintenance of refuge habitats for fish, and the suppression of algal blooms during drier periods. This study and the subsequent [NSW Ken Matthews](#) review found the hydrological character of the river had changed since around the year 2000. Cease-to-flow periods, especially towards the lower end of the Barwon–Darling (i.e. downstream of Bourke) have occurred more often and for longer

¹ MDBA (2017), Observed flows in the Barwon-Darling 1990-2017, a hydrological investigation, Murray–Darling Basin Authority, Canberra.

periods. A further study by MDBA ([released late 2018](#)) has found that both climate and upstream development have contributed to observed flow changes.

The 2012 WSP allowed irrigators to extract larger volumes at an increased rate during low flow periods, and from a flow immediately after a dry period. The volume of water extracted by A-class licences has increased (Figure 2) and irrigators can extract water faster (due to the removal of pump size restrictions), which has contributed to less water passing downstream of Bourke during dry and low-flow periods.

For some irrigators the A-class entitlements are now a core aspect of their business model. Some irrigators hold A-class entitlements, whereas others use trade to access unused (sleeper) A-class allocations. A-class entitlements are now highly valued for their ability to provide relatively high reliability water access.

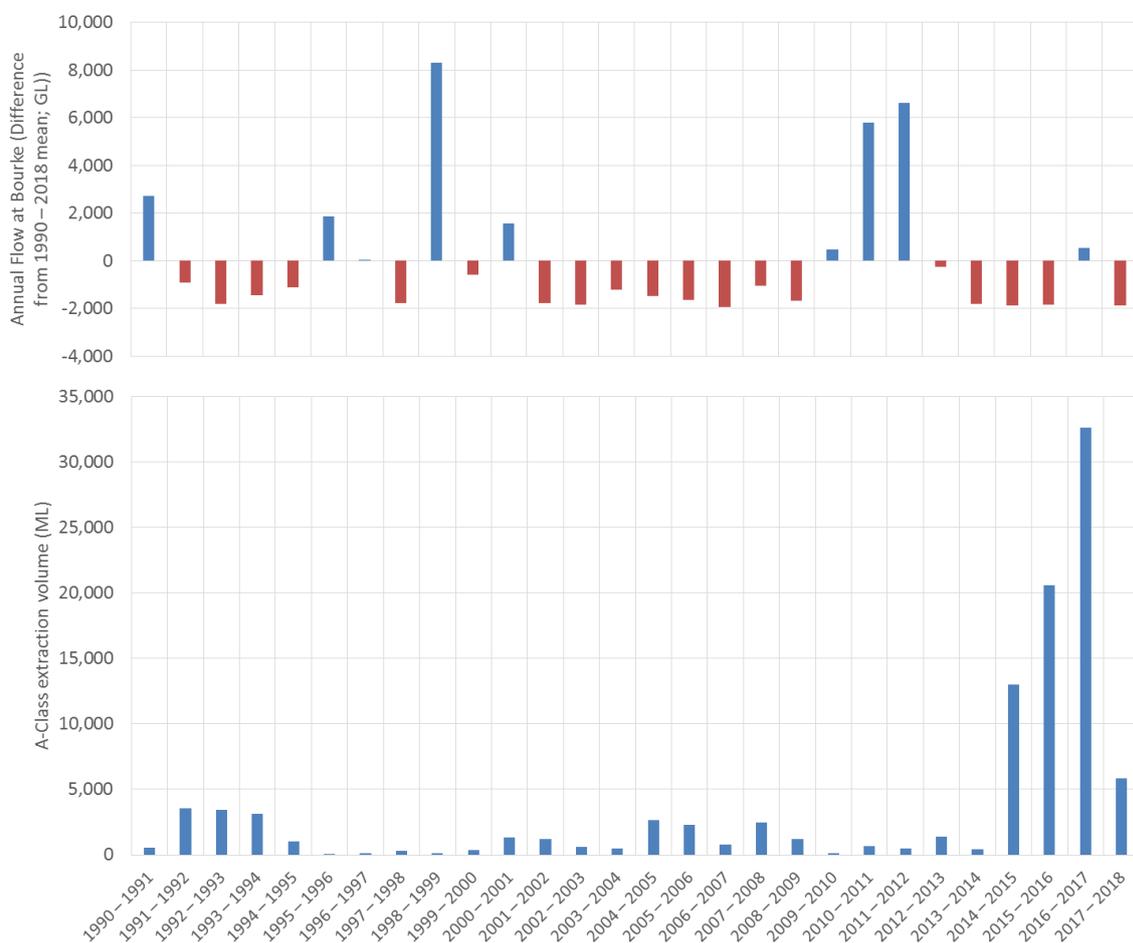


Figure 2: Top — annual flow at Bourke as a difference from the 1990–2018 average (blue indicates above average, red indicates below average). Bottom — annual A-class extraction volume, sourced from NSW DPI (pre-2012) and the NSW Water Register (post-2012)

Forecast capability

As described in section 2, existing forecast tools are able to support active management in the Barwon–Darling, albeit with some caveats. Additional investment is required to enhance this capacity to place active management on a firmer footing.

Upgrades to forecast capability over coming years would seek two broad outcomes: to improve the forecast period (increasing the announcement period from days to weeks); and to improve the forecast accuracy. This can be achieved by investing in new knowledge and technologies, specifically:

1. an improved hydrometric network (see below)
2. real-time extraction data (i.e. telemetry; see below)
3. an improved river management tool.

Regarding this third point, discussions with WaterNSW indicate that the current tool used to forecast Barwon–Darling flows is a spreadsheet which requires manual intervention and a significant element of expert knowledge and interpretation. This should be upgraded to a more rigorous river management tool, such as a hydrodynamic model. This tool would aim to be less manual, more deterministic, and include a greater collection of information (such as hourly extraction data, evaporation rates, pool levels and antecedent condition loss forecasts).

Data sources

Improve the water resource model, especially in relation to low flow representation.

The MDBA has found that the hydrologic model used for the Barwon–Darling could be improved. The [Podger et al. \(2010\)](#) report ‘River System Modelling for the Basin Plan: Assessment of fitness for purpose’ rated the Barwon–Darling model’s ability to assist with water policy development (such as the Basin Plan) as ‘very poor’.

The MDBA’s experience using this model found that it was suitable to assist with long-term macro decisions (such as determining the SDL), but had a number of weaknesses which limited its utility on other fronts. Specific weaknesses include the modelled representation of low flows, A-class extraction, floodplain harvesting, and the transmission of water downstream to Menindee Lakes. Furthermore, the model does not include the array of Barwon–Darling weirs. This hinders water managers’ ability to examine potential impacts of policy and management decisions on critical human water needs. Furthermore, the transmission of water through the river after a dry period is highly dependent on the volume required to refill the weir pools — the model is unable to represent the crucial relationship between cease-to-flow periods, weir pool levels, and subsequent weir pool refilling requirements.

The MDBA acknowledges the data difficulties in this river compared to other parts of the Basin, such as gauge station data. Overall however, the current model has a significantly greater level of uncertainty compared to hydrologic models for other parts of the Basin, requiring a reliance on other data sets to assess the impact of any changes. It is not clear if this WSP review will rely solely on modelling to draw conclusions, and the MDBA would not consider this an adequate approach.

The MDBA also acknowledges that NSW is making efforts to progress model analysis techniques, including a commitment to an improvement program to develop hydrologic models for all seven major NSW Murray–Darling Basin river systems using the eWater Source software.

Improve the gauging network to track flows at a greater spatial resolution and to track climatic conditions.

Additional gauge stations are required to increase the resolution at which flow is measured. Under the existing network, some gauging locations in the Barwon–Darling are separated by two or three days flow travel time — active management would be enhanced with a gauging resolution of around one day, hence more gauge stations should be installed along the Barwon–Darling. Additional

stations are also required to ensure all Barwon–Darling tributary inflows are adequately measured, specifically for the Gwydir, Castlereagh and Macquarie catchments.

A successful active management framework will track flow, explicitly drawing out environmental flows, through the Barwon–Darling and into the Menindee Lakes. This is required for environmental water from the northern Basin to be recognised in line with the Menindee Lakes savings project proposed by NSW. Currently the most downstream station prior to Menindee Lakes is located at Wilcannia. River flow distance (chainage) between these two locations is more than 200 km, through which substantial (but uncertain) volumes of water can be lost depending on antecedent conditions and the prevailing climate. Using Wilcannia flows as a proxy for Menindee inflows will not provide the necessary accuracy for active management connecting the northern and southern Basin. Hence an additional gauging station is required at the Lake Wetherell inflow site.

Furthermore, in addition to river height and flow, these stations should measure meteorological and water quality information — this information is required to support management interventions (such as tributary environmental water releases) and long-term planning tools (such as enhanced hydrologic models).

Ensure the best ecological science is used to support active management protocols

As stated in section 2, an important role for active management is to preserve and enhance the ecology of the Barwon–Darling River, for which there must be clear criteria by which an ecologically sustainable flow regime can be defined and monitored. The MDBA anticipates that this need will be addressed through the Barwon–Darling long-term watering plan, which is under preparation by NSW and due to be completed this year.

The MDBA anticipates that the best ecological science will be captured through the long-term watering plans, currently under development by NSW. The active management protocols should reference this information as part of its rules (e.g. for first flush or small pulse flow protection). The Basin Plan requires regular updates to the long-term watering plans (at most every five years) to capture advancing science, and these updates should trigger an automatic examination of the associated active management protocols.

Improve the management of floodplain harvesting

Support the management of overland flows, including floodplain harvesting, in upstream catchments through a licensing regime.

Work is underway in New South Wales (and Queensland) to gain an improved understanding of how much water is harvested from floodplains now and how much was being harvested prior to the Basin Plan. It has historically been very difficult to accurately measure the volume of floodplain harvesting that occurs, and therefore this water use is not fully accounted for under existing arrangements.

Improving water accounting is a priority for all Basin state governments. Accurate accounting and measurement is vital to operating and enforcing limits on water use. If particular uses, such as floodplain harvesting, are not brought into the accounting system, the water used for these activities cannot be fully regulated. Improvements are to be achieved through the following actions:

1. Floodplain harvesting should be well measured and fully brought into the Basin's water accounting system.

2. Transparent information about historical growth in floodplain harvesting and associated infrastructure, and the potential impacts on environments and downstream users, should be readily available.
3. Data, processes and methods used to estimate historical and current volumes of floodplain harvesting should be transparent, with a strong focus on independent oversight and review.
4. Infrastructure should be well-managed to allow for the most efficient storage and use of floodplain harvesting water, while managing impacts on the environment and downstream users.
5. A monitoring and compliance framework should be implemented that provides verification of water take and use, and should enforce compliance of rules for water take and associated infrastructure.
6. Measurement, monitoring and compliance should make full use of available technology.

These are long-term actions (i.e. over the next three-to-five year period) that the MDBA expects will be reflected in future revisions of the Barwon–Darling WSP. The MDBA acknowledges the continued NSW efforts to improve arrangements for floodplain harvesting. These efforts will see better estimates of the volume of floodplain harvesting, and the full licensing and measurement of this method of take.

In the interim, the MDBA will be seeking confidence that NSW will be monitoring extraction, limiting further growth, and establishing decommissioning principles for infrastructure that is illegal, unlicensed, or is having an intolerable impact on the environment or other users. It is expected that this confidence will be provided through the water resource planning process (due for completion in 2019), and that floodplain harvesting changes will be incrementally included in the WSP over coming years.

Conclusion

The current settings for the Barwon–Darling WSP do not currently align with best practice water management for the Basin, and the need to manage a complex system for all users. This review of the Barwon–Darling WSP will be integral to restoring community confidence in water management arrangements in the northern Basin and in the implementation of the Basin Plan.

In February 2019 the Authority noted that prior to making a recommendation to the Minister to accredit northern Basin water resource plans, it must be satisfied that they deliver on undertakings made following the Northern Basin Review. The MDBA’s assessment of the Barwon–Darling water resource plan for accreditation will depend on the inclusion of measures to address these undertakings, and therefore the MDBA expects to see these measures in the next iteration of the WSP.

The overall reform program to move to full active, event based management is significant and will take time. However, a step-change is required now to immediately restore balance to the system. These immediate reforms need to be complemented by a longer term, disciplined approach to progressively build community confidence in the increased active management of water resources in the northern Basin. Ultimately, arrangements for active, event based management will provide the most equitable basis for water sharing that balances all user needs in the highly connected Barwon–Darling river system.