Resumption of flows rule in the Barwon–Darling Unregulated River Water Source

Fact sheet – March 2021

Managing resumption of flow

This fact sheet explains how we use water sharing plan rules in the Barwon–Darling unregulated water source to manage the resumption of flows after a long period of low or no flows.

Why we need the 'resumption of flows' rule

The first flow of water after a period of low or no flows has important social, cultural and environmental outcomes. This rule reflects the need to protect the first flow after an extended dry period.

The Barwon–Darling River is unregulated and the first flows after a dry period are particularly important. Protecting the first flows benefits the communities of the Barwon–Darling region. Aboriginal communities who have a long association with the river benefit culturally. All local communities benefit mentally and in general wellbeing because they can swim, boat and fish, or simply view the flowing river.

Low-flow periods can stress water plants and animals (biota) that survive in refuges such as pools behind weirs and natural pools. During dry periods, there are often no connections between pools. Water quality in these pools worsens during no-flow periods, typically putting the animals that rely on the river under significant stress. Protecting the first flow after a dry period will help maintain water in vital refuge pools for dependent biota in dry times. It may also improve water quality. Finally, wetting the river channel with the first flows reduces water losses from any larger flows that follow. This benefits irrigators and downstream communities.

Aims of the rule

The main aim of the resumption of flows rule is to protect the critical first flows after an extended low-flow or dry period. The rule is triggered when a flow event happens after a continuous period of no or low-flow conditions. It prevents water users from accessing the first flow down the river until a flow meets a target. Normal access conditions then apply after the flow has reached the required target flows (Figure 1).

The NSW Department of Planning, Industry and Environment – Water used flow modelling to inform the design of the rule. This gives the rule the most potential to improve watering of the environment at very low flows without compromising the environmental benefits of higher ones. We considered societal, recreational and local economic improvements qualitatively when designing the proposed rule.

The rule is clause 50 in the water sharing plan

Clause 50 of the *Water Sharing Plan for the Barwon–Darling Unregulated River Water Source 2012* (Barwon–Darling WSP) establishes the resumption of flows rule.

Previously, the water sharing plan used mainly commence-to-pump (on a rising river) and cease-to-pump (on a falling river) thresholds to protect low flows. These thresholds did not allow the first flows after an extended dry period to pass downstream without extraction and reach towns on the lower reaches of the river, such as Wilcannia.

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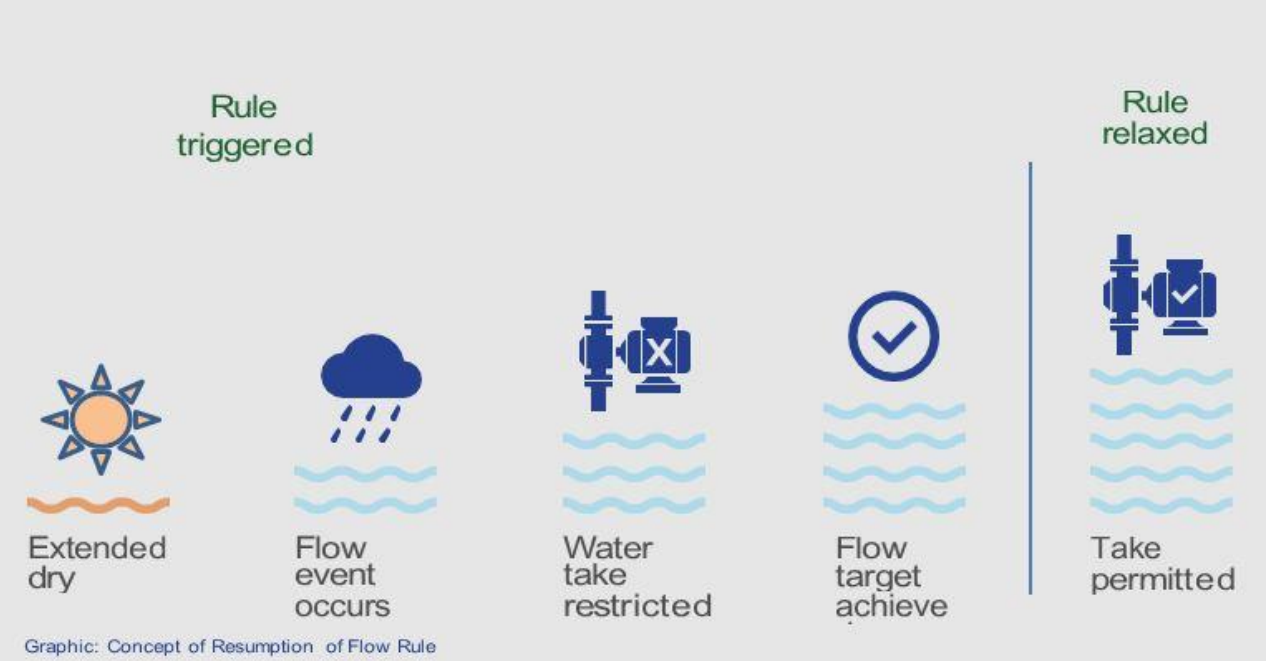


Figure 1. Concept of resumption of flows rule

The water sharing plan specifies the conditions under which the rule will ban access, and then when we will relax the restrictions to allow access again. The rule specifies triggers for the 4 river sections of the unregulated Barwon–Darling, measured at Walgett, Brewarrina, Bourke and Wilcannia. We will evaluate the resumption of flows rule before the 2023 remake of the water sharing plan. If needed, we will revise it to achieve plan objectives.

If it is in the public interest, we can use a section 324 order under the *Water Management Act 2000* to prevent access to flows. However, the resumption of flows rule offers water users greater certainty about which flows we will protect. It also reduces the need to use section 324 orders at short notice.

Triggers for activating the resumption of flows rule

WaterNSW will ban access if one or more of the following flow conditions occur:

- less than 326 ML/day for more than 150 consecutive days at Dangar Bridge (Walgett) (Gauge 422 001)
- less than 468 ML/day for more than 150 consecutive days at Brewarrina (Gauge 422 002)
- less than 450 ML/day for 120 days consecutive days at Bourke Town (Gauge 425 003)
- less than 200 ML/day for 90 consecutive days at Wilcannia (Gauge 425 008).

Triggers for relaxing the resumption of flows rule

There are two ways access to flows can begin again (subject to other water sharing plan conditions being met). The first is when WaterNSW forecasts that reinstating access will not stop a total of 30,000 ML passing Bourke after the resumption of flows rule was triggered. The other way is when WaterNSW forecasts reinstating access will not prevent flows of at least:

- 706 ML/day for 10 consecutive days at Dangar Bridge (Walgett) (Gauge 422 001)
- 1,008 ML/day for more than 10 consecutive days at Brewarrina (Gauge 422 002)

- 972 ML/day for more than 10 consecutive days at Bourke Town (Gauge 425 003)
- 400 ML/day for more than 10 consecutive days at Wilcannia (Gauge 425 008).

Either relaxation trigger can happen independently of the other, and prompt WaterNSW to reinstate access. They may also happen together, and prompt WaterNSW to reinstate access.

The very first time the relaxation can happen is the first day **after** the resumption of flows rule is triggered. That is, on day 90 the rule is triggered, so the very first day it can be relaxed is (the following) day one of the prohibited access period.

For the 30,000 ML past Bourke relaxation trigger, this means the count for the total 30,000 ML begins on day one, not any day before that. For the 10-day flow target triggers at Walgett, Brewarrina, Bourke Town and Wilcannia, this means a forecast of **more than 10 consecutive days** of the listed flows. And these must begin day one of the relaxation opportunity period.

What this rule means for licence holders

Once the resumption of flows rule is activated, access to flows is banned. This means no pumping from the Barwon–Darling River is allowed until the relaxation triggers are met and WaterNSW has announced access is reinstated.

How it works

WaterNSW will announce a No Flow Class to restrict access once the resumption of flows rule is triggered. WaterNSW will also announce when it relaxes the rule and reinstates access. This information, along with forecasting information and likely flow conditions, is available on the WaterInsights Portal.[1] Licence holders can also see announcements at iWAS.[2]

WaterNSW will use its forecasting system to predict when the activation and relaxation triggers happen. WaterNSW will use a conservative forecast when it estimates if relaxation criteria will be met and when it distributes available water above the trigger. WaterNSW does this to ensure that granting access will not stop the relaxation criteria from being met.

River sections

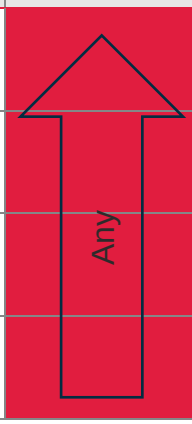
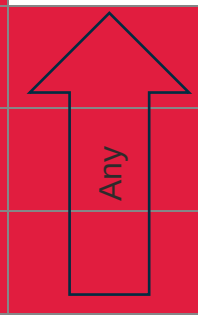
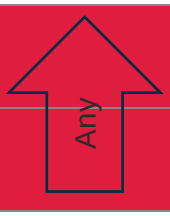
If access is suspended in a river section, access in all sections upstream will also be suspended. This is to protect flows that could contribute to the downstream section.

The activation triggers for suspending access are unique to each river section. They are a flow target combined with a number of consecutive days. So, when flows in a particular river section are below the listed volume for the corresponding number of days, WaterNSW bans access in the river section and all downstream river sections. For each section, these values are equivalent to 200 ML/day and 90 days at Wilcannia.

Table 1 shows which triggers can contribute to suspension of access for each section. If **one or more** of the criteria is met, the resumption of flows rule is activated for that section.

[1] https://waterinsights.waternsw.com.au/
[2] https://iwas.waternsw.com.au/iwas/login.iwas

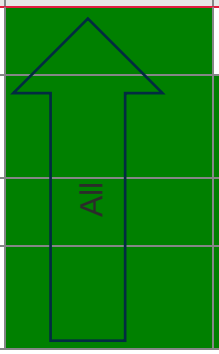
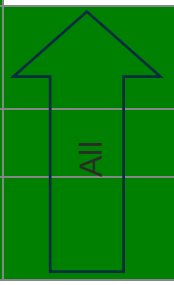
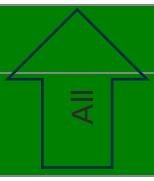
Table 1. Triggers for activating the resumption of flows rule in each river section

Activation trigger	Section 1 Mungindi to Walgett	Section 2 Walgett to Brewarrina	Section 3 Brewarrina to Bourke	Section 4 Bourke to Wilcannia
below 326 ML/day for 150 days at Dangar Bridge (Walgett)		n/a	n/a	n/a
below 468 ML/day for 150 days at Brewarrina			n/a	n/a
below 450 ML/day for 120 days at Bourke Town				n/a
below 200 ML/day for 90 days at Wilcannia				

If access is reinstated (that is, the rule is relaxed) in a downstream river section because of a tributary inflow to that section, access to the upper sections would remain suspended if they still meet the conditions for suspension.

To relax the rule, a flow of 400 ML/day must pass Wilcannia for 10 consecutive days, or the forecast total flow passing Bourke during the event must exceed 30,000 ML. If there are tributary inflows into the lower river sections the criteria can also be relaxed, which is the reason for the multi-sectional rule design. The triggers for relaxing the rule for river sections 1, 2 and 3 are equivalent to the trigger at Wilcannia. Table 2 shows the triggers for relaxing the rule .

Table 2. Triggers for relaxing the resumption of flows rule in each river section

Relaxation trigger	Section 1 Mungindi to Walgett	Section 2 Walgett to Brewarrina	Section 3 Brewarrina to Bourke	Section 4 Bourke to Wilcannia
706 ML/day for 10 days at Walgett		n/a	n/a	n/a
1,008 ML/day for 10 days at Brewarrina			n/a	n/a
972 ML/day for 10 days at Bourke				n/a
400 ML/day at Wilcannia for 10 days				
OR				
Cumulative flow past Bourke (since activation began) greater than 30,000 ML				

Appendix – Rule development

Summary of considerations when developing the rule

The Murray–Darling Basin Authority reported on ecological needs of low flows in the Barwon–Darling. It recommended that water sharing arrangements in the Barwon–Darling should be implemented to limit the no and very low flow periods from exceeding 60–80 days at Bourke and 120–150 days at Wilcannia. It also noted that there is a very high likelihood of system-scale connectivity through to Wilcannia, with an event volume of at least 20,000 ML at Bourke. This event would be enough to mix and refresh pools within management zones and give native fish some opportunities to move locally. However, the magnitude (ML/day) and volume of the event would not give native fish opportunities to move or disperse at a system scale and would not guarantee connectivity to the Lower Darling River downstream of Wilcannia.

The Natural Resources Commission Review of the Water Sharing Plan for the Barwon-Darling Unregulated and Alluvial Water Sources 2012[3] recommended that the flow values used to design the resumption of flows rule align with the environmental water requirements in the Barwon–Darling Long Term Water Plan

Table 3 summarises the issues that we considered when developing the rule and assessing its performance in addressing these issues.

Table 3. Assessment criteria for resumption of flow rule for the Barwon–Darling

Criteria	Feature	Value	Performance
Hydrology	Interflow duration (at Wilcannia)	90 days	High-risk length of no flow for Wilcannia Town Water Supply is 120–150 days.[4]
	Start trigger (at Wilcannia)	200 ML/day	Maintains flows below the base flow for longer than a cease-to-flow trigger.
	Section 324 comparison	no. of expected and additional events (Wilcannia)	At Wilcannia, the expected number of events due to the resumption of flows rule is 18 over the entire flow record (119 years), of which 14 would be covered by s324 under current and historical practice (that is, 4 additional events with access suspended over modelled historical record).
	Total flow forecast at Bourke	30,000 ML	Size of event likely to provide longitudinal connectivity from Bourke to Wilcannia is 20 GL[1]. Volume of 30 GL increases likelihood of event connecting to end of system (Lake Wetherell).

[3] www.nrc.nsw.gov.au/2018-2019-wsp-reviews

[4] Murray–Darling Basin Authority (2018), *Ecological needs of low flows in the Barwon–Darling; Technical Report*. Published by the Murray–Darling Basin Authority.

Criteria	Feature	Value	Performance
Long-term ecological assessment	Preferred options, in order B16, A14, A15	A14 is 2nd choice	Provides potential to improve ecological outcomes at low flow without compromising other flow categories: • Minimise loss of weir and refuge pools as important habitat • Maintain water quality of weir and refuge pools.
Economic analysis	Cost impact of A14	−$774,000 (net present value for 10 years)	Equivalent to 368 hectares per year of lost cultivation or reduction in the average hectares planted of 0.3 %, incremental to the base case.
Water quality	Salinity dilution	400 ML/day	Flow will lower electrical conductivity while flow occurs along the water source.
	Salinity flush	30,000 ML forecast at Bourke	Flow will provide a reasonable sized flush along the water source.
	Thermal de-stratification	400 ML/day	Flow required for destratification of the weir pool at Wilcannia is 200 ML/day, and 450 ML/day at Bourke.[5]
	Thermal de-stratification and blue-green algae	10 days of flow (before rule is relaxed)	Will provide protection from blue-green algae during the 10-day period of the event (and subsequent 4 days until thermal stratification re-establishes after cease to flow).[2]

Designing flow triggers to activate and relax the rule

A key element of the resumption of flows rule is the triggers for activating the rule to ban access, and then to relax the rule once the objectives have been met.

We used these guiding principles for cease-to-flow and low flows, as well as the latest biological and ecological information for native fish:

- the requirement for very low flows for maintaining water quality by de-stratifying refuge pools (that is, encouraging water to mix) is a flow velocity of 0.03–0.05 m/s (Mitrovic et al. 2003)
- the minimum depth for small-bodied and moderate-bodied fish movement is 0.3 m above cease-to-flow (Gippel 2013; O'Connor et al. 2015)
- the minimum depth for large-bodied fish movement is 0.5 m above cease-to-flow (Fairfull and Witheridge 2003; Gippel 2013; O'Connor et al. 2015).

In defining the flow rates for base flow at specific locations, one factor we considered was cease-to-flow plus a 30 cm rise. However, many flow gauge sites are not a representative example of the river channel in the area and did not represent the desired outcome of 30 cm of water to support fish movement. In these cases, we have used a combination of velocity and correlation of flow

[5] Mitrovic, S.M., Oliver, R.L., Rees, C., Bowling, L.C., and R.T. Buckney (2003), Critical flow velocities for the growth and dominance of *Anabaena circinalis* in some turbid freshwater rivers, *Freshwater Biology*, **48**, 164–174.

rates back to more relevant gauges or other published science to determine the appropriate rate. This is the case for the gauge locations included in Table 4. Table 4 summarises the relevant flow referred to in the above principles. It compares them to the access rules for A- and B-class access licences at the downstream gauge sites for each of the river sections in the Barwon–Darling.

Table 4. Comparison of cease-to-flow height and associated rates and baseflow rates

Location	Cease-to-flow (CtF) height (m)	CtF plus 30 cm (ML/day)	CtF plus 50 cm (ML/day)	Baseflow (ML/day)	A Class cease-to-pump (CtP)	B Class CtP
Walgett (422001)	0.99	68	146	326–706	600 ML/day	900 ML/day
Brewarrina (422002)	1.71	7	10.9	468–1,008	460 ML/day	840 ML/day
Bourke (425003)[6]	3.92	972	2,490	450–972	350 ML/day	1,250 ML/day
Wilcannia (425008)	−0.07	71	195	200–400	123 ML/day	850 ML/day

Source: https://realtimedata.waternsw.com.au/ (9 August 2018)

During rule development, the Stakeholder Advisory Panel asked the Department of Planning, Industry and Environment – Water to demonstrate the relationship between the:

- trigger flow rates at Wilcannia (200 ML/day to activate and 400 ML/day to relax)
- equivalent flow rates that were proposed for the upstream river sections.

We used historical observed flows in preference to modelled relationships. We did this to capture the range of variability in outcomes that tends to be lost in models that are calibrated to match long-term behaviour. Observed flows at Bourke were lagged by a typical travel time. We then manually compared them to observed flows at Wilcannia to identify small events with peaks of less than 1,000 ML/day. For each event we identified, we recorded the peaks, the season, and a note on earlier conditions. The analysis showed the relationship between flow rates at the gauges nominated for each river section were fairly consistent, which allowed us to design equivalent rule triggers for each river section.

For example, Figure 2 considers all flows below 1,000 ML/day. It indicates that a flow of:

- 500 ML/day at Bourke will most likely cause a flow of 418 ML/day at Wilcannia
- 500 ML/day flow at Wilcannia requires a 568 ML/day flow at Bourke on average.

[6] The apparent increased height of cease to flow, and associated discharge rate, is a result of the presence of the Bourke weir.

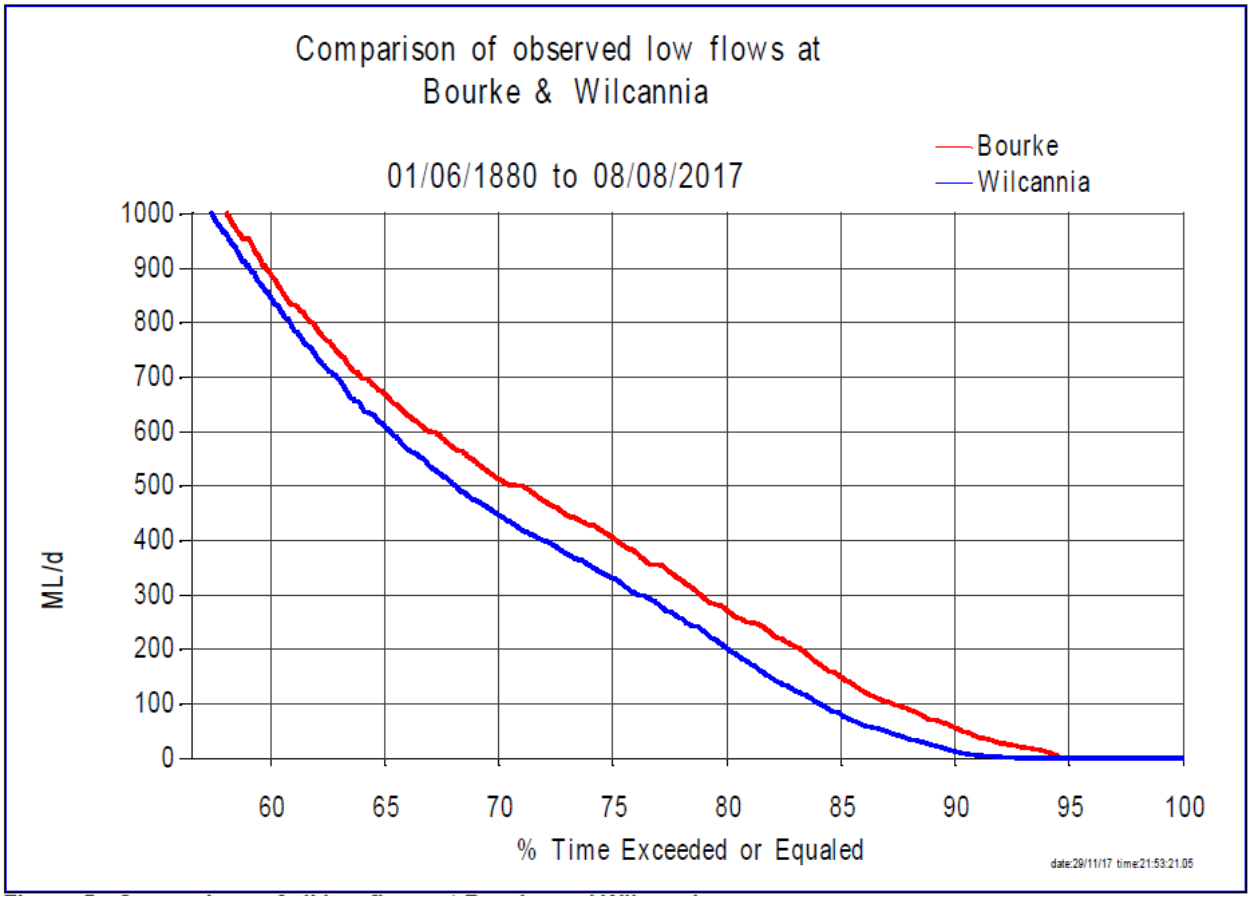


Figure 2. Comparison of all low flows at Bourke and Wilcannia

Modelling effect of the rule

The department's Water group created a model to compare scenarios with and without the resumption of flows rule. We did this to evaluate how effective the rule is and to examine the effect on the system, including flows and access for licence holders. Table 5 lists the characteristics of each river section modelled.

Table 5. Characteristics of river sections for multi-sectional modelling of resumption of flows rule

Variable	Characteristic	Explanation[7]
Trigger condition – minimum flow	< 326 ML/day at Walgett	Bottom of base flow at Walgett
	< 468 ML/day at Brewarrina	Bottom of base flow at Brewarrina
	< 450 ML/day at Bourke	Bottom of base flow at Bourke
	< 200 ML/day at Wilcannia	Bottom of base flow at Wilcannia
	150 days	Model equivalent of 90 days at Wilcannia

[7] This was the base flow information available at the time of rule development; more recent estimates are now available. The rule may be reviewed during evaluation of the water sharing plan as appropriate to consider these new values.

Variable	Characteristic	Explanation[7]
Trigger condition – interflow frequency	150 days	Model equivalent of 90 days at Wilcannia
	120 days	Model equivalent of 90 days at Wilcannia
	90 days	High-risk length of no flow for Wilcannia Town Water Supply is 120–150 days[8]
Relaxing condition – flow magnitude for 10 days	706 ML/day at Walgett	Top of base flow at Walgett
	1,008 ML/day at Brewarrina	Top of base flow at Brewarrina
	972 ML/day at Bourke	Top of base flow at Bourke
	400 ML/day at Wilcannia	Top of base flow at Wilcannia
Relaxing condition – total flow at Bourke	30,000 ML forecast total flow past Bourke since the start of the suspension	Size of event likely to provide longitudinal connectivity from Bourke to Wilcannia is 20 GL^2. Volume of 30 GL increases likelihood of event connecting to end of system (Lake Wetherell).

Figure 3 compares a modelled scenario with the resumption of flows rule at Wilcannia with a scenario using the previous water sharing plan rules. Both scenarios used the same flows with no development. A small pulse was protected between 90 and 120 days, as was the rising of the river after 150 days. The rule was relaxed, and normal access conditions resumed at roughly 160 days, which is after the flow had been above 400 ML/day for 10 continuous days.

The simulation shows that the resumption of flows rule works as intended. It protects the first flows after a dry period, when compared to the previous water sharing plan rules (between roughly 160 to 170 days). After the resumption of flows rule is relaxed, normal access conditions are allowed, and flows decrease as water is accessed. Under the previous water sharing plan rules, water extraction reduces the initial rising of the river and a smaller peak occurs after 180 days.

[8] Murray-Darling Basin Authority (2018), *Ecological needs of low flows in the Barwon-Darling; Technical Report*. Published by the Murray-Darling Basin Authority.

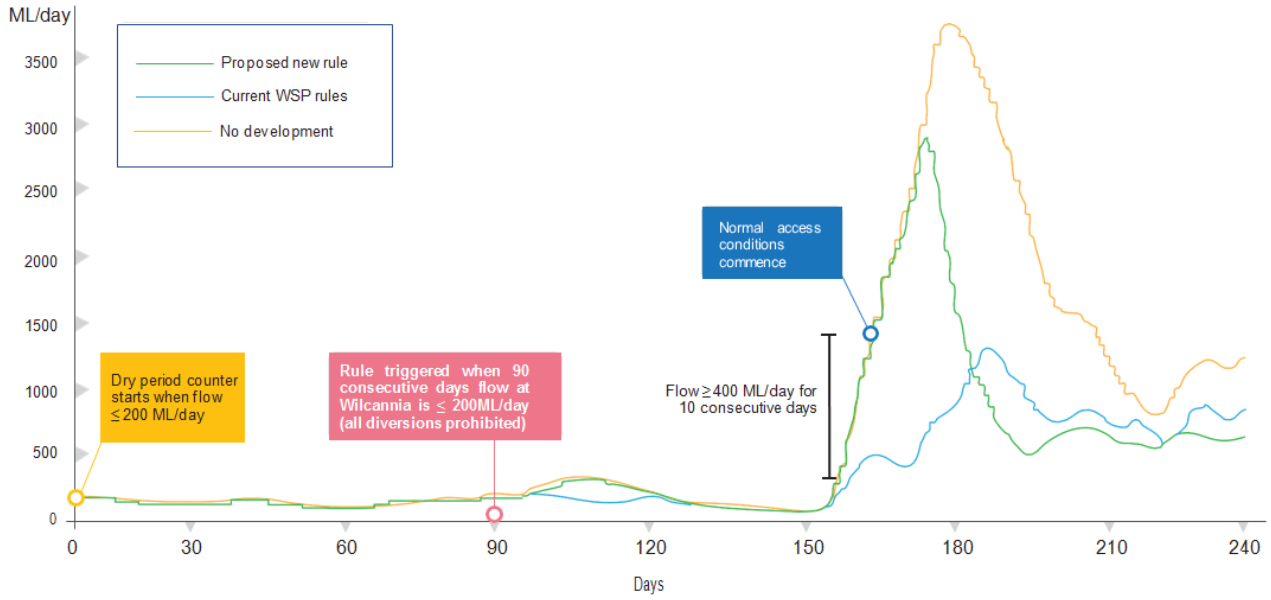


Figure 3. Example of flow with the resumption of flows rule at Wilcannia

Changes to access

Our modelling of the rule amendments (including the resumption of flows rule and the distribution of individual daily extraction limits that was introduced around the same time) changes the access to the long-term average diversion volume as follows:

- A class −0.7%
- B class −0.1%
- C class −1.6%
- total diversion of −0.5%.

An independent analysis of the cost of the resumption of flows rule for changed irrigated production gives an estimated cost over 10 years of $774,000 for the whole water source. This is for current costs (based on a resumption of flows rule to Wilcannia). The calculation of the economic cost to irrigators was based on the modelled volume of water diversions restricted by the rule, multiplied by the calculated gross margin per ML for irrigated cotton, based on 2019 figures. These monetary costs experienced by the irrigation industry can also be presented as equivalent hectares not cultivated (368 ha) and the percentage change in hectares under production (−0.3%), over the entire 10-year period.

These estimates do not factor in the historical practice of restricting access through temporary water restriction orders (section 324 orders) in dry periods to meet critical water requirements. If these restrictions were included in the economic modelling, the net costs would be significantly less.

Table 6 shows results of modelling the package of plan rule amendments, had the resumption of flows rule been in place over the historical 119-year flow record. It shows the number of times that the rule would have been activated and the number of these events that would have been protected by temporary water restriction orders, based on current and historical practice by the NSW Government. The resumption of flows rule replaces a large portion of the temporary water restrictions.

Table 6. Activation of resumption of flows rule compared to temporary water restrictions

Location	Number of times resumption of flows rule activated	Number of times a temporary water restriction would have applied	Number of additional water restrictions due to resumption of flows rule
Walgett	26	20	6
Brewarrina	26	19	7
Bourke	22	16	6
Wilcannia	18	14	4

More information

Read the Water Sharing Plan for the Barwon-Darling Water Source 2012

If you have questions about operational aspects of the rules, please call the WaterNSW Customer Service team on 1300 662 077 or email Customer.Helpdesk@waternsw.com.au

The Natural Resources Access Regulator (NRAR) is responsible for all compliance activity. Call NRAR on 1800 633 362 or email at nrar.enquiries@nrar.nsw.gov.au