Supporting Evidence for Revised A Class Licence Flow Thresholds

Multiple lines of evidence were used to develop the revised A Class flow thresholds in the Barwon-Darling water sharing plan.

Independent scientific reports recommended greater flow protection

Following the major fish kills in the Darling system in 2018/19, two independent scientific reports were released that sought to identify the causes and provide solutions. Although both acknowledged the role of the ongoing drought in NSW, they also noted the impact of water sharing arrangements and recommended greater protection of low flows:

- the “Independent Assessment of the 2018-19 fish deaths in the lower Darling” (known as the ‘Vertessy report’) found that “when flows in the system are low, the capacity of extractions directly from the Barwon-Darling using A Class licences is a serious threat to the connectivity of the river between Bourke and Wilcannia”. The Vertessy report recommendation that “NSW should modify water access arrangements under the Barwon-Darling Water Sharing Plan to protect low flows”.
- the “Investigation of the causes of mass fish kills in the Menindee Region NSW over the Summer of 2018-2019” by the Australian Academy of Science recommended: Within six months take urgent steps to ensure that there is sufficient flow – considering both quality and quantity of water – in the Darling River to prevent stratification and blue-green algal blooms.

A 2019 Natural Resources Commission review of flow thresholds

After the Vertessy and Australian Academy of Science reports were released, the then Minister for Regional Water Niall Blair requested that the Natural Resources Commission (NRC) bring forward their statutory review of the Barwon-Darling water sharing plan (WSP) and make recommendations as to whether changes are required.

The NRC review report has 17 recommendations in total, including Recommendation 7 which suggests the NSW Government Department of Planning, Industry and Environment – Water (DPIE – Water) enhance the protection of low flows to improve environmental and social outcomes. The details are:

7. Implement enhanced flow targets, with a particular focus on protecting low flows, to better deliver environmental and social outcomes, including:
   a) Adopting the revised flow targets specified in Chapter 9.1.1 of this report, or a similar set of targets based on best available information that can be demonstrated to meet riverine ecosystem, water quality and basic landholder needs.
   b) Raising the cease-to-pump threshold for A Class licences to be consistent with the newly established flow targets.

c) **Reviewing and updating the cease-to-pump thresholds for all access classes for the 2023 remake based on analysis of performance under the amended Plan, and best available information regarding any impacts on flow targets.**

d) **Assessing the impacts of current water use under B Class licences, considering observed data and information on actual user behaviour, against sustainable flow targets to be established for the new Plan.**

The proposed changes to A Class cease/commence to pump (CTP) thresholds meet these recommendations.

**Support for the NRC’s proposed low flow thresholds**

The DPIE – Water, Department of Planning, Industry and Environment – Biodiversity Conservation Division (DPIE – BCD) and Department of Primary Industry - Fisheries (DPI F) have reviewed the scientific basis for the revised A Class CTP thresholds in the NRC’s review of the Barwon-Darling WSP. Clarification was sought from the NRC and Professor Fran Sheldon (Griffith University), whose advice informed this aspect of the NRC review³.

There have been a number of scientific studies undertaken on flow requirements in the Barwon-Darling system. The approach adopted by Professor Sheldon was to synthesise the previous scientific work then use an accepted and published method (i.e. the ‘hydraulic habitat’ method) in recommending changes to the Barwon-Darling WSP A Class CTP thresholds.

The hydraulic habitat method seeks to define the relationship between flow volume (discharge) and the amount of habitat provided during flow along a stream or river. The method is globally accepted, well-documented in the peer-reviewed scientific literature, and has been used in several previous studies completed by DPIE to define and set CTP levels (in particular for coastal rivers). The NSW Government has also used this method to inform the flow bands described in the draft Long Term Water Plan (LTWP) for the Barwon-Darling River.

The work of Professor Sheldon and the NSW Government revealed that flows of 500 ML/day at Bourke maintain habitat important for native fish, reduce stratification and therefore algal blooms in channel reaches, and provide connection along the Barwon-Darling River downstream of Bourke. This figure is also supported by previous scientific studies. Flows of 500 ML/day at Bourke occur in the lower 10% of the baseflow band (as specified in the draft Barwon-Darling LTWP).

The baseflow band in the Barwon-Darling LTWP is considered to be very important for long-term ecosystem health and maintenance. An examination of current CTP thresholds for A Class licences shows they are nearly all below the baseflow band, sitting within what is classed as very low flows.

The NSW Government agrees that to protect the most critical habitat from the impacts of flow diversions, the CTP levels for A Class licences in the WSP for consultation, should reflect important habitat inundation requirements, noting that comment will be explicitly sought on these during the public exhibition phase.

**The ecological importance of low flows and baseflows**

Low flows and baseflows are parts of the flow regime that are important for maintaining aquatic habitat for native plants and animals (particularly native fish) in-between larger flow events.

**Low flows** are minimum flows that prevent a cease-to-flow event from occurring. They maintain water levels in pools and provide flow connectivity between pools.

**Baseflows** are slightly larger flows that provide greater connectivity along the river channel between pools, enabling some fish movement along the river. Baseflows are also important for maintaining water quality in the river channel (very-low-flows are not sufficient to maintain water quality).

In the Barwon-Darling these flows occur as small flow pulses, and long slow events at the end of larger flows, or between larger flows, rather than persistent baseflows that can occur in permanently flowing streams in other parts of the basin.

In NSW LTWPs these flows seek to achieve the following ecological objectives:

**Low flows:**
- Prevent loss of native fish species
- Provide and protect a diversity of refugia

**Baseflows:**
- Maintain condition and provide movement opportunities for all native fish species
- Maintain the extent and viability of vegetation communities occurring within channels
- Provide and protect a diversity of refugia
- Create quality instream, floodplain and wetland habitat (instream water quality).

The NSW Government is proposing to increase CTP levels for A Class licences to limit extraction of low flows and baseflows. Consistent with the recommendations of the NRC, we propose to increase the CTP thresholds to the baseflow thresholds described in the draft Barwon-Darling LTWP, plus a small proportion (10%) of the baseflow flow range.

How were the LTWP low flow and baseflow flow rates determined?

A number of previous studies, and undertook some additional assessments to inform development of the proposed baseflow flow rates. The use of these studies and additional work is targeted at identifying flows required to meet the ecological objectives for baseflows (above).

Flows to prevent weir pool stratification and blue-green algae blooms

Mitrovic *et al.* (2006)\(^4\) assessed conditions that lead to the stratification of weir pools and the development of toxic blue-green algae blooms at Brewarrina, Bourke and Wilcannia. The study concluded that flow velocities above 0.03 m/s are required to prevent stratification and algal blooms, and recommended the following flow rates to avoid stratification and algal blooms:

- Brewarrina – 510 ML/d
- Bourke – 450 ML/d
- Wilcannia – 350 ML/d.

Mitrovic *et al.* 2006 also advised that the velocity threshold of 0.03 m/s is likely to apply in similar weir pools in the region. Using this threshold it was identified flow rates likely to prevent stratification and blooms at other sites using flow velocities from Water NSW gauge rating tables.

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Flows to enable native fish movement

DPI Fisheries (2017)\(^5\) recommended a minimum depth of flow above the cease-to-flow level of 0.3m to enable small and moderate bodied fish movement. WaterNSW gauge rating tables were analysed by DPIE to identify flow rates equivalent to this depth of flow. Gauges are often located at sites with hydraulic controls (e.g. weirs) and confined channels, meaning that rating tables may not be representative of reach scale hydraulics, and so it is recognised that this approach has uncertainty.

Flows for native fish condition and spawning

Sheldon 2017\(^6\) and Sheldon 2019\(^7\) propose flow rates to support native fish condition and spawning for specialist fish species that require flowing habitat over large spatial scales (e.g. Murray Cod), and low-flow spawning specialist fish species that require regular low-flows to spawn, recruit and maintain populations (e.g. Olive perchlet). These recommended flow rates draw upon the findings of Mallen-Cooper and Zampatti (2015)\(^8\), and Humphries and Walker (2013)\(^9\).

Hydrologic indicator of baseflows

A number of studies propose using the 20\(^{th}\) percentile natural or pre-development flow as an indicator of baseflows (e.g. Alluvium 2010\(^10\), Sheldon 2017). Significant extractions and regulation in the northern basin commenced in the mid-1960s (Thoms et al. 1995\(^11\)) and observed flows before 1963 have been used to determine the 20\(^{th}\) percentile flow using the approach recommended by Alluvium 2010.

Selecting low flow and baseflow flow rates for LTWPs

The flow rates derived from these studies are summarised in the table below. The proposed flow rates are based on consideration of these multiple inputs, taking into account relative confidence in the data sources and methods, and seeking to align the flow rates between planning units/gauges based on the frequency of occurrence of those flows.

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### Flow rate (ML/d)

<table>
<thead>
<tr>
<th>Information source/approach</th>
<th>Mungindi 416001</th>
<th>Collarenebri 422003</th>
<th>Walgett 422001</th>
<th>Brewarrina 422002</th>
<th>Bourke 425003</th>
<th>Wilcannia 425008</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flows to prevent stratification and algal blooms</strong> (Mitrovic et al. 2006)</td>
<td>203(^1)</td>
<td>336(^1)</td>
<td>NA</td>
<td>510</td>
<td>450</td>
<td>350</td>
</tr>
<tr>
<td><strong>Flows to enable native fish movement</strong> (DPI Fisheries 2017)</td>
<td>541(^2)</td>
<td>982(^2)</td>
<td>52</td>
<td>684(^2)</td>
<td>972(^2)</td>
<td>40</td>
</tr>
<tr>
<td><strong>Flows for native fish condition and spawning</strong> (Sheldon 2017, Sheldon 2019)</td>
<td>-</td>
<td>-</td>
<td>&gt;500</td>
<td>-</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td><strong>20(^{th}) percentile flow, based on observed pre 1963</strong> (Alluvium 2010, Sheldon 2017)</td>
<td>132</td>
<td>206</td>
<td>279</td>
<td>244</td>
<td>954</td>
<td>617</td>
</tr>
<tr>
<td><strong>Selected baseflow flow rate (minimum)</strong></td>
<td>160</td>
<td>280</td>
<td>320</td>
<td>500</td>
<td>500</td>
<td>350</td>
</tr>
<tr>
<td><strong>Selected baseflow range +10% of full baseflow range</strong></td>
<td>198</td>
<td>317</td>
<td>358(^3)</td>
<td>550</td>
<td>605</td>
<td>455</td>
</tr>
</tbody>
</table>

Notes:

1. Determined by DPIE using the threshold of 0.03 m/s and mean flow velocities in Water NSW gauge rating tables. The Walgett gauge is not located in a weir pool and the method may not apply in this environment.
2. Sites where gauges are located in weir pools where the rating table may have added uncertainty in representing conditions along the river channel, outside of the weir.
3. See exceptions below.

### Extension of the NRC’s recommendations to other management zones

The NRC provided recommendations for changes to CTP thresholds for five of the 14 CTP locations on the Barwon-Darling (i.e. Walgett, Brewarrina, Bourke, Louth and Wilcannia). Their approach recommends raising the A class CTP thresholds to protect the entire very low flow range defined in the LTWP plus 10 percent of the baseflow range.

In its review of the work the NSW Government analysed the five revised CTP thresholds using the Barwon-Darling river model (i.e. IQQM) to test their impacts, and then adopted the NRC approach to generate revised CTP thresholds at the remaining river management zones so they could be applied to all A Class licences along the river.

With two exceptions, the NRC-derived A Class CTP recommendations are included in the amended draft Barwon-Darling WSP for consultation. The two exceptions are the thresholds at Walgett Weir Pool (422001) and at Mogil Mogil (422004).

- At Walgett, the current CTP of 600 ML/day will be retained. This is higher than the threshold recommended by the NRC, and is considered necessary to manage the water quality risks to the Walgett town water supply.
- For Mogil Mogil, the threshold generated using the NRC’s methodology would result in an A Class threshold being set above the existing in B Class thresholds. The proposed A Class
threshold will be set below the existing B Class threshold at 220 ML/day. This equates to baseflow identified in the Barwon-Darling LTWP.

Raising A Class licence CTP thresholds will help maintain important habitat

The proposed changes to the A class licence CTP thresholds will reduce the take of low flows and increase the proportion of time that flows are experienced in the Darling below Bourke to Wilcannia and Menindee. The Barwon-Darling will continue to have cease-to-flow events in dry times, however the duration of events may decrease.

Raising the A class flow thresholds will help maintain important riverine habitat for native fish and other aquatic plants and animals during periods of low flow, and also support social outcomes and water security for basic rights and critical town water supplies.

Note also that initial modelling undertaken by the NSW Government indicates that the revised A Class licence CTPs may cause greater pressure on flows in the small ‘fresh’ range above the A Class thresholds. This needs to be examined further, and the potential impacts on key ecological processes tested during the term of the plan.

What it means for licence holders

The NSW Government is determining the impact of these changes on long-term average diversions under A class licences. Preliminary work shows there will be a small impact on the long-term reliability of A class licences. Analytical modelling suggests that the impact on individual A class licence holders will be affected by a range of factors including the number of A class licences held by an entitlement holder, their portion of individual daily extraction limit volume, pump size and on farm storage capacity.

Have your say

We seek your comments on the proposed amendments to the Barwon–Darling unregulated water sharing plan.

Make a submission

Use our online form or send an email to make a submission. All submissions will be considered when finalising the plan. Submissions close at 5 pm on 29th October.

More information


If you would like to stay informed about all of the department’s upcoming engagement activities please visit our website or subscribe to our newsletter.