Annual plan for the Snowy and Snowy montane rivers environmental flows 2023–24

Department of Planning and Environment

NSW GOVERNMENT

Acknowledgement of Country

The Department of Planning and Environment acknowledges the Traditional Custodians of the lands where we work and live.

We pay our respects to Elders past, present and emerging.

This resource may contain images or names of deceased persons in photographs or historical content.

Cover photo: Sampling for fish eDNA in the upper Murrumbidgee River. Paul Doyle/DPE

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Shortened forms

Term	Description
ML	Megalitre
GL	Gigalitre
GWh	Gigawatt hours
RMIF	River Murray Increased Flows
SAC	Snowy Advisory Committee
SHL	Snowy Hydro Limited
SMRIF	Snowy Montane Rivers Increased Flows
SRIF	Snowy River Increased Flows
SWI	Snowy Water Initiative
SWIOID 2002	*Snowy Water Inquiry Outcomes Implementation Deed 2002*

Introduction

This watering plan was developed by the Environment and Heritage Group of the NSW Department of Planning and Environment and incorporates advice from the Snowy Advisory Committee (SAC), ecological experts and water managers.

This annual plan outlines the rationale and intention for use of water for the environment for the Snowy and Snowy montane rivers for the 2023–24 water year (1 May 2023 to 30 April 2024) and gives effect to the NSW Government's commitment to implement the Snowy Water Initiative (SWI) on behalf of the partner governments.

The SWI was formally established in 2002 to significantly improve river health by releasing environmental water into the Snowy, upper Murrumbidgee and upper Murray river systems. Embodied in the *Snowy Water Inquiry Outcomes Implementation Deed 2002* (SWIOID 2002), the SWI is an agreement for water recovery and environmental flows between the NSW, Victorian and Australian governments (the partner governments) and Snowy Hydro Limited (SHL). The NSW Government is responsible for implementation of the SWI.

The Department of Planning and Environment's Environment and Heritage Group manages water for the environment in the Snowy and Snowy montane rivers on behalf of the NSW Government. The SWI allows for the delivery of an average 212,000 megalitres (ML) (or 21% of average annual natural flows) to the Snowy River for environmental purposes. When water allocations are low in the western Murray–Darling Basin water storages, there is less water available for the Snowy and Snowy montane rivers.

The SWI provides for 3 increased environmental water flow regimes to adjust for the diversion of river flows by the Snowy Mountains Hydro-electric Scheme (the Snowy Scheme):

- **Snowy River** – environmental water to be released every day from Jindabyne Dam (Figure 1) as Snowy River Increased Flows (SRIF), to improve the health of the Snowy River in New South Wales and Victoria
- **Snowy montane (higher altitude) rivers** – environmental water to be released continually or according to an annual schedule from a number of designated release points across certain rivers diverted by the Snowy Scheme (Figure 2) as Snowy Montane Rivers Increased Flows (SMRIF) in a quantity proportional to the amount allocated to the Snowy River below Jindabyne
- **River Murray** – water allocation accruing up to 70 gigalitres (GL) in the Murray River system that is callable by environmental water holders as River Murray Increased Flows (RMIF) for delivery into the Murray River.

RMIF are managed in an integrated manner with other environmental water allocations by the Southern Connected Basin Environmental Water Committee and are not covered in this plan.

For the 2023–24 water year 241,347 ML of water for the environment was allocated as SRIF. Of the allocation, a maximum of 212,000 ML is recognised by SHL for delivery. The Department of Planning and Environment's Environment and Heritage Group has sought advice from the Department of Planning and Environment – Water on use of the remaining balance of 29,347 ML and this advice remains pending at the time of the finalisation of this plan.

A volume of water equivalent to 150 gigawatt hours (GWh) of foregone energy generation will be available as SMRIF.

Very high inflows into Jindabyne Dam resulted in the dam spilling between 28 October 2022 and 2 November 2022, and 5 November and 11 November 2022, with several periods of pre-releases (controlled spills) from October 2022 to January 2023. Tributary inflows also resulted in multiple flooding events in the lower Snowy River.

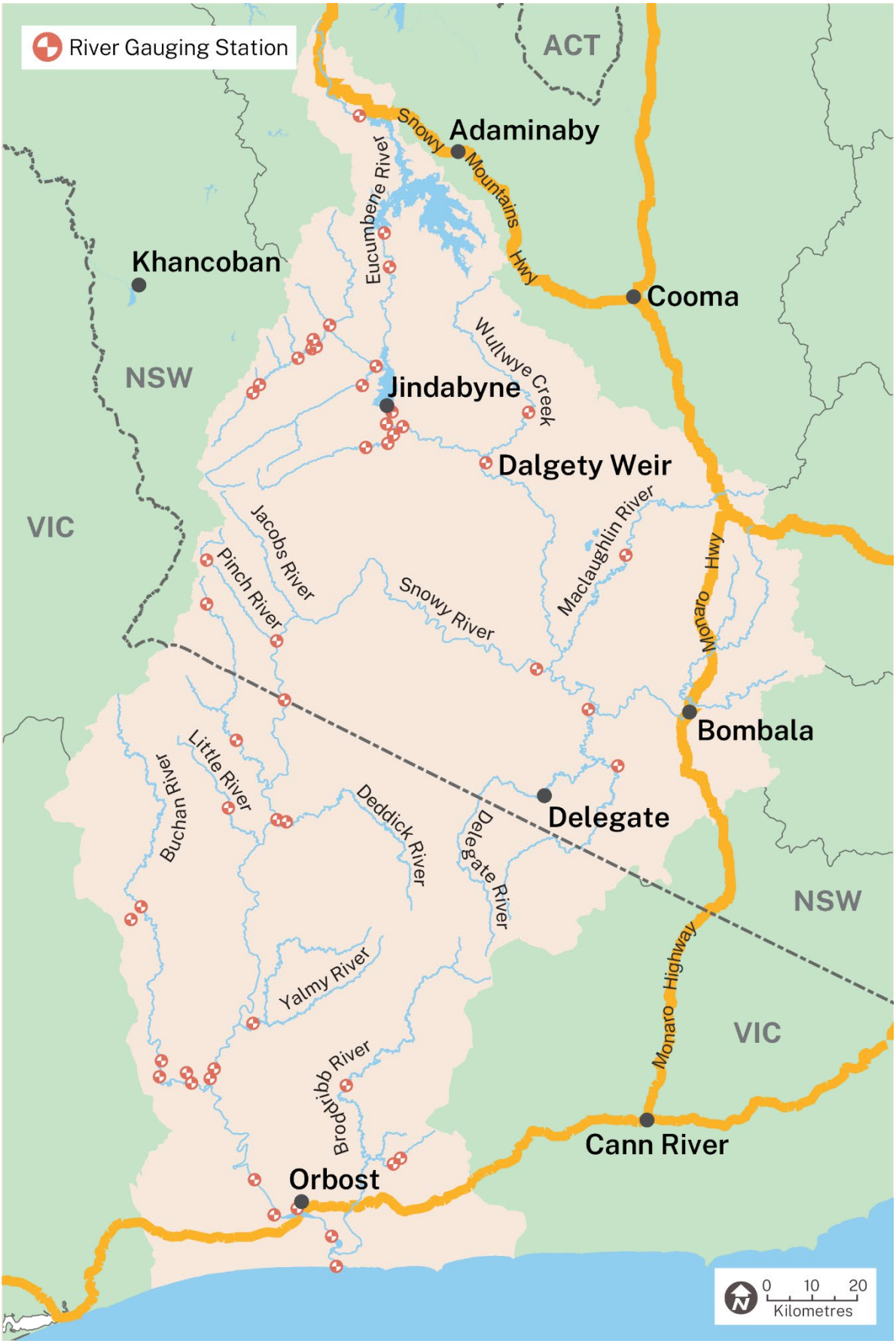

Figure 1 **The Snowy River catchment in south-eastern Australia, showing the location of Jindabyne Dam, major tributaries and hydrological gauging stations**

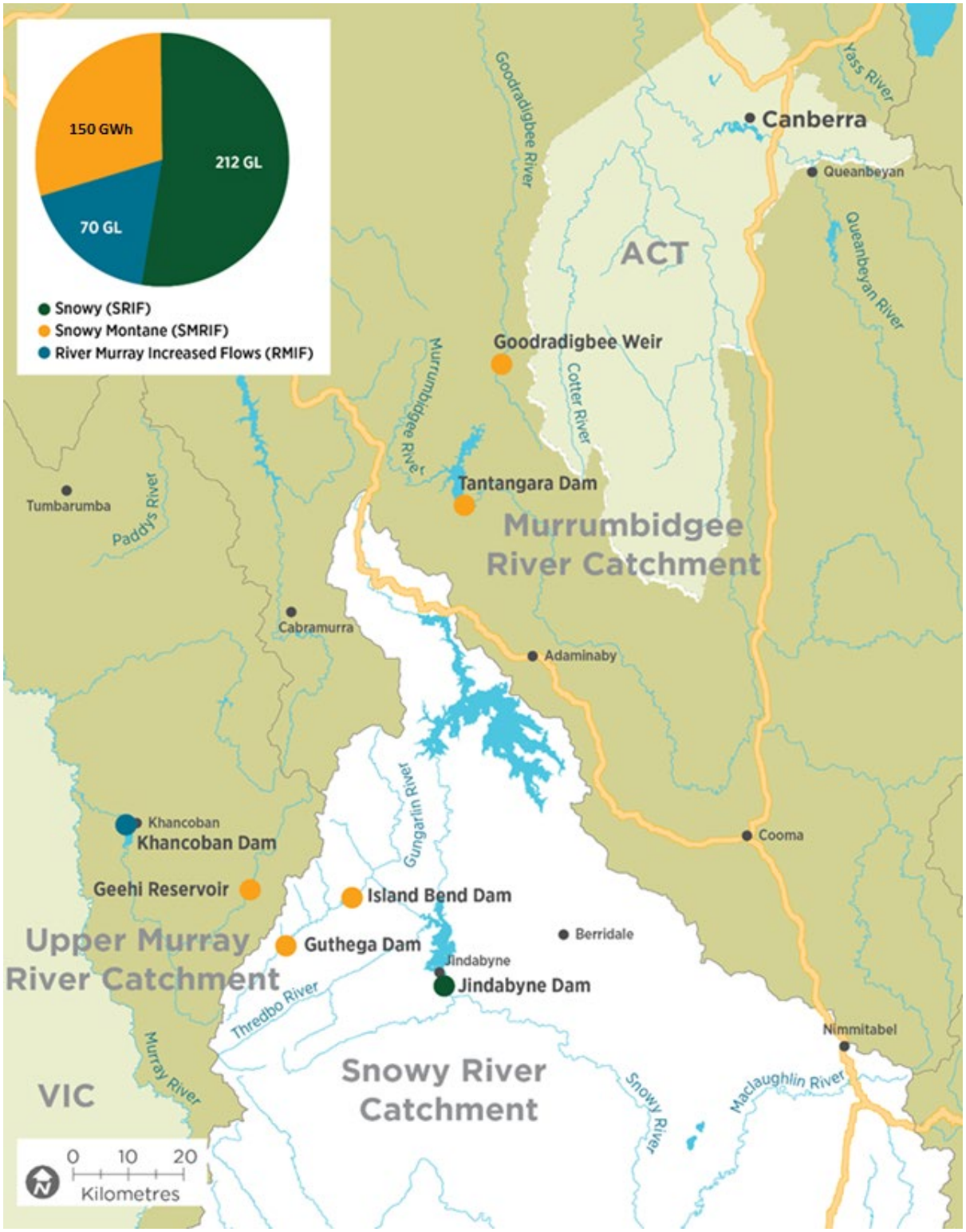

Figure 2 **Locations of the Snowy and Snowy montane rivers water release points, indicated by icons, and a chart indicating the maximum annual flow volumes or maximum forgone electricity generation for the 3 increased flows**

Note the flow volume for the Snowy montane will depend on the delivery points used.

The volumes identified on the pie chart in Figure 2 represent the 212,000 ML allocation scenario (21% of the average natural flow). Volumes in the Snowy montane rivers are dependent on the delivery points chosen – see 'Snowy Montane Rivers Increased Flows' section for detail.

Natural flow scaling of Snowy River increased flows

A ‘natural flow scaling approach’ (Reinfelds et al. 2013) has been used since 2013–14 to deliver environmental water to the Snowy River below Jindabyne Dam, when the recovery of entitlements capable of providing 212 GL for the Snowy River was achieved for the first time under the SWI.

The volume of water available for environmental flows in the Snowy River is approximately equivalent to annual natural flows in the Thredbo River. The Thredbo River is not regulated by dams, so its flow pattern is still close to natural. A practical interim objective using the natural flow scaling approach has been to deliver a flow regime that, over the long term, will drive the hydraulic geometry of the Snowy River below Jindabyne Dam to be more like the Thredbo River as river channel sediment is mobilised and redistributed.

The primary advantage of natural flow scaling is that the pattern of the flow regime is proportional to the volume of available environmental water. Peak flood magnitudes and duration can be tailored to achieve flow transmission and ecosystem objectives, while the flow regime mimics daily, seasonal and annual patterns in flow variability. This approach also provides a secure operational flow forecast that SHL can plan for and deliver.

The natural flow scaling approach recognises that with only 21% of the natural flow available, restoring any single aspect of the pre-regulation Snowy River flow regime could compromise other aspects of the flow regime and not optimise river health. Even the lowest annual discharge recorded in the Snowy River at Jindabyne before the dam and river diversion is approximately double the total volume of water available for environmental flows (Reinfelds et al. 2013).

Snowy River Increased Flows in 2023–24

SRIF annual allocations are determined by inflows into the western catchment storages where Snowy water savings projects and market purchases were implemented to secure various water entitlements. These projects, funded by the NSW and Victorian governments, obtained water shares that were then transferred to Snowy environmental water licences. The water allocated to the SRIF licences in one year is then made available for environmental releases from Snowy storages in the following year. Planning for the forward year commences around November, when the indicative volume of water available on the licences can be forecast with some certainty.

Of the 241,347 ML allocated in 2023–24, there is 212,000 ML of water available for use for the SRIF licences, which is 100% of the mean annual targeted release volume below Jindabyne Dam (Table 1). There is sufficient environmental water available to implement a pre-planned natural flow scaling pattern for the Snowy River.

The SRIF amounts add to a 'base passing flow' amount of 8,500 ML released from Jindabyne Dam. Adjustments of the total volume available are required when the amount of water released in the previous year was more than ('overs') or less than ('unders') the agreed flow volume. That amount is then corrected with changes to actual releases in the following year. In 2022–23 SHL reported an under delivery of 56 ML.

In 2022–23 Jindabyne Dam spilt, resulting in a borrow of 16,000 ML as per the SWIOID 2002. The Water Liaison Consultation Committee is considering a proposal by the Department of Planning and Environment's Environment and Heritage Group for the full borrow amount to be deducted from the undelivered balance of 29,347 ML of 2023–24 allocations. A decision on this proposed use is pending (as of June 2023).

Table 1 Summary of annual water allocation for the Snowy River for 2023–24

Water account	Annual volume (ML)
Snowy River Increased Flows	212,000
Base passing flow – Jindabyne	8,500
Overs/unders	56
Total	**220,556**

The 2023–24 water year will be the 11th consecutive year that the natural flow scaling approach has been used to develop the environmental water release strategy for the Snowy River below Jindabyne. The 2023–24 SRIF daily flow sequence is based on the May to December 1999 and the January to April 2021 water years in the Thredbo River. The 1998–99 water year was selected as the reference until December because it had a good range of peaks spread across winter, spring and early summer. The 2020–21 year was selected as a reference for the period from January to May to provide high autumn flows and variability for the remainder of the water year.

The 2023–24 flow plan shown in the hydrograph below (Figure 3) includes several high flow events with 8-hour peaks. These releases will require active management by SHL to generate the 8-hour peaks and reach the overall daily targets. The high peak flows of this regime will provide increased stream power to flush fine sediment from the stream bed, and the repeated pattern of several peaks is expected to help keep the sediment moving.

Fine sediment and sand are known to move at discharge rates of >1,000 ML/day in the upper reaches of the Snowy River (Williams 2010). While longer peak durations provide greater sediment movement than shorter peaks (Rose 2017), monitoring indicates that most of the fine sediment is moved in the first few hours of the releases (Coleman and Williams 2017; Coleman, unpublished data). The high flows for the Snowy River are therefore short in duration and in line with the natural Thredbo flows, with a maximum peak held for 8 hours for the majority of the highest flows.

Coleman and Williams (2017) also found that a greater increase in magnitude and interval since the previous high flow resulted in a greater amount of sediment moved by the high flow. The proposed flow regime for 2023–24 provides a number of separate high flows, many with intervals of several weeks since the last event.

Flushing flows are important to help develop a more defined river channel within the former riverbed to assist in achieving the long-term goal of returning the Snowy River to a smaller but healthy montane river. The Snowy Water Licence defines flushing flows as those exceeding 5,000 ML/day and can occur when the water year allocations exceed 100,000 ML. Flushing flows need to be delivered from the spillway gates of Jindabyne Dam, which requires high dam levels. SHL manages the dam levels to avoid potential spills; however, when wet conditions persist, a spill cannot always be prevented, as occurred on several occasions during 2021–22 and 2022–23.

Given the current high level of inflows into Jindabyne Dam and consequent increased risk of spills, the Department of Planning and Environment's Environment and Heritage Group has not requested SHL to hold dam levels higher at the beginning of the water year to enable flushing flows. Instead, 2 dates for flushing flows have been planned in case dam levels are sufficiently high to allow them to occur:

- The first planned flushing flow is for 18 May 2023. If dam levels are high enough to allow a flushing flow on this date, an 8-hour peak flow rate of 8,864 ML/day will be released in the middle of the day with lower flow rates on the 8 hours before and after this.
- The second planned date for a flushing flow is 18 October 2023. If dam levels are high enough to allow a flushing flow on this date, an 8-hour peak flow rate of 10,362 ML/day will be released in the middle of the day with lower flow rates on the 8 hours before and after this.

If dam levels are not high enough to deliver a flushing flow on either date, a 24-hour constant flow of 5,000 ML/day will be delivered via the dam valves.

Figure 4 summarises the total monthly discharge patterns for 2023–24 below Jindabyne Dam. A pattern of higher flow rates over winter, spring and early summer reflects the rainfall/runoff patterns typical of a mixed rainfall and snowmelt river system characteristic of the Snowy Mountains.

Lower flows are provided during the natural low-flow periods of summer and autumn; however, a number of small flushes (less than 2,000 ML) will occur for the health of the Snowy River and its estuary.

Natural tributary inflows below the junction of the Delegate River are expected to provide the most substantial contribution to the flow regime and ecosystem processes of the lower reaches of the Snowy River and its estuary in this water year.

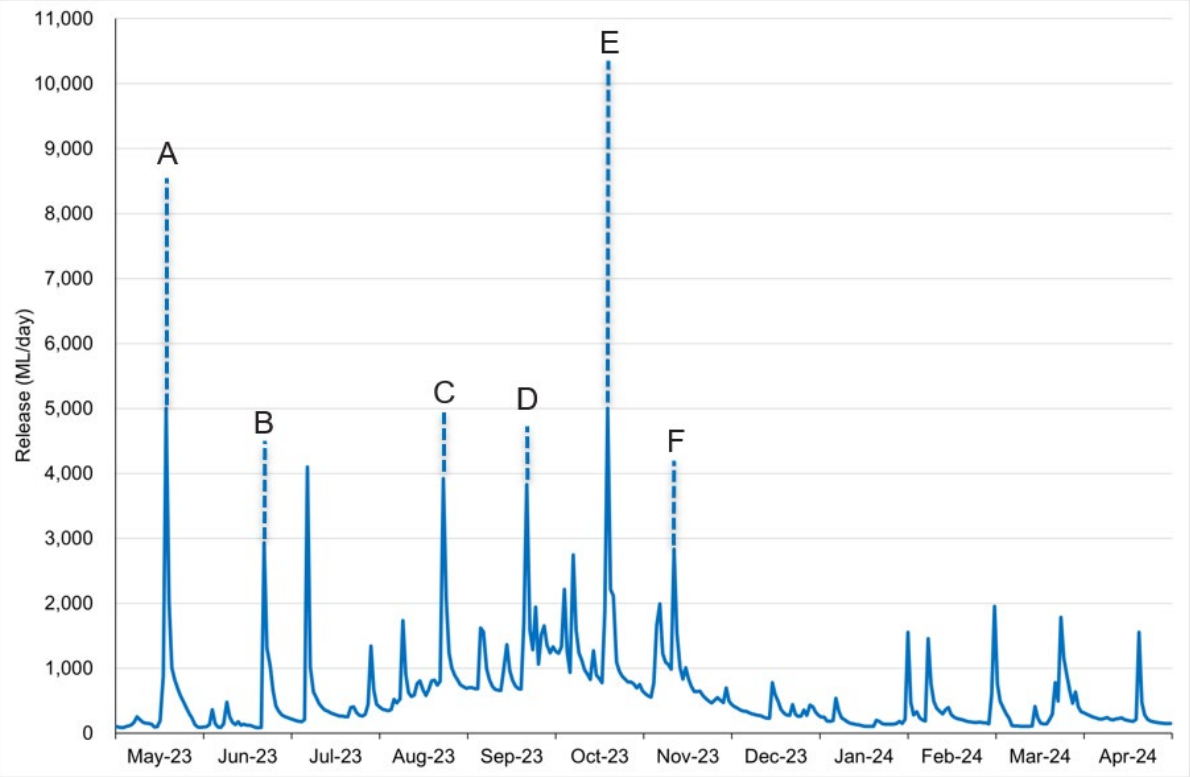

Figure 3 **Daily flow targets for Snowy River releases from Jindabyne Dam in 2023–24**
The letters (A–F) refer to the 8-hour peaks listed in Table 2.

Table 2 **Dates and rates of Jindabyne Dam 8-hour release peaks**
The letters (A–F) refer to the events shown in Figure 3.

	Date	8-hour peak flow rate	Average flow for full day	Note
A	18 May 2023	8,864 ML/day	5,000 ML/day	Flushing flow – subject to sufficiently high dam levels to enable delivery
B	21 June 2023	4,507 ML/day	2,931 ML/day	
C	22 August 2023	5,000 ML/day	3,919 ML/day	
D	20 September 2023	4,699 ML/day	3,827 ML/day	
E	18 October 2023	10,362 ML/day	5,000 ML/day	Flushing flow – subject to sufficiently high dam levels to enable delivery
F	10 November 2023	4,236 ML/day	2,832 ML/day	

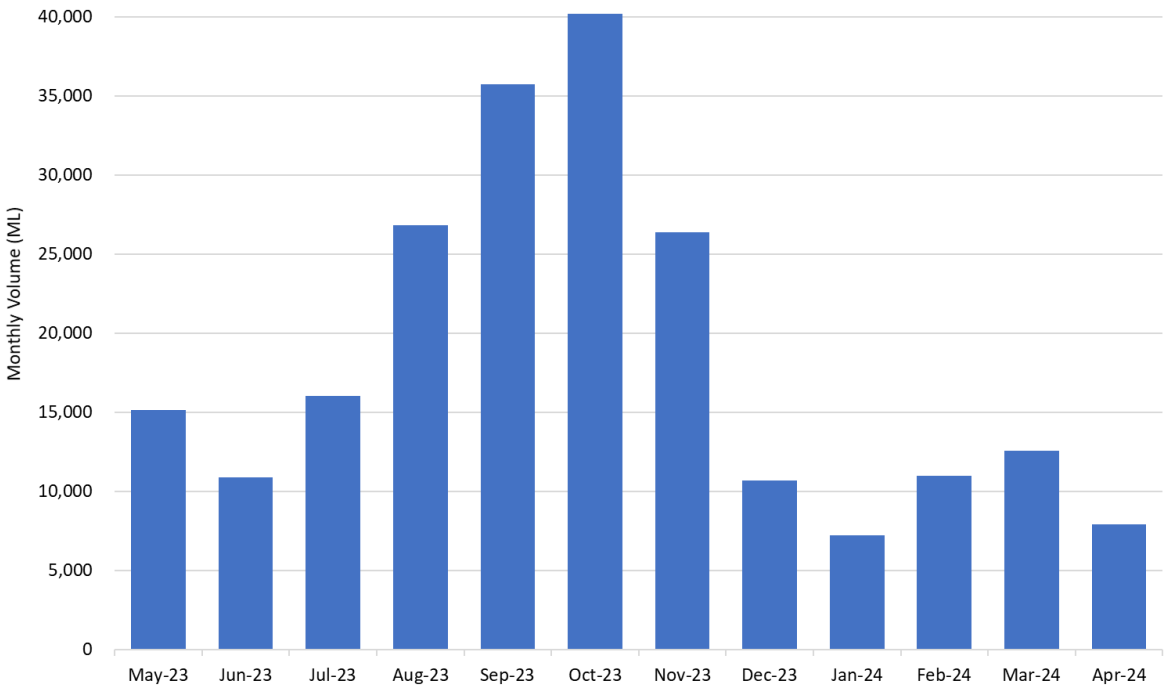

Figure 4 **Snowy River below Jindabyne Dam total monthly discharge pattern for 2023–24**

Objectives for SRIF

In determining how to use water for the environment in the Snowy River below the Jindabyne Dam, the partner governments agreed that a primary ecological objective would be achieved by storing and then releasing sufficient volumes to provide annual flushing flows and occasional channel maintenance flows.

Flushing flows scour and transport finer sediment (sand, silt and clay) and improve the physical condition of the instream river channel habitat and overall river health. Channel-forming flows scour larger sediments (gravel and cobbles) and define a channel pathway within the overall riverbed. Over time it is expected that as the river physically responds to these higher energy flows, the recovery process can transition to meet other secondary ecological objectives.

The SWIOID 2002 sets out 5 key environmental objectives for the SRIF:

1. improving the temperature regime of river water
2. achieving channel maintenance and flushing flows within rivers
3. restoring connectivity within rivers for migratory species and for dispersion
4. improving triggers for fish spawning
5. improving the aesthetics of currently degraded riverine environments.

The Department of Planning and Environment – Water redefined the SWIOID 2002 overarching ecological objective:

> To facilitate the rehabilitation and evolution of the Snowy River below Jindabyne Dam into a smaller but healthy montane river.

This incorporated new knowledge and scientific information to better define the aspects of riverine health that are key to the recovery of a geomorphologically confined Snowy River (Williams 2016a). As aquatic plants and animals are adapted to local climatic and hydrological conditions, being able to represent the varied characteristics of the local hydrology is a key driver to river recovery from flow diversion.

Phase 1 of the Snowy Long Term Water Plan (Alluvium 2022) further developed the Snowy River objectives to cover native fish, native vegetation, other species (including frogs, platypus and macroinvertebrates), geomorphology, supporting functions and water quality.

The focus of the SRIF regime for 2023–24 is:

- **native fish**: increase opportunities for movement (multiple peak events and flushing flows)
- **native vegetation**: limit the encroachment of terrestrial plants into the river channel (multiple peaks and flushing flows) and establish native aquatic and riparian vegetation (daily flow variability, multiple flows above 1,000 ML/day to inundate low benches, backwaters and connected ponds)
- **other species:**
  - **maintain and protect native fauna** – provide suitable habitats for macroinvertebrates, frogs, platypus and turtles by increasing resource availability and productivity, and providing opportunities for breeding and recruitment
  - **frogs** – connect wetlands and ponds to provide breeding opportunities for frogs in the Snowy River (daily flow variability, multiple flow peaks, multiple flows above 1,000 ML/day to inundate low benches, backwaters and connected ponds)
  - **macroinvertebrates** – increase the abundance of aquatic invertebrate fauna commonly found in unregulated Snowy montane rivers within gravel and cobble substrate (daily flow variability, multiple flow peaks); an important food resource for native fish, frogs and platypus
  - **platypuses** – provide increased opportunities for movement and feeding (daily flow variability, multiple flow peaks)
- **geomorphology:**
  - **riverbed maintenance** – improve channel condition by providing several high flow events, reducing fine sediment build-up and algae smothering, and cleaning riffles, cobbles and gravel by mobilising fine sediment (multiple peak flow events)
  - **channel morphology** – develop a more defined river channel within the former river channel via a flushing flow
- **supporting functions** – provide daily variable flows with higher release rates during winter and spring that are typical of a snowmelt river (daily variability)
- **water quality:**
  - **thermal regime** – provide a thermal regime similar to an unregulated montane river (daily flow variability)
  - **basal resources** – enhance delivery of complex dissolved organic carbon and other basal resources by inundating lower in-channel river benches (multiple peak flow events).

Snowy Montane Rivers Increased Flows

The SWIOID 2002 also provides for environmental releases into a number of higher altitude (montane) rivers whose flows are significantly affected by the operation of the Snowy Scheme. These are known as the SMRIF allocation. The environmental water is released from small weirs as a passing flow, or as managed releases from Tantangara Dam for the:

- Snowy River above Jindabyne Dam
- Goodradigbee River
- Geehi River
- Murrumbidgee River below Tantangara Dam.

Each water release point results in a different amount of foregone generation potential for SHL for each megalitre of water that is released, up to a maximum of 150 GWh each year.

Each year, the degree to which generation is foregone by SHL is proportional to the volume of environmental water allocated to the Snowy River. If the average 212,000 ML target is available for the Snowy River, the full 150 GWh of generation potential equivalence will be allocated to the Snowy montane rivers. As the water is either reregulated by the Snowy Scheme, or by water supply storages in the western rivers, we do not need additional water savings to enable these releases.

All of the targeted release points have the required modifications to existing diversion works to allow us to make the releases. This was undertaken progressively as the SRIF water licences accrued.

Releases to the upper Murrumbidgee River are made from Tantangara Dam, a much larger structure than the other release points. Tantangara releases usually comprise 2 components: a SMRIF amount, plus a required annual base passing flow.

The Tantangara base passing flow has 2 key operating rules required by the Snowy Water Licence:

- 32 ML/day minimum river discharge maintained at Mittagang Crossing, near Cooma
- 2,000 ML/year volume on average is targeted over the longer term.

Snowy montane releases from the other, smaller weirs reflect the catchment inflows to each weir pool and it is not practical to prescribe a daily flow target. The downstream flow from the smaller weirs reflects the hydrology of their inflows where, in wetter years, the flow will exceed the long-term target and, in drier years, the annual volume will be less than the target.

The SMRIF sets an annual yield so that over the long term the annual volume will approximate the nominated increased flow target. To achieve the long-term target, each weir has been modified to either allow all water to pass downstream (known as ‘transparent releases’), or in the case of the Goodradigbee River, allow a proportion of the daily inflows to pass downstream (known as ‘translucent’ releases). This is so that the flow characteristics downstream of the modified weirs will reflect the hydrology of a smaller mountain river or stream.

Figure 2 provides a pie chart of maximum annual flow volumes for the 3 increased flows that represent the 212,000 ML allocation scenario (21% of the average natural flow).

Snowy Montane Rivers Increased Flows in 2023–24

The SRIF allocation for 2023–24 will lead to a foregone generation value of 150 GWh for SMRIF. There is sufficient allocation to operate all the weirs of the Snowy montane program. The allocation to the Goodradigbee River will be 7,000 ML rather than the maximum 12,000 ML. This is to provide an additional 5,000 ML for the upper Murrumbidgee River, which supports the endangered native fish species, Macquarie perch (*Macquaria australasica*). SHL have confirmed that there was an under delivery of 445 ML in 2022–23. This brings the total environmental water available for release from Tantangara into the upper Murrumbidgee River to 41,202 ML.

The SMRIF allocations for each river reach and the works to deliver the environmental water are identified in Table 3.

Table 3 SMRIF allocations and settings for the 2023–24 water year

River reach/ catchment	Modified works	Conversion factor (GWh per GL)	Forgone electricity generation (GWh)	2023–24 volume (GL)
Murrumbidgee River	Tantangara Dam outlet	1.94	69.4	40.8
Goodradigbee River	Goodradigbee River Weir	1.94	23.3	7
Geehi River	Middle Creek Weir	1.85	32.4	17.5
	Strzelecki Creek Weir	1.85	9.6	5.2
Snowy River – Island Bend to Lake Jindabyne	Tolbar Creek Weir	0.71	6.7	9.5
	Diggers Creek Weir	0.71	6.7	9.4
Snowy River – Guthega to Island Bend	Falls Creek Weir	0.57	1.9	3.4
Total			**150**	**92.8**

Similar to the Snowy River, when there is sufficient environmental water available, a modified 'flow scaling' approach has been applied to the Murrumbidgee River to assist in providing natural seasonality and daily variability. This approach uses historical flows from the gauge on the Murrumbidgee River above Tantangara as a reference. For the 2023–24 water year, the 1992–93 water year was used as a reference because it included a good range of flow peaks across the winter–spring season. The proposed flows have been scaled down to approximately 25% to fit within the available SMRIF of 41,202 ML.

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 snowline, therefore snowmelt flow is not as pronounced as in the Snowy River.

There will be no environmental flow released from Tantangara for 12 periods totalling 87 days as there is insufficient water available to maintain the flow regime for every day of the year that includes multiple high peaks. During this time, SHL is required to make releases to maintain flows at or above 32 ML/day at Mittagang Crossing if tributary flows do not provide this level of flow.

Two flow scenarios were considered for the Tantangara releases in 2023–24:

- **keep it wet** – provide continuous daily flows for the entire year
- **keep it clean** – provide daily variability and higher peaks to flush sediment and clean riffles.

The SAC expressed a preference for a 'keep it clean' scenario with multiple peak flows and several small flushes rather than providing persistent base flows. Maintaining the minimum deliverable flow of 30 ML/day for the full year requires almost 11,000 ML and it is not possible to return permanent flows to the 27 km stretch of river from Tantangara Dam to the Yaouk River confluence every year.

The planned upper Murrumbidgee flow pattern set out in Figure 5 includes:

- some daily flow variability to reflect a scaled natural flows pattern
- 7 flows above 500 ML/day across 3 peak events, including 2 daily high flow peaks at the maximum release rate of 1,500 ML/day and one of 1,450 ML/day to move fine sediment and inundate low lying benches. Although the peaks are accentuated, they are still smaller than the 'pre-scaled' size of the original Murrumbidgee above Tantangara flows (highest daily peak in 1993–94 reference year was 3,108 ML/day)
- the 12 cease-to-flow periods ranging from 5 to 9 days
- flows are continuous between 31 May 2023 and 10 January 2024
- there are a series of small freshes (i.e. up to 150 ML/day) provided from January to April 2024.

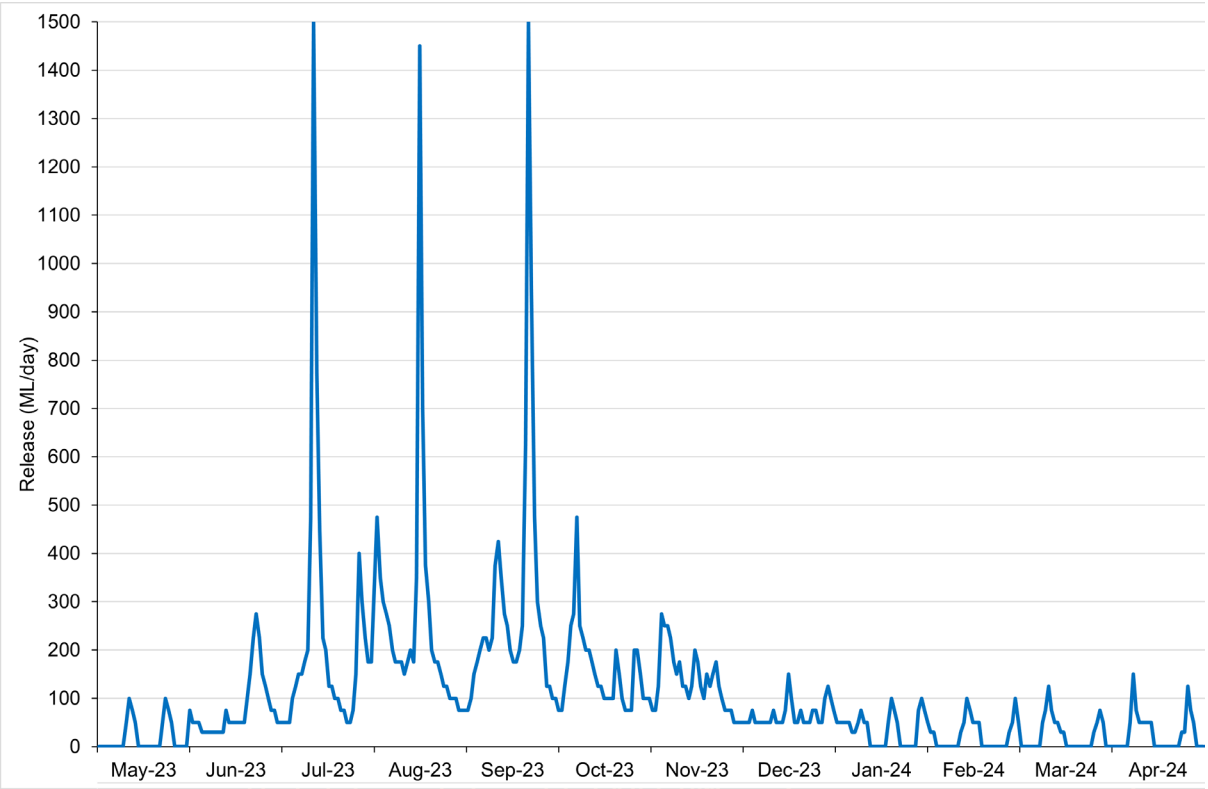

Figure 5 **2023–24 Snowy Montane Rivers Increased Flow pattern for the upper Murrumbidgee River below Tantangara Dam**

Objectives for SMRIF

The SWIOID 2002 set the following ecological objectives for the Snowy montane rivers:

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

Using newly available knowledge and scientific information, the Department of Planning and Environment – Water refined the objectives (refer to Williams 2016b).

For the Murrumbidgee River specifically, the following overarching objective has been identified:

> To facilitate the rehabilitation and transition of the Murrumbidgee River below Tantangara Dam into a smaller but healthy river.

The focus of the Tantangara flow regime for 2023–24 is:

- **hydrology** – provide some variability that has higher flow rates during winter and spring that are typical of a snowmelt river
- **channel morphology and riverbed maintenance** – the release plan provides 3 peaks of 1,450 ML/day or greater to help move sediment, clean riffles and reduce encroachment of vegetation. These peaks are provided with an interval between events to allow greater sediment movement

- **fish (Macquarie perch)** – the endangered Macquarie perch is present downstream of Yaouk. Macquarie perch spawn from October to December and their eggs lodge in gravel and cobble in riffles (Lintermans 2007). The 3 high flow releases in 2023–24 are timed to flush gravels and cobbles prior to the breeding season to provide a better substrate for the eggs. Very high flows should be avoided during October to December to reduce the likelihood of eggs being displaced or stranded with evidence of spawning not seen when flows exceed 2,500 ML/day (Prue Haantjens, NSW Fisheries, email 28 January 2021). Some variation in flow is required during the breeding season because Macquarie perch have been found to lay their eggs in riffles on the recession of freshes. Flows should be maintained from October to December to keep riffle habitat and the eggs they contain wet
- **flora and fauna** – flow variability and inundation of connected ponds aims to provide habitat and increase productivity, providing benefits for a range of biota, including macroinvertebrates. Improved populations of macroinvertebrates will in turn provide food for platypus, fish and other animals
- **frogs** – high flows will inundate low-level connected ponds and slack water areas during late winter and spring, and freshes in summer will provide opportunities for flow-dependent frog species. The higher flows above 500 ML/day are also highly likely to provide habitat and recruitment opportunities for the flow-stream species such as stony creek frog (*Litoria lesueurii*) (unpublished data E Wilson, 2021).
  The alpine tree frog (*Litoria verreauxii alpina*), a subspecies of the broadly distributed whistling tree frog, is nationally vulnerable and endangered in New South Wales. The alpine tree frog occurs in the south-eastern NSW and Victorian high country (alpine and sub-alpine zones) generally above 1,100 m, mostly located within Kosciuszko National Park (OEH 2017). The species was detected at multiple locations along upper Murrumbidgee and connected ponds, including metamorphed juveniles in December 2021 and 2022 (unpublished data, E Wilson, 2021, A Walcott 2022). The releases from Tantangara Dam will assist in providing suitable habitat conditions and potential breeding opportunities for the alpine tree frog
- **productivity** – the higher peaks are expected to wet lower streamside channels and provide organic matter to help encourage productivity and drive food chains
- **connectivity** – continuous flows during the wetter months with several small freshes to assist with maintaining connectivity.

Monitoring of SRIF and SMRIF

Monitoring, evaluation and reporting will inform planning and use of Snowy and Snowy montane environmental water.

In 2000, the NSW Government established the Snowy Flow Response Monitoring and Modelling program to assess the changes in river condition attributed to the environmental flows. The monitoring parameters included hydrology, geomorphology, macroinvertebrates, aquatic vegetation, water quality, productivity (biofilm, algae, carbon) and fish.

Elements of the program were initially funded by the NSW, Victorian and Australian governments. A large portion of the monitoring effort until 2012 focused on the Snowy River and included geomorphology, water quality, hydrology, fish and macroinvertebrate studies. In the Snowy montane rivers the focus was on macroinvertebrate response to environmental flows.

Since 2020 smaller biannual macroinvertebrate studies in the Snowy and Snowy montane rivers have been continued, with other monitoring undertaken opportunistically, dependent on funding availability, including studies on fine sediment mobilisation and assessment of changes to the Snowy River channel and vegetation.

Table 4 is a framework for proposed monitoring against SRIF and SMRIF objectives that will be developed by the Department of Planning and Environment's Environment and Heritage Group with the advice of relevant experts. With the annual watering plan complete, the monitoring framework can be refined with input from the SAC and experts.

Table 4 Framework for proposed monitoring against SRIF and SMRIF objectives

Parameter	Site	SWIOID objective: Snowy	SWIOID objective: Snowy montane	Snowy Long term Water Plan objectives	Williams (2016b): objectives for Snowy montane rivers
Fish (eDNA)	Upper Murrumbidgee and Snowy River (Jindabyne to Dalgety)		Objective 1	Native fish	Objective 6
Frogs	Snowy River (Jindabyne to Dalgety), upper Murrumbidgee River		Objective 1	Other species	Objective 6
Geomorphology	Snowy River	Objective 2		Geomorph-ology	
Hydrology (water volumes delivered, tributary inflows)				Supporting functions	
Macroinvertebrates	Snowy montane rivers, Snowy River			Other species	Objectives 4 and 6
Riparian vegetation	Snowy River, upper Murrumbidgee River		Objective 2	Native riparian vegetation	
Water quality (electrical conductivity, pH, temperature)	Snowy montane, Snowy River, upper Murrumbidgee	Objective 1	Objective 2	Water quality	

Social, cultural and economic considerations

The Snowy and Snowy montane rivers are of great significance for their connection to a range of communities and people. This has remained a driving force behind the actions that have led to their ongoing recovery.

It is important the key linkages and dependencies of communities and people to the mountain rivers are recognised and, where possible nurtured, by the effective use of environmental water. These understandings will grow with increased knowledge of traditional and contemporary practices of the First Nations Peoples' movements following seasonal travel routes and the availability of food and resources.

The SAC, established by the NSW Government, will be a primary source of advice to environmental water managers on these relationships: cultural, social or economic. The committee has developed a strategic plan to guide its activities through to 2025.

Consistent with its statutory basis, the SAC will seek to provide advice for the SRIF and SMRIF allocations that is first and foremost about what is best for the environment, but will also consider cultural, social and economic benefits where they are compatible with achieving environmental outcomes. The SAC considers that multiple benefits should be sought when providing its advice. Most importantly, the committee considers that Aboriginal culture and heritage must be included in all advisory considerations.

Over time, the SAC considers that integrating these objectives will guide more detailed and nuanced flow management and monitoring activities. These understandings will grow around the central concepts of the rivers and their First Nations Peoples, with an intention to provide for healthy rivers that support a diversity of cultural, social and economic activity.

Healthy rivers recovered from a history of water diversion will remain the primary purpose of water use. The direction set by the SAC will, however, lead to better identification of river-use constraints with the intention that water managers will better communicate plans and, where possible, optimise multiple benefits for river-use objectives such as the availability of water for recreational activities.

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More information

- Snowy Flow Response Monitoring and Modelling program
- Snowy Water Initiative
- Snowy Water Inquiry Outcomes Implementation Deed 2002 [PDF 283KB]
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