

# **Appendix C**

## **History of environmental flows**





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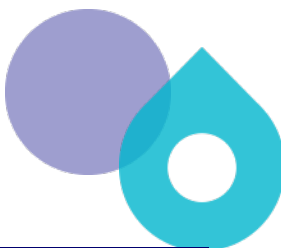
Although it is not Sydney Water's role to develop the environmental flows regime for the Hawkesbury-Nepean River system, we are a key stakeholder and the project will produce water that can contribute to environmental flows. SEAR 6 requires Sydney Water to provide a detailed analysis of environmental flows to Warragamba River over the past 20 years, which is addressed in this appendix. We have addressed the flows, and how the policy and regulatory context has changed them over time.

### Policy and regulatory context


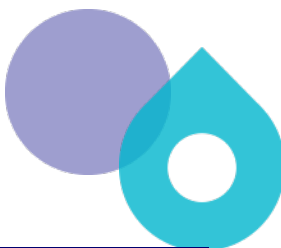
Table 1 summarises how the policy and regulatory context around environmental flows has changed since 1999 and the implications for the flow regime from Warragamba Dam. It continues to evolve through development of the Greater Sydney Water Strategy and review of the water sharing plans.

Table 1 Historic policy context and decisions for environmental flows in the Hawkesbury-Nepean

Year/ period	Legislative and policy framework	Key events and decisions	Flows regime from Warragamba Dam
1998- 2000	Sydney Water Catchment Management Act 1998, Water Act 1912	<p>Sydney Catchment Authority (SCA) completed an environmental flows trial from 1998-2000 as part of its operating licence to trial releases from dams on Hawkesbury-Nepean River. The only trial flow released into Warragamba River was Flow C, which was a variable stepped down flow from Warragamba Dam lasting nine days in June and July 1998. Releases varied from 100 to 201 ML/d with a total release volume of 1,225 ML.</p> <p>Australian Museum Business Services (AMBS) assessed the response of a range of physical and biological characteristics in Hawkesbury-Nepean River to these trial flows. Measures associated with Flow C included physiological response of attached native macrophytes and floating plant cover. Results associated with this flow release were confounded by heavy rainfall during the study period. However, a more variable flow strategy was considered necessary for the Hawkesbury-Nepean including higher flows of longer duration and seasonal and variable flows.</p>	The SCA was required to operate its water storages with the aim of ensuring that flow over Penrith Weir was 50 ML/day for riparian purposes. 43 ML/d of this was from Warragamba Dam.


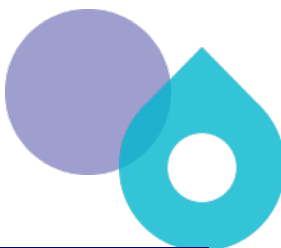



Year/ period	Legislative and policy framework	Key events and decisions	Flows regime from Warragamba Dam
2001- 2004		<p>Establishment of Hawkesbury Nepean River Management Forum (HNRMF) and Independent Expert Panel (IEP) to advise the HNRMF. These were established to make recommendations for the future environmental flow requirements of the Hawkesbury-Nepean river system for inclusion in the SCA's water licence. The HNMRF comprised state and local government agencies, Sydney Water, irrigators and fishers. The IEP comprised an independent chair and expertise in ecology, hydrology and hydrologic modelling, geomorphology, engineering and resource and socio-economic assessment.</p> <p>The HNRMF and IEP reviewed the AMBS report of the environmental flows trial and the HNMRF recommended release of all inflows to water storages during periods of low flow (transparent releases) and the release of a proportion of inflows during medium and higher flows (translucent releases), with additional contingent flows when needed to manage environmental problems such as aquatic weed infestations. The recommendation for Warragamba Dam releases was:</p> <ul style="list-style-type: none"> <li>• 20% translucent flow (that is, of incoming flows, 20% would be released from the dam)</li> <li>• 95<sup>th</sup> percentile transparent flow (that is, flows up to the 95th percentile would be passed through the dam) and</li> <li>• 3GL/year contingent flow for aquatic weed management.</li> </ul>	The flows recommended by HNMRF were not implemented and the flows regime from Warragamba Dam described above continued.

Year/ period	Legislative and policy framework	Key events and decisions	Flows regime from Warragamba Dam
2004- 2010	2004 and 2006 Metropolitan Water Plans	The 2004 Metropolitan Water Plan recognised the importance of environmental flows in ensuring river health in the Hawkesbury-Nepean River system. It indicated environmental releases would commence from the Upper Nepean Dams consistent with HNRMF recommendations, starting with the Avon Dam after construction of improved outlet works. The 2006 Metropolitan Water Plan reiterated the recommendations of the 2004 plan. It noted that environmental flows from the Avon Dam would be followed by releases from Cataract, Cordeaux and Nepean Dams by 2009 and at Pheasants Nest and Broughtons Pass weirs sometime earlier. These flows progressively commenced between 2008-2010. The 2006 plan proposed the releases would be accompanied by increased flow gauging and an environmental monitoring program.	Environmental flows from Warragamba Dam not implemented at this stage due to concerns over the potential impacts on yield of Sydney's drinking water supplies as well as infrastructure limitations. MWP 2004 envisaged sufficient information available for a decision on environmental flow releases from Warragamba Dam by 2015. The flows regime from Warragamba Dam described above continued, although it temporarily reduced to about 22ML/day between June 2005 and March 2008, likely as a response to drought.

Year/ period	Legislative and policy framework	Key events and decisions	Flows regime from Warragamba Dam
2010- 2016	<p>2010 Metropolitan Water Plan</p> <p>Water Sharing Plan for the Greater Metropolitan Region</p> <p>Unregulated River Water Sources 2011</p> <p>Water Management Act 2000</p>	<p>Sydney Water's Replacement Flows Project commenced in 2010, involving recycling from the St Marys Advanced Water Recycling Plant and release of very-high quality treated water to Nepean River via Boundary Creek at Penrith. This project was designed to replace 18 billion litres of drinking water (that is, about 50ML/day) being released from Warragamba Dam each year by replacing the environmental releases with the highly treated water from the Advanced Water Recycling Plant.</p> <p>The 2010 Metropolitan Water Plan indicated the next major investment in environmental flows would be from the Warragamba Dam. Interim flows were to be considered from 2009 provided sufficient water was available and subject to further detailed analysis to identify an optimal flow regime. The analysis was proposed over the following four years for inclusion in the 2014 Metropolitan Water Plan.</p> <p>The NSW Government established the multi-agency Environmental Flows and River Health Outcomes Group (EFRHOG) and technical working group to undertake this analysis. These groups considered a variety of transparent and translucent environmental flows scenarios from Warragamba Dam, using a combination of environmental data, model outputs, scientific literature and expert opinion to estimate the likely response of the river to additional flows. Results showed that flow, water quality and the ecology of the river would benefit from transparent and translucent flows as far downstream as the Sackville reach. The investigations also found there was strong community support for improving the condition of Hawkesbury-Nepean River downstream of Warragamba Dam through the introduction of environmental flows. In 2016, a preliminary paper recommended adoption of the 90/10 scaled environmental flow releases. Additional infrastructure would be required at Warragamba Dam to facilitate these releases.</p> <p>The Metropolitan Water Sharing Plan was also established over this period which specifies Warragamba Dam releases that remain in place in 2021.</p>	<p>The Water Sharing Plan required the daily release of water from the Warragamba Pipeline into Megarrity's Creek/Warragamba River:</p> <ul style="list-style-type: none"> <li>• 25 ML/day from 1 November to 31 March and 17 ML/day from 1 April to 31 October, for water supply purposes</li> <li>• 5 ML/day, to dilute effluent discharged from Wallacia Wastewater Treatment Plant.</li> </ul>

Year/ period	Legislative and policy framework	Key events and decisions	Flows regime from Warragamba Dam
2017 - present	2017 Metropolitan Water Plan	<p>The 2017 Metropolitan Water Plan recommended variable environmental flows from Warragamba Dam following a 90/10 scaled flow rule based on the EFRHOG advice. This option would see reduced environmental flows in a scaled manner during periods of extended low flows as dam levels drop. The 2017 plan also recommended monitoring of the river to facilitate adaptive management of flows for the best outcomes. The final release strategy would be refined and reviewed before releases start.</p> <p>This environmental flows regime, including the infrastructure at the dam to allow flow releases, has not yet been implemented and remains under ongoing consideration by the NSW Government.</p>	The Water Sharing Plan regime described above continued.

## Flows to Warragamba River

Figure 1 shows a 2000-2019 time series of riparian releases from Warragamba Dam via the Warragamba pipeline into Megarritys Creek, downstream of Warragamba Weir. Early in the record (2000 -2003), daily flows were variable and ranged from zero to 147 ML/d with a daily average of about 48 ML/d. By mid-2004, daily riparian releases were less variable than the previous period ranging from about 43 - 48 ML/d. In June 2005, releases were reduced to 22 ML/d, most likely due to drought conditions in the catchments. These releases continued until March 2008 when flows were reinstated at about 43 ML/d which again continued until July 2011 when flows were reduced to 22 ML/d. This reduction in flows may be related to the commencement of the Replacement Flows project. Following this period, a more systematic release pattern appears in the record with flows of about 22 ML/d released during winter months and about 30 ML/d during summer months.

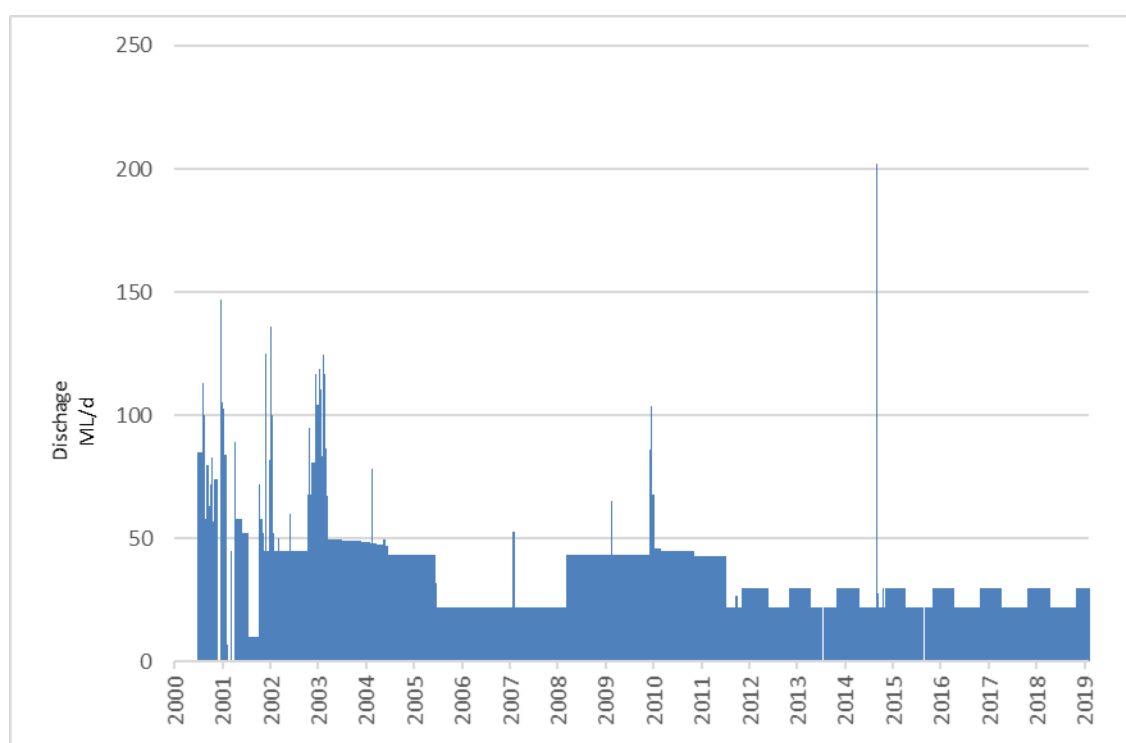


Figure 1 Riparian releases from Warragamba Dam (2000-2019)

The riparian releases were not the only inflows to Warragamba River as evidenced by the record from Warragamba Weir (Gauging Station 212241) during the period 2000 to 2020 as shown in Figure 2. During this time, average daily flows gauged at Warragamba Weir on Warragamba River varied between 0 and 85,770 ML/d which occurred in June 2013. The median average daily flow at Warragamba Weir between 2000 and 2020 was 4.4 ML/d reflecting extended periods of low flow coupled with several significant events during the period of record. These flows represent local catchment inflows, flood spills (via the Warragamba Dams crest gates and central spillway) and other releases from Warragamba Dam. Spills at Warragamba Dam between 2011 and 2018 are shown in Figure 3 demonstrating the role of spills in flow recorded at Warragamba Weir.



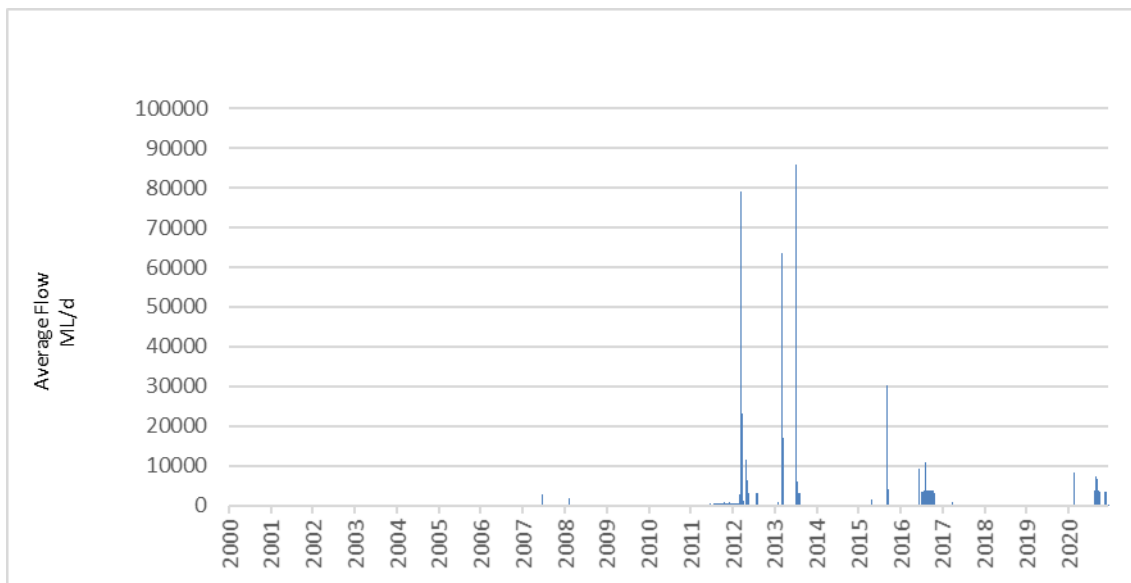


Figure 2 Flows across Warragamba Weir between 2000-2020

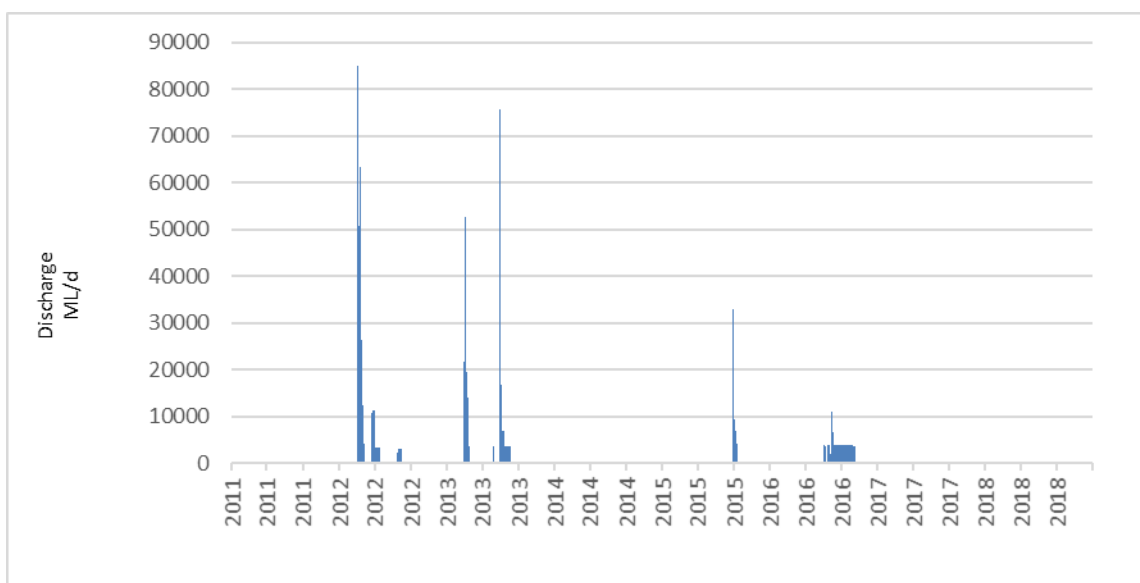


Figure 3 Spills from Warragamba Dam between 2011-2018