

Protecting low-flows in the Upper Bega–Bemboka Rivers Water Source

Why the NSW Department of Planning and Environment is considering greater protection for low-flows

Protecting low flow is important as they provide and maintain aquatic refuges, support the life cycle of water dependent plants and animals and allow their survival throughout the drier summer months.

- Analysis shows that when flows at Kanoona gauge drop below 6 ML/day, connectivity is lost along the length of the Upper Bega and Bemboka rivers, upstream of Kanoona.
- The current water access restriction (cease-to-pump rule) in the Upper Bega–Bemboka Rivers is inconsistent with the management of similar coastal rivers as:
 - a. the tributaries have higher cease-to-pump rules than the larger main stem
 - b. other water sources on the NSW coast with similar entitlement levels and mean annual flows have higher cease-to-pump rules.
- Modelling shows that if we restrict access to flows more, this reduces the frequency and duration of low-flow and cease-to-flow events significantly. This protects the basic needs of river ecosystems and ensures water is more available in dry times to supply basic landholder rights, as well as requirements for health, hygiene and emergencies.

The risk we identified

The department's Water group has identified a high risk to aquatic ecosystems because of reduced flows and increased cease-to-flow periods in the Upper Bega–Bemboka Rivers Water Source. This water source has the largest amount of unregulated water use in the Bega River Area water sharing plan, with 9,557 ML (9.6 GL) of entitlement. This represents 27% of all unregulated entitlement in the plan (34,779 ML in total).

The department has reviewed the environmental and hydrological information available for this water source to consider how we can lessen the high risks by adjusting the cease-to-pump rule for very low-flows. This fact sheet outlines the information we considered.

Hydrology of the water source

The water source has 2 key gauges: the upstream gauge is the Bemboka River at Morans Crossing (219003) and the downstream gauge is the Bega River at Kanoona (219032). Analysis of the flow duration curves (Figure 1a) shows that Morans Crossing never drops below 1 ML/day, while Kanoona frequently records flows below 1 ML/day. The critical change appears to be around the 70th percentile, where flows begin to drop rapidly until the 100th percentile.

We also know that cease-to-flow conditions in some reaches of the water source happen at 6.1 ML/day at Kanoona, resulting in loss of surface flows and river connectivity (Figure 1b).⁽¹⁾

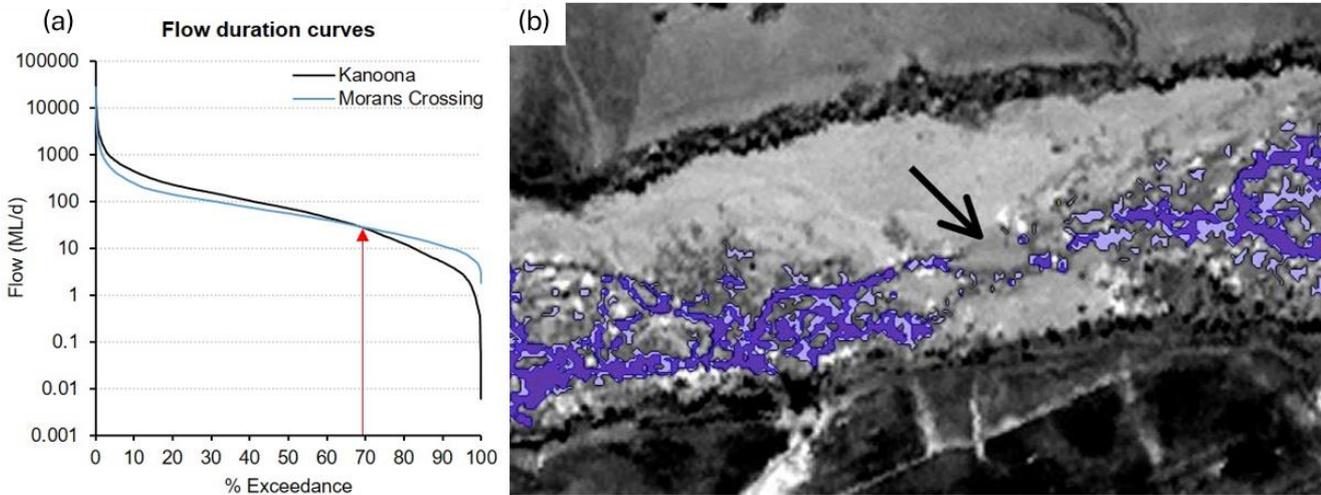


Figure 1. (a) Flow duration curves for gauge 219032 (Kanoona) and 219003 (Morans Crossing), and (b) inundation patterns using Daedalus imagery (Nov 2002) showing disconnection at a flow rate of 6.1 ML/day at the Kanoona gauge⁽¹⁾

The effects of surface water extraction on the hydrology of this system are well documented.⁽¹⁻³⁾ The department identified that diversions can significantly reduce the depth of water over summer months. Low-flow habitats are exposed to drying for 3 months compared to 1 to 2 weeks under natural conditions.⁽²⁾

Further, flows below 10 ML/day happen 2 to 3 times more often because of surface water diversions.⁽²⁾ Modelling by the department shows that cease-to-flow periods are eliminated with a 10 ML/day rule scenario (Table 1), based on 130 years of data.

Table 1. Hydrological model outcomes for cease-to-flow (CtF) frequency and duration at gauge 219032 (Kanoona) under 4 different commence-to-pump scenarios

Frequency and duration	2 ML/day	5 ML/day	7 ML/day	10 ML/day
Frequency (number of years with CtF spells per 130 years)	46	40	4	0
Duration (average number of CtF days per year)	5	2	0	0

Cease-to-pump rules for low-flows and water use

A review of the observed flows at both gauges during 2 dry periods (Dry period 1: 2008–2009 and Dry period 2: 2019–2020) highlights how often cease-to-flow events happen at Kanoona, compared to Moran’s Crossing (Figure 2). There is also evidence that pumping causes steep flow declines from about 5 ML/day to 0 ML/day, followed by a rapid increase in flows during dry period 1.

Observed flows during two dry periods

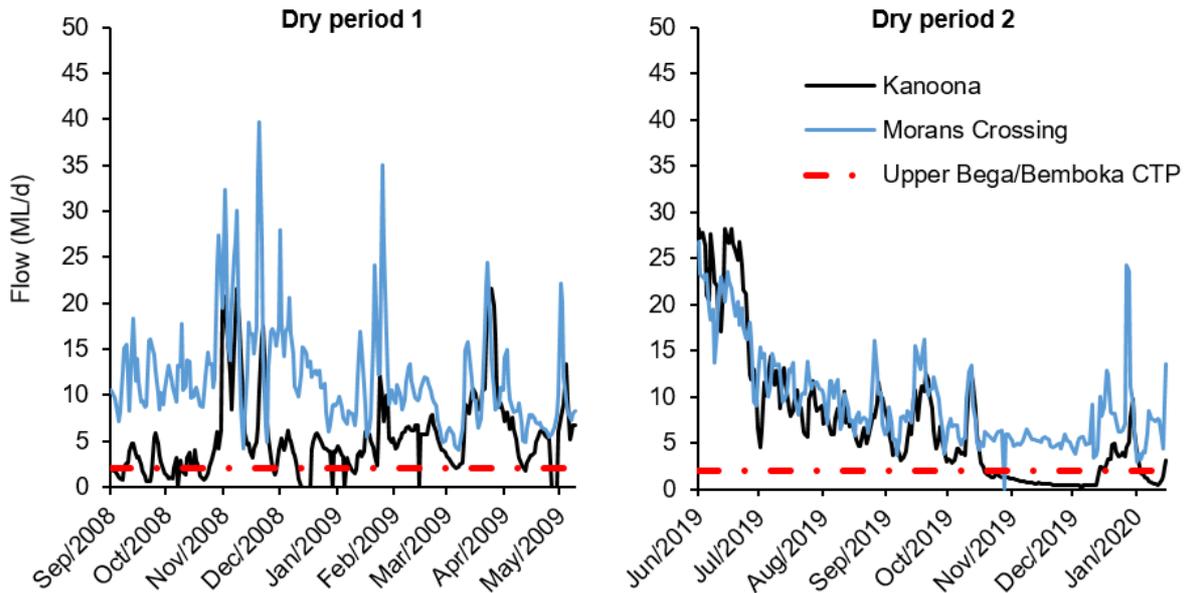


Figure 2. Observed daily flows (ML/day) for gauge 219032 (Kanoona) and 219003 (Moran’s Crossing) during 2 dry periods. The red dashed line represents the current 2 ML/day commence-to-pump rule.

The very low-flow class rule restricts access in the water source when flows are below 2 ML/day at the Bega River at Kanoona gauge (219032). In contrast, this water source has 2 key tributary water sources with higher cease-to-pump rules: Sandy Creek (3 ML/day); and Tantawangalo Creek (5 ML/day).

The mean annual flow for the Bega/Bemboka water source is 273 GL. A review of all water sources on the NSW coast (328 in total) identified 2 with similar levels of entitlement (+/- 2 GL) and mean annual flow (+/- 35 GL). Both are in the Clarence River catchment. They are the Upper Orara River Water Source (mean annual flow 279 GL and 8.5 GL entitlement) and the Bielsdown River Water Source (mean annual flow 305 GL and 7.6 GL entitlement). Both water sources have much higher cease-to-pump rules than the Upper Bega–Bemboka, with a cease-to-pump of 8 ML/day in the Upper Orara River Water Source and 23 ML/day in the Bielsdown River Water Source.

Daily water extraction in the Upper Bega–Bemboka can divert 10.5 ML/day on average, and up to 41.5 ML/day during peak periods.⁽²⁾ Table 2 gives a simple comparison of extraction potential in the 3 water sources.

Table 2. Extraction potential

Water source	Average daily entitlement (total entitlement/365 days)	Daily amount of water available at the 80th percentile
Bega	26.2 ML	12.8 ML
Orara	23.4 ML	30.8 ML
Bielsdown	21.2 ML	69.9 ML

At the 80th percentile (the lowest 20% of flows), the daily amount of water available in these rivers is significantly less than the Upper Bega’s potential 26.2 ML average daily entitlement requirement.

Aquatic ecology of the water source

The Bemboka and Bega rivers support a range of aquatic species, including the Endangered Australian Grayling, Australian Bass, Shorthead Lamprey, the Endangered Stuttering frog, and a variety of aquatic insects important in the river food chain. These species require some level of flow in the river ⁽⁴⁻¹⁴⁾ to ensure riffle (flowing habitats) and pool habitats remain viable⁽¹⁵⁾ for some parts or all of their life cycle. Aquatic insects living in flowing riffles are particularly vulnerable to cease-to-flow periods,⁽¹⁶⁻¹⁸⁾ and are a useful indicator for environmental health.

Monitoring data from 2014–15 that the department collected shows that the Bega River has significantly fewer aquatic insect species (42 species) compared to rivers with less flow alteration (Tuross: 49 species and Wadbilliga: 55 species). The species missing often rely on flows, or are sensitive taxa (such as stoneflies).⁽¹⁸⁾

The increased frequency and duration of cease-to-flow events in this river may be contributing to this reduced number of aquatic insects as drying has been recognised as one of the leading causes of diversity decline in rivers.^(17, 19, 20) We also know that the recovery of aquatic insect diversity after drying in some NSW rivers can take more than a year (Figure 3).⁽¹⁶⁾

To protect the environment in the Bega–Bemboka River, we must reduce cease-to-flow events and maintain river connectivity.

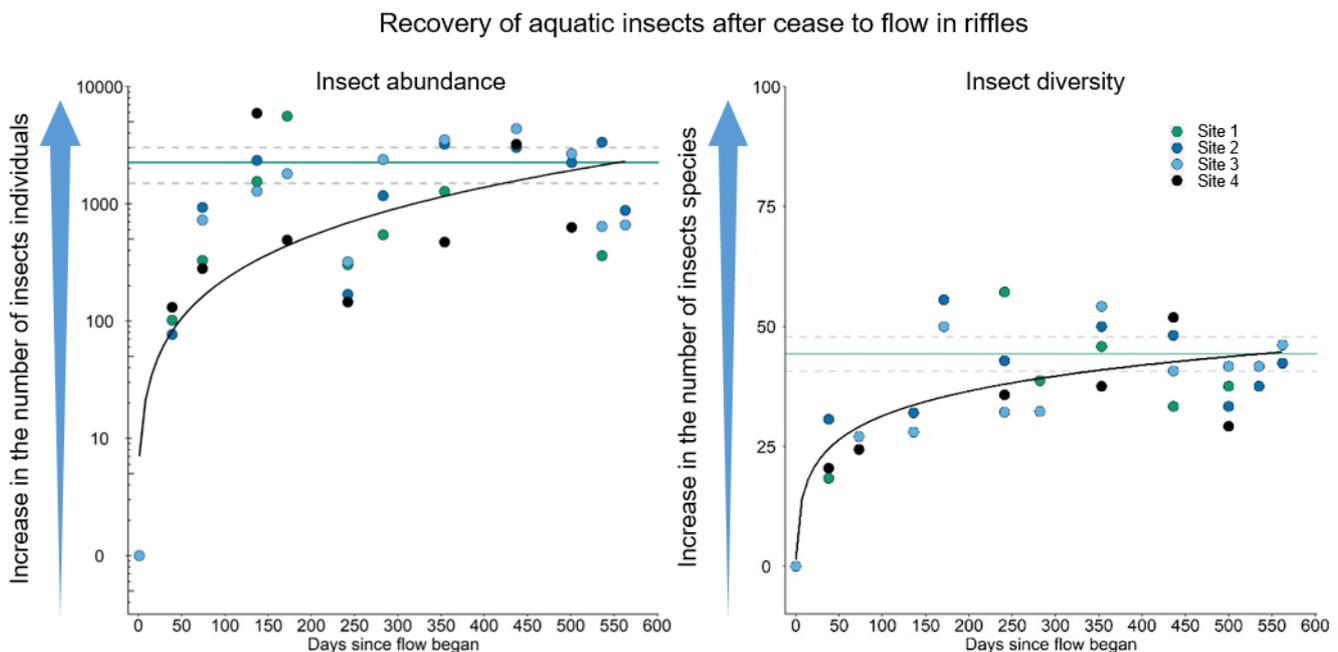


Figure 3. The recovery of aquatic insect abundance and diversity in riffles after drying. The solid green line represents the abundance and diversity of NSW rivers which did not dry.

Benefits of increasing the commence-to-pump level

Increasing the commence-to-pump level would have ecological benefits. It would:

- protect flows above the cease-to-flow threshold and maintain river connectivity
- reduce the frequency and duration of cease-to-flow events
- protect aquatic ecosystems, and a range of flow-dependent insects, threatened fish and frog species
- protect low-flows to improve the availability of water for basic landholder rights, health, hygiene and emergencies
- align the management of low-flows with other coastal streams in NSW and meet community expectations for improved protection of aquatic ecosystems.

More information

To read the draft *Water Sharing Plan for the Bega River Area Regulated, Unregulated and Alluvial Water Sources 2023* and related fact sheets, visit [the Water pages of the department's website](#).

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