Department of Primary Industries Water

SNOWY RIVER RECOVERY: SNOWY FLOW RESPONSE MONITORING AND MODELLING PROGRAM

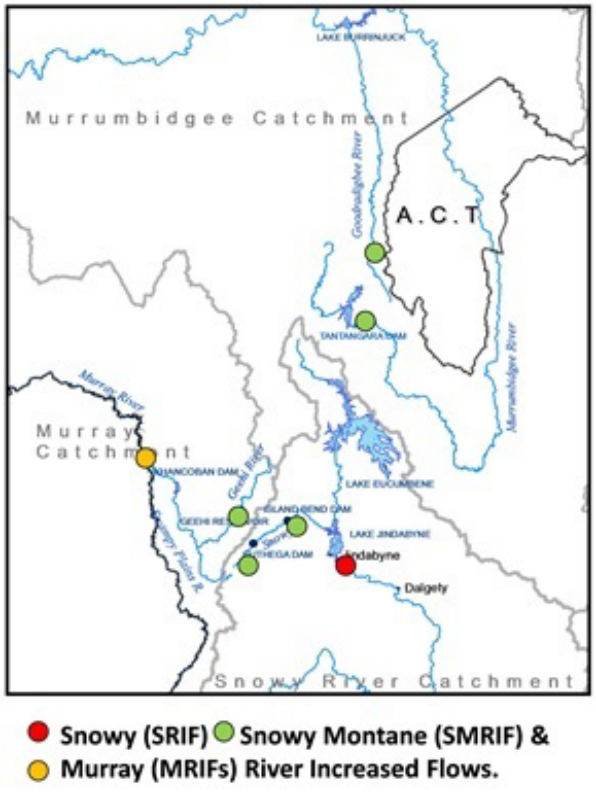
Strategy for the Snowy Montane Rivers Increased Flows 2015-16

July 2015

The Snowy Initiative is an agreement for water recovery and environmental flows between the NSW, Victorian and Australian Governments, and is set out in the Snowy Water Inquiry Outcomes Implementation Deed 2002 (SWIOID 2002).

The initiative provides three main environmental water programs as part of rebalancing the impacts of the Snowy Hydro Scheme on montane rivers. These three programs are increased flows for: (i) Snowy River, (ii) Murray River, and (iii) Snowy Montane Rivers (Figure 1). Five Snowy Montane Rivers are identified to receive environmental (Figure 1; Table 1).

Figure 1. Location of the Snowy Montane River release points (indicated by green icons).



The SWIOID 2002 provides for Snowy Hydro Limited (SHL) to forego up to 150 Giga Watt hours (GWHrs) of electricity generation to allow for environmental releases to be made, known as the Snowy Montane Rivers Increased Flows (SMRIF).

This value of 150 GWHrs is converted into a volumetric allocation, but the conversion factor differs depending on the location of the releases in the Snowy Mountains Scheme. In some locations water released can be re-used to generate electricity so a smaller conversion factor is applied (Table 1).

Table 1. Snowy Montane Rivers annual targets and the conversion factor of lost energy generation to water allocation.

Snowy Montane Rivers Increased Flows	SWIOID Annual Target (GL)	Conversion factor
Murrumbidgee River @ Tantangara	27	1.94
Goodradigbee River*	12	1.94
Geehi	12	1.85
Snowy River- Island Bend	25	0.71
Snowy River- Perisher Range#	30	0.57

The water availability for SMRIFs is linked to the water availability for environmental flows to the Snowy River, which is determined by the water recovery in the western rivers and the climatic conditions.

The Snowy Montane Rivers Strategy differs from that for the Snowy River Increased Flows (SRIF), in that the release points are typically weirs (Figure 2) with the exception of the Murrumbidgee River at Tantangara Dam, and there is limited capacity to actively manage releases.

Typically the releases reflect the catchment inflows to the weir pool as it is not practical to prescribe a daily flow target. Accordingly, the

Snowy Montane Rivers Increased Flows program sets annual, rather than daily flow targets for these weirs.

Additionally, as the SMRIF program is implemented, two key aspects are being considered: (i) maximising environmental outcomes and (ii) minimising changes to the existing SHL infrastructure (i.e. to allow water to pass downstream).

Since the Snowy Water Inquiry, further work to implement the program has provided new information such as reductions water yields in the high country. Therefore, implementation of the SMRIF has been staged to ensure that environmental outcomes can be maximised.

Figure 2. SMRIFs to the Geehi River are delivered via Middle Creek Weir. Water is released by over topping the weir (Source S. Williams).

This fact sheet describes the 2015-15 SMRIF program and the intended environmental benefits.

Key aspects of the 2015-16 SMRIFs strategy

Four of the five locations identified in the SMRIFs program are currently receiving environmental water (Table 1). Only the Upper Snowy, in the Perisher Range remains to be implemented. This will require some additional technical analysis and minor infrastructure upgrades before the site(s) in this location can receive environmental water.

Table 2 outlines the 2015-16 annual targets for the Snowy Montane Rivers.

Table 2. Snowy Montane Rivers Increased Flows, SWIOID Target, Adjusted Target, and 2015-16 annual target.

Snowy Montane Rivers Increased Flows	SWIOID Annual Target (GL)	Average Annual Yield (GL)	2015-16 Annual Volume (GL)
Murrumbidgee River @ Tantangara	27	27	15.84
Goodradigbee River*	12	12	12
Geehi	12	17.5	17.5
Snowy River- Island Bend	25	18.9	18.9
Snowy River- Perisher Range#	30		

Note: The management options for the Perisher Range still requires further analysis in order to be implemented.

2015-16 SMRIFs strategy - Snowy Weirs

In the existing Snowy Montane Rivers the releases occur via weirs, and a long term average annual yield is targeted (Table 1). This means that over the long term the annual volume will average the nominated target.

The flow will typically reflect the hydrology of the inflows. In wetter years, the flow will exceed the long term target and in drier years the annual volume will be less than the target.

To achieve the long-term target each weir has been modified to either (i) allow all water to pass downstream (i.e. 'transparent releases') or (ii) in the case of the Goodradigbee River, allow a proportion of the daily inflows to be released (i.e. `translucent' release). It is anticipated that the hydrological characteristics will reflect the hydrology of a Snowy montane river.

Ecological outcomes

The Snowy Water Inquiry Outcomes Implementation Deed 2002 sets a series of ecological objectives for the Snowy Montane Rivers. The SWIOID 2002 defines these broad objectives as follows:

- To protect endangered/ threatened species
- To maintain natural habitats
- To maintain wilderness and national parks values.

The SWIOD 2002 also requires these objectives to be further defined. For the Snowy Montane Rivers, it is envisaged that the following ecological benefits will be realised by the releases:

- Provision of substantially increased wetted in-stream habitat, and the river channel better reflecting the natural hydraulic characteristics of a montane river.
- A thermal regime that better reflects a montane river.
- Regular scour of the river substrate.
- Improved hydrological and ecological connectivity along the water source.
    - Downstream provision of dissolved organic carbon, and dissolved silica.
    - Downstream provision of river bed sediment.
    - Downstream provision of plant prologues.
    - Downstream drift of aquatic macroinvertebrates.
- Reduction in the ingress of terrestrial vegetation in the channel, such as tea-tree.
- The ecological communities (i.e. benthic bacteria, periphyton, aquatic plants, bugs, and fish) reflecting those of a Snowy Montane River.

2015-16 SMRIFs strategy- Murrumbidgee River below Tantangara Dam

Releases to the Murrumbidgee River are made from Tantangara dam, a much larger structure than the other release points, for which a gated release structure is available (Figure3).

Accordingly, the 2015-16 daily flow release strategy for the Murrumbidgee River differs from the other release points.

The releases comprise two components: (i) the SMRIFs and (ii) a Base Passing Flow (BPF). The BPF has some key components, these being:

- A 2GL year target is targeted over the longer term.
- A 32 ML/day discharge is to be targeted at Mittagang Crossing, near Cooma.
- A maximum of 3.5GL is set for any one year.

The Base Passing Flow releases typically occur during drier weather.

Figure 3. Tantangara Dam on the Murrumbidgee River essentially acts as a large diversion weir and diverts water to the Eucumbene Dam for electricity production (Source: S. Williams).

The ‘flow scaling’ approach used to set SRIFs releases to the Snowy River has also been applied to the SMRIFs in the Murrumbidgee River. This approach uses the recorded flows in a nearby natural catchment (in a year where similar volumes of flow occurred) to set daily releases.

For releases to the Murrumbidgee River from Tantangara dam, the initial daily flow targets for 2015-16 were set using the 2012-13 flow sequence for the Murrumbidgee River above Tantangara.

Figure 4. The Murrumbidgee River above Tantangara Dam, was used as the hydrological surrogate to develop the 2015-16 release strategy (Source: L. Hardwick).

In 2015-16 the full allocation of 27GL (i.e. 30% of the Mean Annual Flow) is not available for release, given the drier conditions in the western rivers.

Instead, an annual target of 16.230 GL was available for the Upper Murrumbidgee River below Tantangara Dam in 2015-16. This also includes a minor deduction of 400 ML based on

an over release in 2014-15. This is the 6th largest allocation since 2005-06 (Figure 5).

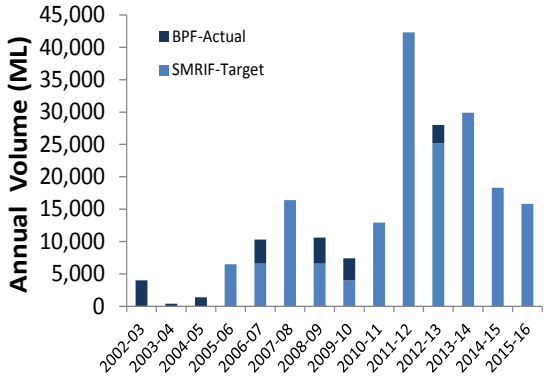


Figure 5. Total annual SMRIF target (light blue) and actual base passing Flow (dark blue) to the Murrumbidgee River below Tantangara, 2002-03 to 2015-16.

The proposed daily flow pattern (Figure 6) attempts to include the key hydrological signals typical of a smaller mixed snowmelt - rainfall river system characteristic of the northern Snowy Mountains consistent with the (i) volume available and (ii) the dam outlet capability.

The natural flow pattern of the Upper Murrumbidgee River varies from that of the Snowy River, as there are strong climatic gradients across the Snowy Mountains.

Typically, the Upper Murrumbidgee River catchment is lower in elevation than the Snowy River Catchment and has substantially less catchment area above the snow line. Thus, the snow melt signal is not as pronounced as the Snowy River.

In a moderate allocation period, the 2015-16 flow strategy attempts to reinstate some of these montane hydrological cues, these include:

- A monthly flow pattern that reflects a winter-spring signal and includes five of these months (i.e. July-November) above 2 GL, with three months above 3 GL (i.e. July to September) (Figure 7).
- Minor daily flow variability during the winter-spring period, with flow varying between 50 and 300ML/d and with discharge above 200 ML/day on five occasions during winter-spring period.
- A peak event of 300 ML/day to reflect a winter storm event in the Snowy Mountains.
- A base flow of 50 ML/day in late spring-early summer, punctuated by three minor events.
- A transition base flow discharge of 30 ML/day in early summer.
- There will also be two periods without releases, these being: (i) May-June and (ii) between Jan-April 2016, as there is insufficient water available to maintain flows for every day of the year.
- The 2015-16 flow sequence differs from the previous year and introduces daily variability between years.

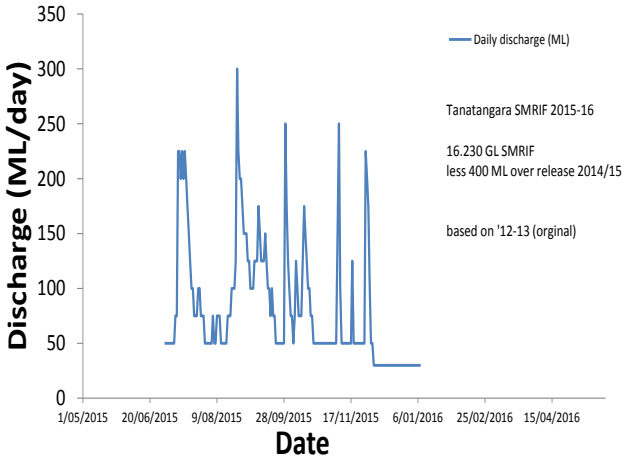


Figure 6. Mean daily discharge pattern for the Murrumbidgee River below Tantangara in 2015-16 (blue).

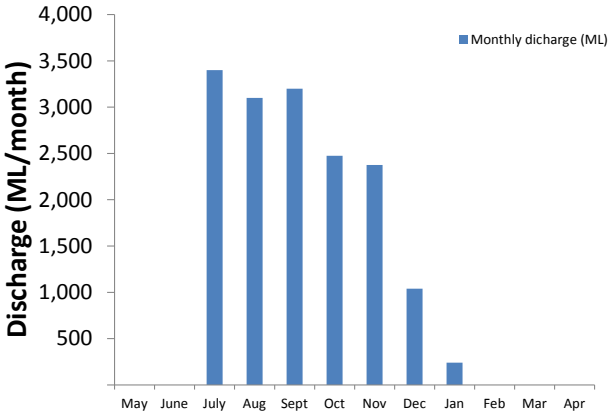


Figure 7. Total monthly discharge in the Murrumbidgee River below Tantangara Dam for 2015-16.

Overall long long-term rehabilitation of the upper Murrumbidgee River

The long-term objective for an environmental flow regime based on natural daily flow sequences in the Upper Murrumbidgee River is to facilitate the rehabilitation and evolution of the

Murrumbidgee River below Tantangara Dam into a smaller but healthy river.

Over decadal to century long time scales, environmental water releases scaled to the Upper Murrumbidgee River will allow the Murrumbidgee River to slowly develop a size, shape and perhaps condition, similar to that of a smaller but healthier Snowy Montane river.

The largest hydrological alteration has historically occurred between Tantangara Dam and the junction with Yaouk Creek, the first major perennial tributary with the Murrumbidgee River.

It is anticipated that flows from Tantangara Dam will support the inflows from these smaller tributaries, and the ecosystem services provided via tributary contributions. It is expected that in this wetter part of the Snowy Mountains, that the tributaries will be a key mechanism to ecological recovery, but the dam releases will facilitate this ecological recovery.

The long-term objective implicitly recognises that:

- It is not possible to restore or maintain the Murrumbidgee River to its former size with less than one third of its former annual flow volume.
- The in-stream habitat needs to be improved in order for major secondary and tertiary ecological responses to occur. This forms the primary focus of the strategy in the early stages of the river recovery, where water is available.
- The releases will complement inflows from the major downstream tributaries to provide the opportunity for ecological recovery.

The allocation of 16.230GL is seen as a moderate allocation and hence the primary objective for 2015-16 is primarily focussed on the maintenance of the existing improvements to the river since environmental water via SMRIF commenced in 2005-06.

Objective- Winter- Spring higher flows

The higher winter-early spring base flow interrupted by smaller regular events is designed to provide a low level of disturbance in the riffles (Figure 7) of the Murrumbidgee River.

It is envisaged that the following ecological benefits are likely to be realised via the greater flow variability and peak flow rates:

- Slightly improve the physical habitat condition of the river riffles due to increased scour and water mixing.
- Improved riffle habitat condition will facilitate:
    - Increased opportunities for water and nutrient exchange in the riffles, and support improved heterotrophic primary productivity.
    - Sustain the aquatic macroinvertebrate fauna, by maintaining the current abundances of mayflies, caddies flies and stone flies.
    - Increased utilisation by Macquarie Perch
- Provide minor pulses of dissolved organic carbon by inundating lower benches and promoting heterotrophic primary productivity (Figure 8).

Figure 8. The quality of the bed of the Murrumbidgee River below Tanatangara Dam can be improved by the provision of higher magnitude flow events to scour the benthos. A prerequisite to encourage secondary and tertiary ecological responses to the SMRIFs. (Source: S. Williams)

Figure 9. Higher flow events in the Murrumbidgee River will inundate the lower benches and will (i) provide dissolved organic carbon and promote heterotrophic primary productivity and (ii) limit the ingress of terrestrial vegetation in aquatic habitats. (Source: S. Williams).

Objective- Aquatic vegetation

The increased winter-spring daily flow variability is designed to frequently wet the lower margins of the riparian zone and maintain moisture in the soil profile of the riverbank.

It is expected that the proposed daily flow variability will favour the development of aquatic and riparian vegetation within a band just above the low water level of the Murrumbidgee River bank.

Additionally, the daily flow variability will attempt to limit the ingress of terrestrial vegetation back into the river channel between the Tanatangara Dam and Yaouk Creek. The regular inundation will disadvantage these terrestrial vegetation types, by keeping the root zone wet.

Objective- Spring low flow riffle protection

The preservation of the low flow conditions (i.e. 50 ML/day) during spring is designed to provide minor protection of riffles. Flowing water habitats (i.e. riffles runs and glides) are the first in-stream habitat to be impacted by low flow periods. The protection is provided by maintaining water over the running water habitats such as riffles (Figure 9).

This will provide some protection of riffle dependent biota, such as aquatic heterotophic bacteria, macroinvertabrates (i.e. mayflies, caddies flies and stone flies) and fish eggs such as Macquarie Perch (*Macquaria australasica*).

Objective- late spring- flow events

The two events in November 2015 provide an opportunity for Macquarie Perch (*Macquaria australasica*) to lay eggs in the river riffles.

Fish such as Macquarie Perch need elevated water levels to gain access to the riffles. The higher flows aim to facilitate this access for the adult fish to breed.

However, there is some uncertainty in the duration of inundation of these running water habitats to support the development of the Macquarie Perch eggs.

Figure 9. The reach of the Murrumbidgee River near Yaouk is an important habitat for Macquarie Perch (Source: S. Williams).

Objective- Summer low flow riffle protection

The preservation of a very low flow of 30 ML/day trial attempts to provide a transition period to limit hydrological stranding of aquatic biota.

This very low period in December 2015 and early January 2016, is designed to replicate the gradual drying of the river, and may provide the opportunity for aquatic biota to transition to a no-flow period between January and April 2016.

More information

www.water.nsw.gov.au

Acknowledgments

The document should be cited as
Williams, S. (2015). Proposed flow release strategy for the Snowy Montane Rivers Increased Flows, 2015-16. Snowy Flow Response Modelling and Modelling program, NSW Office of Water, Sydney.

Published by the Department of Primary Industries, a Division of NSW Department of Industry, Skills and Regional Development.