COMMONWEALTH ENVIRONMENTAL WATER HOLDER SUBMISSION ON THE REVIEW OF THE BARWON-DARLING WATER SHARING PLAN BY THE NATURAL RESOURCES COMMISSION

Structure

The Commonwealth Environmental Water Holder (CEWH) appreciates this opportunity to make a submission to this important review of the Barwon-Darling water sharing plan. The statutory functions of the CEWH are to be performed for the purpose of protecting or restoring the environmental assets of the Murray-Darling Basin. Hence this submission has an emphasis on environmental outcomes. The CEWH acknowledges that social, cultural, and economic outcomes, as well as environmental outcomes, are important in achieving a healthy working Murray-Darling Basin.

The Barwon-Darling contains important environmental assets. For example, at least four resident fish species are listed under the *NSW Fisheries Management Act 1994*. The 'Lowland Darling River aquatic endangered ecological community' is also listed under the same NSW Act. Additionally, Murray cod and silver perch are listed on the International Union for the Conservation of Nature red list of threatened species, and also listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*

The CEWH acknowledges that flows along the Barwon–Darling River are highly variable, and are affected by: the weather; storage and take in tributaries; and take along the Barwon-Darling. Hence, the CEWH understands that there is a high degree of complexity in water sharing in the Barwon-Darling.

Some of the matters raised in this submission have been raised through the Stakeholder Advisory Panel in the Barwon-Darling Water Reform Process, and through the interagency working group for the 'better management of environmental flows' under the NSW Water Reform Action Plan (WRAP). Whilst, in most cases, good progress has been made by this interagency working group and the NSW Department of Industry – Water, the matters raised have not been finalised, and this is a matter of urgency.

This submission is structured in a way that is broadly consistent with principles and objectives outlined in the NSW *Water Management Act 2000* and Part 2 of the Barwon-Darling water sharing plan, namely:

1. manage these water sources to ensure equitable sharing between users;
2. protect, preserve, maintain and enhance the important river flow dependent ecosystems and contribute to the maintenance of water quality; and
3. protect, preserve, maintain and enhance the Aboriginal, cultural and heritage values of the water sources.

Some additional comments of relevance to the NRC review are also provided at the end of this submission.

1. Manage Barwon-Darling water sources to ensure equitable sharing between users

Hierarchy of priorities

The CEWH appreciates that water sharing during droughts is particularly challenging and contentious. It is important that equitable water sharing arrangements are founded on a clear articulation of priorities for access to water, particularly when there is insufficient water to satisfy all

demands for water. WaterNSW, in recent presentations on drought, has articulated the hierarchy of water priorities under the NSW *Water Management Act 2000* as per **box 1**.

Box 1

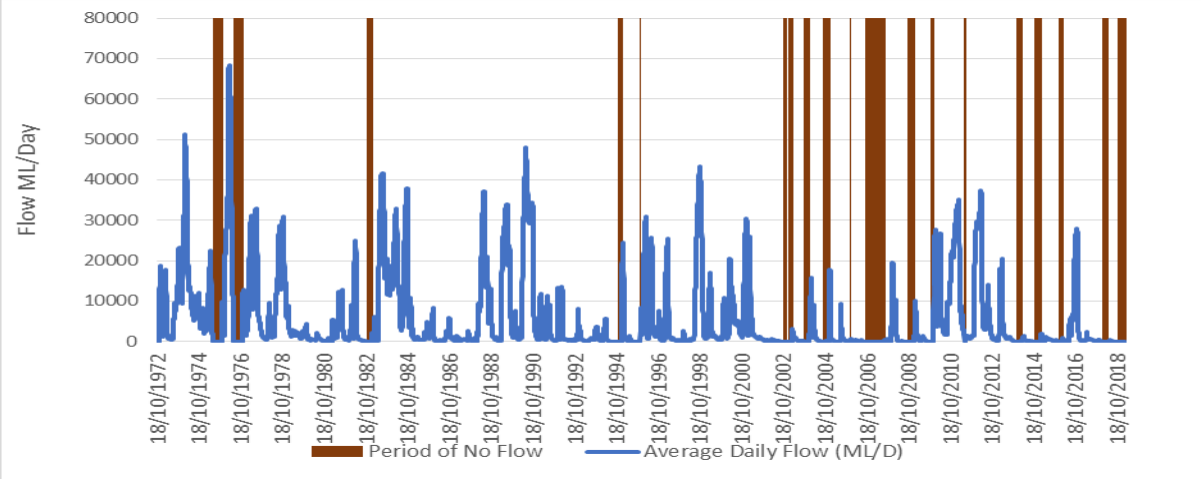
Hierarchy of water priorities

Priority	Take/type of use
1	• Critical human water needs: - core human consumption requirements - non-human consumption requirements that a failure to meet would cause prohibitively high social, economic or national security costs
2	• Needs of the environment
3	• Stock • High security licences • Commercial and industrial activities authorised by local water utility • Water for electricity generation on a major utility licence • Conveyance in supplying water for any of these needs in this paragraph
4	• General security & other

https://www.industry.nsw.gov.au/water/allocations-availability/droughts-floods/update

However, there is evidence that periods of cease-to-flow are becoming increasingly frequent in the Barwon-Darling. An example, using flow data at Wilcannia, is shown in **box 2**.

Box 2 - Cease-to-flow periods at Wilcannia 1972 – 2019



(Updated from the version in: http://www.environment.gov.au/water/cewo/publications/northern-rivers-update-8)

Understanding why **box 2** suggests that cease-to-flow events are occurring more often and have a longer duration is important when refining policy settings in the Barwon-Darling water sharing plan to better contribute to environmental, social and economic outcomes.

Water sharing in dry times is critical for social, environmental and economic outcomes. From a social perspective, low flows are important for improved water quality for town water supplies, algal bloom risk mitigation, reduced frequency of salinity spikes, and social wellbeing of communities, including Aboriginal communities.

Following a cease-to-flow event in the Barwon-Darling, resumption flows are critical for social and environmental outcomes and for equitable sharing under priorities 1-3 in **box 1**, including critical human water needs. The current rules in the Barwon-Darling enable significant (and legal) take for irrigation under priority 4 following a resumption flow event before priorities 1-3 have been fulfilled along the length of the Barwon-Darling, at least to the Menindee Lakes. This is discussed in more detail later in the submission. But for now, it is possible that, without an embargo on pumping or agreement of entitlement holders not to take water, that pumping for irrigation, particularly against A class licences and B class licences between Mungindi and Walgett (**box 3**), can prevent a small resumption flow (for example, the size of a northern connectivity event) from reaching Wilcannia. Cease-to-pump settings and the ability to accumulate large account balances become key in determining the set of social, environmental and economic outcomes achieved in dry times.

Box 3 – From Simpson (2017)

To achieve more of the identified low flow targets primarily requires dealing with the significant risk posed by the significant take of water by A Class licences, and take by B Class licences in the upper sections between Mungindi and Walgett, and the relaxation of existing operational channel capacity constraints in the lower sections of the regulated tributaries.

https://www.environment.gov.au/system/files/resources/df3666cb-16ed-483c-b73c-a49e63f6df6e/files/barwon-darling-low-flow-environmental-watering-impediments-opportunities.pdf

As cease-to-flow events seem to be becoming more common (**box 2**), the tensions around resumption flows and low flows generally appear to be growing. Broadly, the current rules may be inconsistent with the priority of water allocation in the NSW *Water Management Act* that some key social and environmental needs are not met before significant consumptive take of water.

Recommendation 1: *That the NRC investigates whether the current rules in the Barwon-Darling water sharing plan permitting take for economic outcomes are consistent with the hierarchy of priorities for water allocation in the Water Management Act 2000, particularly during resumption flow events. Specifically, that the NRC review the rules associated with carryover and the use limit.*

Resumption flows

With regard to environmental outcomes, to prevent the loss of species of conservation significance in the Barwon-Darling, the CEWH is highly supportive of measures that protect ecologically significant elements of the resumption flow (or 'first flow') event following a prolonged dry period.

Current account management rules within the Barwon-Darling water sharing plan provide for unlimited carryover with a use limit of 300% in any one year. During prolonged dry periods, flows are generally insufficient to allow consumptive users to fully utilise account volumes. This results in account volumes being carried forward into subsequent water years that makes large quantities of take permissible by consumptive users. The taking of such large volumes of water under these circumstances can significantly prolong dry periods in the lower parts of the Barwon-Darling river system.

Currently, two mechanisms by which a resumption flow event can produce greater social and environmental outcomes through more water being left in the river are:

- the relevant NSW Minister agrees to an embargo on irrigation take under section 324 of the Water Management Act; and
- irrigators collectively choose to not pump the resumption flow after a cease-to-flow event.

While both embargos and voluntary decisions not to pump by some irrigators have occurred in recent years, a rules-based solution provides both more certainty and clarity, and community confidence, and is less subject to discretion and the willingness of individuals. A 'first flush' rule, currently under consideration in the WRAP process, is important to protect a resumption event after a trigger duration has been reached for cease-to-flow, and would be more consistent with the hierarchy under the NSW *Water Management Act* than the current Barwon-Darling water sharing plan, and produce better social and environmental outcomes.

The above reflects that the water entitlement system and rules governing access within the Barwon-Darling water sharing plan have evolved primarily to allow the efficient extraction of water for economic outcomes when there were less cease-to-flow events.

Recommendation 2: *That the NRC investigates whether the impact of the 300% use limit is reasonable on social and environmental outcomes, particularly following cease-to-flow events and that the NRC recommends that an appropriate individual take limit over three consecutive water years is set for A, B and C class licenses and incorporated into the Barwon-Darling water sharing plan.*

Hydrological analysis that informs decision making

The NSW Department of Industry - Water has the role of developing a hydrological model of the Barwon-Darling. This hydrological model is foundational in analysing policy settings in the Barwon-Darling water sharing plan. However, it is generally recognised that hydrological models do not represent all parts of the flow regime well, and are particularly limited in their ability to represent low flows or flow patterns on an event by event basis. The Barwon-Darling hydrological model does not represent low flows well (**box 4**).

Box 4 - Some quotes from some publicly available independent reviews of the Barwon-Darling hydrological model are below:

1. changes in low flows are not simulated well by the hydrological model[1]
2. previous independent audits of Cap and water sharing plan hydrological models found that "hydrological model performance is poor for periods of low flow"; "care should also be taken in using hydrological models for any low flow environmental water demands" Table 5-4 –
    - Darling River at Bourke: Hydrological model was able to replicate daily flows very accurately (errors of 3 to 7 percent) in the whole range, except for the low flows where the rating is very low; and
    - Darling River at Wilcannia: Overall calibration was of high to very high quality, except for the low flows where it is low. [2]

1 - https://publications.csiro.au/rpr/download?pid=changeme:1928&dsid=DS1
2- https://www.mdba.gov.au/sites/default/files/pubs/NB-modelling-report_0.pdf

Fundamental policy settings established in the Barwon-Darling water sharing plan have been informed by hydrological models. The hydrological model is important in establishing policy settings that determine what social, environmental and economic outcomes are achieved, even for periods of low flows. If the hydrological models are not sufficiently accurate, particularly at low flows, and are inconsistent with observed data and trends in recent years (see **boxes 8** and **9** discussed subsequently), these models can 'inform' policy settings that are not an appropriate balance of social, economic and environmental outcomes.

Given the importance of low flows and particular types of events (such as resumption flows) in delivering key environmental outcomes in the Barwon-Darling River system, these hydrological modelling limitations need to be clearly considered when deciding on different policy settings. Other lines of evidence need to be considered in addition to hydrological models, including observed

(gauged) flow data to 'ground-truth' hydrological modelled outcomes. There would be greater confidence in the water sharing arrangements in the Barwon-Darling if there was greater confidence in the hydrological model.

Recommendation 3: *That the NRC recommends an independent review of the accuracy of the Barwon-Darling hydrological model, particularly for low and medium flows, by comparing hydrological model results with observed data in particular flow events, and that a report is prepared for a general audience and released.*

Active management

To ensure equity between entitlements held by environmental water holders with those held by consumptive users, an 'active management' framework is currently being developed through the WRAP process. The framework will provide a structure to recognise environmental water as part of the flow regime through unregulated systems which can then inform the active management by river operators of variable thresholds along the river at which pumping is allowed. The resulting active management system would be defacto protection of a managed environmental water flow. An active management framework would:

- protect held environmental water flowing into the Barwon-Darling, including against supplementary or unregulated entitlements, including water from entitlements in Queensland;
- protect environmental water between Barwon-Darling management zones; and
- provide equitable application of accounting rules within the Barwon-Darling, and water that is becomes available for environmental management at a location where water has been recovered is protected downstream.

To ensure active management is equitable, it must:

- determine the volume of held environmental water that must remain in-stream in accordance with water availability (determined consistent with water allocation account management rules) as well as flow class and daily access rules in the water sharing plan;
- determine the volume of water available for all unregulated licence holders; and
- determine how water will be equitably distributed amongst licence holders.

The CEWH sees that the finalisation of arrangements to support an appropriately configured active management framework (including operational details set out in relevant protocols) as a priority. Fixed cease-to-pump rules are no longer capable of managing the competition for the increasingly scarce water resource to balance environmental, social and economic outcomes right along the Barwon-Darling River.

Additionally, as a matter of principle, the characteristics of licensed entitlements held by environmental water holders should be equitable to the same class of entitlements held by other water users for irrigation or other purposes. This includes being subject to no less favourable conditions, including access to allocations, capacity to use, trade and carryover, than 'like' entitlements. Additionally, licensed entitlements held by environmental water holders should be have the same opportunity to 'take' and leave the flow in the river as the previous owners of these water entitlements.

Current water management arrangements within the Barwon-Darling River system do not support effective management of unregulated licences held by environmental water holders for environmental outcomes.

i. The Commonwealth has acquired licences from properties along the Barwon-Darling, and seeks to leave water in rivers at volumes, times and locations to improve the health of the river system. Consumptive users take water directly from the river when the flow is above a prescribed cease-to-pump level (assuming sufficient account and storage volume). In the Barwon-Darling, held environmental water left in the river without protection contributes to keeping the flow above prescribed cease-to-pump thresholds of other licence holders creating additional opportunities for consumptive users to take, and enhancing the reliability of their entitlements.

ii. Unlike other licence holders with pumps and storages, under current rules in the Barwon-Darling water sharing plan there is effectively no mechanism to enable the Commonwealth to actively manage account volumes to carry water allocations over from one water year to another despite the previous owners of the entitlements being able to do this. This is significantly different from arrangement in place for consumptive users who have unlimited carryover with an individual take limit of 300% in any one year. At the moment, without rules to enable an alternative, the practice has been that the maximum water use that can be accounted against Commonwealth unregulated licences has been 100% in a year. This has been an operational defacto limit. The CEWH would like the capacity to 'virtually' order water to the use limit on account water of the held entitlements in any year, and then for the water to be protected downstream. It would be appropriate and consistent with Basin Plan principles to provide all unregulated entitlement holders with the right to 'carryover' and use to the same level.

iii. Commonwealth environmental water also increases the amount water flowing from upstream tributaries into the Barwon and Darling Rivers. Current rules within the Barwon-Darling water sharing plan allow environmental water that is released from upstream storages and flows into the Barwon-Darling River system to be legally extracted unless there are specific decisions to protect it, such as under a section 324 order. This limits the ability of environmental water released from tributary storages to achieve desired outcomes along the Barwon River, and the capacity of the CEWH to achieve longitudinal connectivity or other whole of system outcomes.

At present, the Commonwealth pays the same fees and charges as other licence holders for rights that the previous owners could exercise fully but that the Commonwealth cannot, by virtue of the rules and it not owning pumps and storages. This means that downstream licence holders are receiving improved reliability from Commonwealth environmental water. This is not equitable sharing of water resources.

As mentioned previously, the NSW Government has made progress in developing the operational management arrangements necessary ('active management') to enable held environmental water either in the Barwon-Darling, or delivered to the Barwon-Darling River system from regulated rivers, to be protected from extraction by consumptive users. There is more work to be done to finalise and implement active management.

Recommendation 4: *That the NRC supports that practical active management arrangements are implemented as a matter of priority, including: protecting environmental water from all NSW and Queensland water sources that flow into the Barwon-Darling; and protecting water against unregulated Commonwealth entitlements in the Barwon-Darling.*

Long-term averages mask impact of shorter timescales, and important flow events

In addition to the question of inaccuracy of the Barwon-Darling hydrological model, it is important that results from the model are reported in a meaningful way. The Barwon-Darling water sharing plan includes the following note (**box 5**) which is often quoted in a misleading way.

Box 5 – Quote from the Barwon-Darling water sharing plan

'*At the commencement of this Plan the long-term average annual commitment of water to the environment in the Barwon-Darling Unregulated River Water Source has been estimated to be 2,607 gigalitres per year made using the Barwon-Darling IQQM with system file LT92_30.sqq. This equates to approximately 94% of the long-term average annual flow in this water source'.*

https://www.legislation.nsw.gov.au/#/view/regulation/2012/488/part4

This statistic is sometimes paraphrased to imply that 94% of the water in the Barwon-Darling river system in any given year flows directly to support the environment and hence is managed to support specific environmental outcomes. Other water sharing plans have similar notes – but the statistic by itself makes even less sense for an unregulated system with a highly variable flow regime like the Barwon-Darling. The statistic is sometimes used to imply that water sharing arrangements in the Barwon-Darling are skewed towards achieving environmental outcomes at the expense of economic outcomes. The problem with the long-term average statistic in the Barwon-Darling is that it is dominated by a few large floods (including two in the 1950s). Floods make up the majority of the total volume in the hydrological modelled record and dominate this average statistic and the impression it gives, but very little time in the record and is a poor representation of flow events. There can be years when much of the flow could be taken, and it could be masked by a singled large flow event. An average such as this ignores critical events, including low flow events and cease-to-flow events, and, by itself, is misleading.

From year to year, the actual amount of diversion from the Barwon-Darling water source varies, as shown below between 2012/13 to 2018/19 (**box 6**). The diversion was not be less than 6 percent in any of the six years between 2012/13 and 2017/18. In some years, such as 2015/16, it is a much higher proportion.

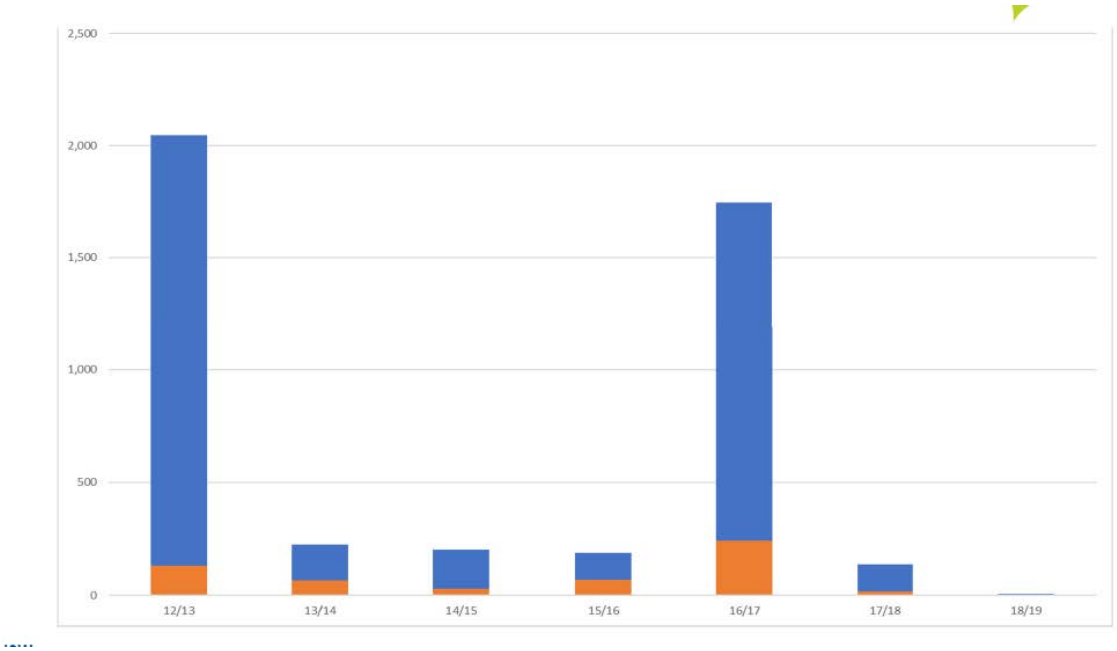
Section 109 of the Basin Plan highlights the importance of identifying planned environmental water. In particular, this section of the Basin Plan requires supporting rules and arrangements to be identified. The CEWH sees that the rules and arrangements outlined in Part 9 of the Barwon-Darling water sharing plan provide a much better description of planned environmental water in the Barwon-Darling River system. For this reason, the CEWH seeks that NSW delete the note in **box 5** as the preferred remedy to this misleading statistic.

Two other ways to remedy this misleading statistic that the NRC may consider are: to add the following note 'The long-term average annual flow in an unregulated system with highly variable hydrology is not a reflection of the typical proportion of water to the environment in most years: which will be significantly less than 94%'; or to add other statistics that give a fairer impression on whether there is equitable water sharing between users for particular flow sequences, such how often the Darling River ceases-to- flow, and for how long.

Recommendation 5: *That the NRC recommends that this misleading statistic in the Barwon-Darling water sharing plan is remedied because it implies that water sharing arrangements in the Barwon-Darling water sharing plan are skewed towards environmental outcomes - 'approximately 94% of the long-term average annual flow in this water source is a commitment to the environment'.*

Box 6 - Barwon-Darling: volume of flow, and volume of diversion in years since 2012/13

The total height of each bar corresponds to the inflow. The orange part of each bar is the extraction.



https://www.waternsw.com.au/supply/drought-information/regional-nsw/lower-darling

Use of observed data – resumption of flows

There is much that can be learned from observed (gauged) flow data. The data in **boxes 7** and **8** provide examples of what can be used for this purpose, with an emphasis on low flows.

The data in **box 7** are for a sample of resumption flow events between Bourke and Wilcannia since 1995. The resumption flow events occurred following a range of durations of cease-to-flow events, and occurred at different times of the year. The data are the volume of a flow that passed Bourke, the volume of the remnant of the same flow as it passed Wilcannia, and the difference between these two volumes. The difference is a measure of 'initial loss' (comprising evaporation, seepage, filling up of waterholes) following a large proportion of the bed of the Darling River being dry. The initial loss is highly relevant to the design of a 'first flush' rule for a resumption flow, currently being considered in the WRAP process.

Box 7

The below is an indication of the volume in a flow event passing gauges at Bourke and Wilcannia following a prolonged cease-to-flow event

Bourke start date	Bourke volume (GL)	Wilcannia volume (GL)	Volume difference (GL)
6/12/1995	158	126	32
16/02/2002	32	22	10
15/03/2003	69	42	28
8/10/2004	10	1	10
12/06/2005	226	181	45
7/07/2007	22	7	14
25/11/2007	887	882	5
19/12/2008	52	27	24
27/12/2009	1302	1112	190
17/02/2014	69	52	17
27/01/2015	41	25	16
26/04/2015	34	17	17
30/01/2016	26	9	17
19/06/2016	180	127	52
26/03/2018	21	1	20
24/05/2018	13	7	6

19/09/2002	2	0	2
3/11/2003	9	0	9
22/11/2004	3	0	3
6/04/2007	1	0	1
18/05/2007	14	0	14
3/07/2008	3	0	3
27/09/2008	5	0	5
25/11/2013	3	0	3
10/11/2014	1	0	1

The median volume of 16 resumption flow events in the table above was 17.3 GL. The average volume was 31.5 GL.

The data in **box 7** suggest that 20-30 GL is needed after a prolonged cease-to-flow event to overcome 'initial losses' between Bourke and Wilcannia (a river distance of about 590 km). Additional water would be needed following cease-to-flow events between Mungindi and Bourke (approximately 600 river km), and between Wilcannia and the Menindee Lakes (approximately 200 km, although it does vary with water level in the Menindee Lakes). Initial losses may not be in the current Barwon-Darling hydrological model, the 'losses' may be hydrological modelled simply as a proportion of flow, and this may affect hydrological model findings at low flow.

The inclusion of a 'first flush' rule within the Barwon-Darling water sharing plan which allows flows similar to those occurring during autumn and winter 2018 to be protected from extraction would improve both water quality parameters and assist key ecological communities to recover following prolonged dry periods, such as the current dry spell. If an individual take limit over three consecutive water years for A, B and C class licenses is set and incorporated into the Barwon-Darling water sharing plan it would further assist in meeting the water sharing plan objectives.

Recommendation 6: *That the NRC recommends inclusion within the Barwon-Darling water sharing plan of a 'first flush' rule which allows for flows similar to those occurring during autumn and winter 2018 to be protected from extraction. The 'first flush' rule should rule should provide connection through to the Menindee Lakes.*

Use of observed data – cease to pump thresholds

The data in **box 8** relate to whether pumping down to cease-to-pump thresholds result in the Darling River flowing less often at Wilcannia, and downstream to the Menindee Lakes. It seems that the current cease-to-pump thresholds are too low to protect some small flow events providing connectivity down the river.

Box 8 summarises a comparison of the peak flow in ten small paired flow events passing Bourke, and the peak flow passing Wilcannia, for data from 1990 onwards, with peak flows at Bourke in the range of 540 – 1,254 ML/day at Bourke. Under the Barwon-Darling water sharing plan, the cease to pump for A class licences at Bourke is 350 ML/day (and was originally established for dis-aggregated horticulture). The cease-to-pump for B class licences at Bourke (for large scale irrigation pumping) is 1,250 ML/day – and this is taken as the upper bound of the events selected in **box 8**.

It is reasonable to expect that, for small flow events to pass from Bourke to Wilcannia, the observed difference in peak flow for flow events would need to be less than 350 ML/day.

For the flow events in **box 8**, a flow of around 570 ML/day at Bourke is expected to result in about 8 in 10 of these events arriving at Wilcannia.

Box 8

Event	Year	Peak flow at Bourke (ML/day)	Peak flow at Wilcannia (ML/day)	Difference (ML/day)
1	1998 (Mar)	965	268	697
2	2001 (Dec)	745	478	267
3	2002 (Mar)	1095	671	424
4	2006 (Mar)	914	535	379
5	2007 (Aug)	794	452	342
6	2007 (Sep)	1086	550	536
7	2015 (Nov)	971	405	566
8	2017 (Mar)	1254	542	712
9	2018 (May)	884	494	390
10	2019 (Jul)	540	165	375
			Median	407
			Maximum	712
			Average	469

There were 14 flow events between 1998 and 2018 in the above. The median difference is 407 ML/day, the average difference is 469 ML/day. The eighth percentile is 566 ML/day.

Further, drawing on the ecological data in **box 10,** to suppress waterhole stratification and blue-green algae growth at Wilcannia, an additional flow of say 350 ML/day would be needed at Wilcannia.

This analysis suggests (but does not prove) that

- if irrigators pumped what they were entitled to (e.g. down to 350 ML/day at Bourke, there are lower pumping thresholds further upstream) and had a high enough account balance after several dry years and therefore could continue pumping for some time, it is possible that the flow might not reach Wilcannia for an extended period (perhaps several weeks) or at all; and
- to ensure an adequate flow reaches Wilcannia for social and environmental outcomes, given that high account balances and large take rates are currently permitted, the cease-to-pump at Bourke would need to be considerably higher than current settings.

Further analysis is warranted as the cease-to-pump settings affect the distribution of water between social, economic and environmental outcomes in dry periods.

Recommendation 7: *That the NRC reviews cease-to-pump thresholds – particularly A class and B class between Mungindi and Walgett – and examine higher cease-to-pump rules that adequately protect low flows getting to specified locations downstream, for social and environmental outcomes.*

2. Protect, preserve, maintain and enhance important flow dependent ecosystems, and contribute to the maintenance of water quality

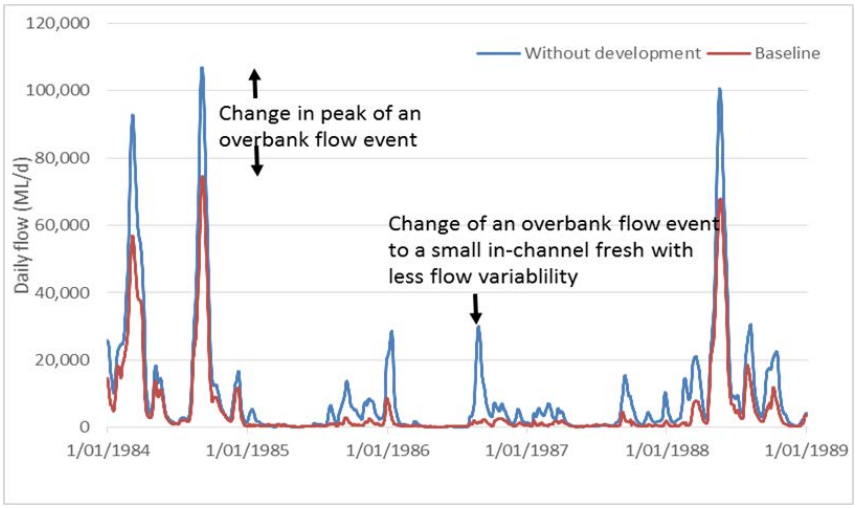
The Barwon-Darling River contains an important endangered ecological community and endangered species, as well as species of large social and environmental significance.

Flows along the Barwon–Darling River are highly variable. Environmental science work by Sheldon (**box 9**) and the MDBA has shown that small flushing flows form a very important part of the Barwon-Darling's hydrology. Work undertaken by the MDBA and Sheldon showed that for the 2000-2017 period there was an increase in the length of dry spells (length of no flow period) as compared with the previous 10 year period (1990-1999), and this was most pronounced downstream of Bourke. This is consistent with **box 2** that indicates that cease-to-flow events are becoming more frequent. This finding is supported by the Murray–Darling Basin Water Compliance Review which found that the current for the Barwon-Darling water sharing plan 'failed' to provide adequate protection for environmental water, particularly during low flows.

The condition of flow dependent ecosystems in the Barwon-Darling is sensitive to the times, places and rates of take and the resulting impact take has on low flows.

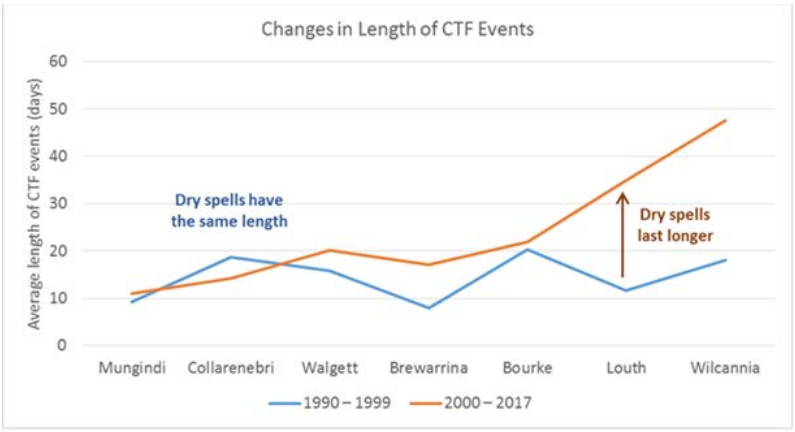
Box 9 – From Sheldon (2017)

Water resource development and water management has modified flow regimes across nearly the entire Murray–Darling Basin, including the northern Barwon–Darling River and its associated tributaries. In 1996 it was recognised that associated with water resource development in the northern basin there had been a decrease in annual and daily volumes along the Barwon-Darling, increased rates of flood recession (related to pumping for irrigation), decreases in the frequency of small flow pulses and marked changes in the character of flood frequencies.



Daily flows of the Darling River at Bourke over a five year period from 1984 to 1989 (hydrological modelled without development conditions and baseline conditions). From MDBA

In the period 2000-2017 there was an increase in the length of dry spells (length of cease-to-flow) compared with the previous 10 year period (1990-1999), and this was most pronounced downstream of Bourke. Increasing cease-to-flow periods in this section of the Barwon-Darling will have had impacts on water quality and the successful spawning and recruitment of many small native fish. Periods of no flow can cause stratification of standing water bodies, which can induce hypoxic or anoxic conditions in lower parts of the water column and provide conditions conducive to algal blooms in surface waters. In some reaches low stable water levels contribute to an increase in saline in-flows from local groundwater aquifers, which can further exacerbate the declining water quality in refugial pools, not only by increasing measured conductivity but also by assisting in the flocculation from suspension of clay particles which can increase water clarity and stimulate algal blooms – which can further reduce oxygen levels.



Comparison of average length of dry spells from upstream to downstream, (MDBA 2016)

https://environment.gov.au/water/cewo/publications/characterising-eco-effects-changes-barwon-darling-2017

Recently, more environmental information has been summarised (e.g. the summary in **box 10**) that should be considered when assessing environmental outcomes from different settings in the Barwon-Darling water sharing plan. This includes low flow settings.

Box 10 – From Sheldon (2017)
Example of recent environmental information

Table 2: Ecologically relevant flow thresholds (ML/day) for different gauged sites within the Barwon-Darling river system.

		Gauge Station – Discharge ML/day				
Flow Band	Flow Description	Walgett	Brewarrina	Bourke	Louth	Wilcannia
Low Flows (Figure 6)	Riparian Flows – minimum flows for reaches to remain connected (Interim Northwest Unregulated Flow Plan, 1992)	700	550	390	280	150
Small In-channel Flow Pulse (Figure 6)	Critical discharge (ML/day) required to suppress persistent stratification and *Anabaena circinalis* growth in the Barwon-Darling River (from Mitrovic et al. 2010)		510	450		350
	80th percentile (without development) flows required to inundate low-level in-channel surfaces and associated habitat – important for maintenance of fish and invertebrate populations and water quality mediation (from Carlisle, 2017)	261	346	440	401	361
	Flows that enhance spawning in low-flow spawning specialist fish, such as olive perchlet (endangered) and other small bodies fish (see Humphries and Walker 2013).	500		500	350	
Moderate In-channel Flow Pulse (Figure 7)	50th percentile flows required to inundate low to mid- level in-channel surfaces and associated habitat – important for within-channel connectivity, fish and invertebrate dispersal, nutrient transfer and water quality mediation (from Thoms et al. 1996)			2,500	5,500	2,000
	Threshold flows required for spawning and migration of Golden Perch – duration of flows at this threshold >10 days (Stuart and Sharpe, 2017)		3,000			
	Algal Suppression Flows: Access to uncontrolled/unregulated flows is managed to achieve a flow of at least 2,000ML/day for 5 days at Wilcannia in the period October to April inclusive, unless a flow of at least this size has occurred within the preceding months (Interim Northwest Unregulated Flow Plan, 1992).					2,000
Large In-channel Flow Pulse (Figure 7)	25th percentile flows required to inundate mid-high level in-channel surfaces and associated habitat – important for fish and invertebrate breeding, riparian vegetation health, mediate nutrient transfer from unwetted to wetted surfaces (from Thoms et al. 1996)			9,500	10,500	10,000
	Fish Migration Flows: Access to uncontrolled/unregulated flows is managed to achieve a target flow of at least 14,000 ML/day at Brewarrina and/or 10,000ML/day at Bourke for 5 days in the months September to February inclusive, unless 2 such flows have occurred within this period (Interim Northwest Unregulated Flow Plan, 1992).		14,000			10,000
	10th percentile flows required to inundate mid-high level in-channel surfaces and associated habitat – important for fish and invertebrate breeding, riparian vegetation health, mediate nutrient transfer from unwetted to wetted surfaces (from Thoms et al. 1996)					
Overbank Floods (Figure 8)	Discharge (ML/day) required to inundate 50% of the floodplain wetlands and provide opportunities for large scale waterbird and fish breeding events, maintenance of floodplain vegetation health and large scale nutrient transfer from unwetted to wetted surfaces (from Cooney 1994).		19,000	30,000		21,000

https://www.mdba.gov.au/sites/default/files/pubs/NBR-environmental-water-requirements-Barwon-Darling.pdf

The extent of cease-to-flow events since the year 2000 seems exceptional compared to the preceding period (**box 2)**. Sheldon suggested that the presence of Murray cod in the Darling River is inconsistent with the extent of dry periods that are now occurring (**box 11**).

Box 11 – From Sheldon (2019)

The Barwon-Darling River is a "dryland river", which means it is naturally prone to periods of extensive low flow punctuated by periods of flooding. However, the presence of certain iconic river animals within its channels tell us that a dry river bed is not normal for this system. The Murray cod, dead versions of which have recently bought graziers to tears and politicians to retch, are the sentinels of permanent deep waterholes and river channels – you just don't find them in rivers that dry out regularly.

http://theconversation.com/the-darling-river-is-simply-not-supposed-to-dry-out-even-in-drought-109880

Box 9 suggests that the Barwon-Darling population of this endangered species may be at risk, and if the population decreases significantly or is lost in coming decades, it would be an example of a poor environmental outcome. The rules in the Barwon-Darling water sharing plan should contain rules that preserve more flow through events to the Menindee Lakes. There will be occasions when the Barwon-Darling ceases-to-flow, but the frequency should not be increased as a result of the pursuit of economic outcomes.

The Murray-Darling Basin Water Compliance Review found that in combination the following arrangements in the Barwon-Darling allow substantial diversion of low flows:

- allowing transfer of B and C class licences to A class conditions (meaning that large diverters can pump at lower river heights, previously reserved for stock and domestic or small holdings);
- unlimited carryover with an individual take limit of 300% in any one year;
- not setting individual daily extraction limits, although the plan has allowed for limits to be set for several years; and
- a discretionary power to allow individual entitlement holders to continue pumping in defined circumstances once the cease-to-pump level has been reached.

As part of its WRAP, the NSW Government is currently exploring a range of options to better manage environmental flows. Significant progress has been made through the work of an interagency working group. A significant amount of work remains to be done, including with respect to trialling where needed, and implementation. The CEWH supports this work. It is important this work is fully resourced by NSW to continue with the urgent work needed to implement these critical measures.

One option being explored by the NSW Government to better manage environmental flows is to limit daily water take in the Barwon–Darling through the use of Individual Daily Extraction Limits (IDEL) and Total Daily Extraction Limits (TDEL). The CEWH sees the finalisation and implementation of IDEL's and TDEL's as an important step forward but insufficient in itself to remedy the issues raised in this submission.

Recommendation 8: *That the NRC recommends the inclusion of both IDEL and sustainable TDEL within a revised version of the Barwon-Darling water sharing plan as a matter of priority.*

On connectivity

In April–June 2018, NSW was prepared to actively manage access to environmental flows in the Barwon–Darling River for the northern connectivity event. The flows in the event were protected through a section 324 order. As part of these flows, held environmental water released from upstream storages was used in-stream and managed to flow through to Menindee Lakes.

In March–April 2018, the first flow after an extended dry period (during this period the Darling River at Bourke did not flow for 65 days) was managed through the Barwon–Darling River system by implementing a temporary water restriction (again, through a section 324 order). This unregulated flow event allowed the subsequent 'northern connectivity event' using regulated water to travel further down the river system.

The temporary water restrictions for both of these low flow events ensured that pools were reconnected and refreshed and water quality along the Barwon-Darling River system upstream of Menindee Lakes enhanced. The outcomes from these two events highlight the importance of protecting part or all of the first flow after a prolonged dry period. Total inflows into the Barwon-Darling River systems from these two events were in the vicinity of 50 GL.

Also with respect to connectivity of flow in the rivers in the northern Murray-Darling Basin, it is not clear whether the Interim North West Flow Management Plan is in effect, or is effective, and how it interacts with existing water sharing plans, including the Barwon-Darling water sharing plan. This uncertainty should be resolved.

Recommendation 9: *That the NRC reviews whether the* Interim North West Flow Management Plan *is in effect, and is effective towards the achievement of an appropriate balance of social, environmental and economic outcomes.*

Co-ordination of environmental flows in the northern Basin

Under the Basin Plan, connectivity flow events using held and planned environmental water will be considered in the future. This is challenging for current water sharing arrangements, because flows occur across water sources and from Queensland to NSW. Decisions about priorities of the use of water for the environment within an upstream water source (such as the Gwydir or Namoi water sources) or somewhere downstream (such as in the Barwon-Darling River) will be required. Sometimes it will be possible to produce environmental outcomes in both the upstream water source and the downstream water source.

Recommendation 10: *That the NRC recommends that steps are taken to formalise interagency and community-based collaboration for the management and coordination of both planned and held environmental water throughout the northern Basin, including the Barwon-Darling.*

3. Protect, preserve, maintain and enhance the Aboriginal, cultural and heritage values of the Barwon-Darling water source

The CEWH acknowledges the cultural and spiritual significance of the rivers in the Barwon-Darling, and of many sites, for Aboriginal people. Healthy rivers and full waterholes and weirpools also contribute significantly to the health and wellbeing of Aboriginal communities along the rivers.

Particular sites with the Barwon-Darling River system are significant because they are a rare example of a particular ecosystem; others contain habitat for rare or endangered species, while others provide habitat for migratory bird species. Some species are considered to be totemic by Aboriginal

communities. Some places, such as the Brewarrina fish traps, are also particularly significant because they hold spiritual or cultural significance for Aboriginal people.

The Murray–Darling Basin Water Compliance Review presents a useful case study highlighting the impacts of water extraction along the Barwon and Darling Rivers on Aboriginal communities (**box 12**). The case study again highlights the importance of low flows and the need for the water sharing plan to include arrangements which seek to further increase the level of protection for this type of flow.

A relatively high proportion of the population of the Barwon-Darling catchment is of Aboriginal descent.

Recommendation 11: *That the NRC recommends that steps are taken to enhance engagement with the Aboriginal community in relation to cultural flows and water management, and if appropriate, establish cultural licenses.*

4. Some additional comments

Risk Identification

The issues and risks analysis undertaken to inform the development of the Barwon-Darling Water Resource Plan and discussed in the Stakeholder Advisory Panel process have identified a number of opportunities to improve water sharing arrangements in the Barwon-Darling. It is important to ensure that these risks are being acted upon as required under the Basin Plan, and that these risks are being mitigated as required under the Basin Plan.

Recommendation 12: *That the NRC consider whether the risks identified in the Barwon-Darling Water Resource Plan process are being adequately managed.*

Comparison of large unregulated systems

Large unregulated systems like the Barwon-Darling with significant water take are unusual. The most similar system is the lower Balonne system in Queensland. There is an opportunity to compare rules and other arrangements (role of river operators, compliance regime, metering) so that the best features of the management of each large unregulated system are captured in best practice arrangements.

Recommendation 13: *That the NRC considers comparing water sharing arrangements in the Barwon-Darling with those in another large unregulated system, such as the lower Balonne to lead to the clarification and implementation of best practice.*

Reasonable use guidelines

Currently, riparian landholders can take water from environmental flow events for stock and domestic purposes. Whilst NSW has a Natural Resource Access Regulator, it currently does not have rules or guidelines that this regulator can use to assess whether the take of water for basic landholder rights is reasonable in terms of the volume of take. This needs to be resolved as a matter of priority.

Recommendation 14: *That the NRC recommends that NSW complete and publish 'reasonable use guidelines' for the take of stock and domestic water and basic landholder rights as a matter of priority.*

Box 12: Case study: impacts on Aboriginal communities in the Barwon-Darling of extractions from low flows – from MDBA (2017)

The iron law of water is that extractions upstream affect communities downstream. The need to address the conflicting interests of the two groups is why extraction is regulated.

In a submission to the Northern Basin review, a group of young Aboriginal people from Wilcannia described what water means to them:
If we had no water, it would mean no life, or no food, and no culture, no river red gums and vegetation/shade, no wildlife for us to survive as the wildlife feeds from our water. There are no fish to feed our community as fish is a reliable source of food for our community, we cannot shower, we cannot wash our clothing, we cannot camp as there is no shade, no swimming as the non-flowing water is not safe (contamination), birds find it hard to find habitats, and there is no bush/tucker cooking.
In the Barwon-Darling, there are Aboriginal communities living in Wilcannia, Brewarrina and Bourke. These are towns of considerable disadvantage. The average life expectancy of Aboriginal men born in Wilcannia is 37 years. For women it is 41 years.

Water and the connection to it are an important part of Aboriginal cultural identity and the quality of life. Brendon Adams, a Wilcannia Aboriginal man, has described the significance in the following way:
The river is a vital source for our everyday survival… When it is up we get together, we swim in the river, go fishing to feed our family and Elders… when the river is down our young people do not have a place to come together in a positive way: crime is up as much as 60%.

An Aboriginal Client Service Specialist, working in the Local Courts system, has observed:
When the [Darling] river is down, the crime rate is high. Most families spend weekends on the river – fishing, swimming and on boats. When there is no water in the river, they're stuck in town, there is nowhere to go.

A Wilcannia Community Health Worker has reported the same connection between water in the river and the social wellbeing of Aboriginal communities:
What also affects the [Wilcannia] community is the river; it's a really important one here. It takes you back to the cultural side, and how connection to our river and our land is really important…Early 90's, we had a stage there when we were in a drought really bad, people were really down and crime rates right up. By the end of that year when the river had filled, friends of mine appeared, they'd come over for court…they only had one case. And the river was absolutely full, kids were swimming in the river, people were fishing, the spirit was just really high.

Fish traps constructed by Aboriginal people at Brewarrina are among the oldest manmade structures in the world. For Aboriginal people, the fish traps are a testament to the enduring strength of their relation to country and the continuity of practices. They provide a place at which young people can learn about how to live from the natural resources of their environment. Restricted low flows deny these opportunities. Upstream extractions from low flows mean communities like Wilcannia and Brewarrina suffer. Restricted flows mean fewer fish, which reduces the capacity of families to feed themselves, limited recreation opportunities, and less relief from the extreme heat. The result is the increased social dysfunction and crime described here.

https://www.mdba.gov.au/sites/default/files/pubs/MDB-Compliance-Review-Final-Report.pdf

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