Returning environmental flows to the Snowy River
An overview of water recovery, management and delivery of increased flows
The NSW Office of Water is a separate office within the Department of Environment, Climate Change and Water. The Office manages the policy and regulatory frameworks for the State's surface water and groundwater resources to provide a secure and sustainable water supply for all users. The Office also supports water utilities in the provision of water and sewerage services throughout New South Wales.

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Introduction

The Snowy River is an iconic river in south eastern Australia. It rises near Mount Kosciuszko and, up until the construction of the Snowy Mountains Hydro-electric Scheme, it was the largest snowmelt river in Australia, renowned for its Spring flows, particularly in floods.

The Snowy Mountains Hydro-electric Scheme was jointly built by the New South Wales, Victorian and Commonwealth Governments over a 25 year period from 1949 to 1974. It collects and stores water from the head waters of the Snowy River and diverts it westward through trans-mountain tunnels and power stations to the Murray and Murrumbidgee Valleys.

The construction of the Snowy Mountains Hydro-electric Scheme resulted in the diversion of 99 per cent of the Snowy River's mean natural flow at Jindabyne. For fifty years, the Snowy Mountains Scheme has met critical demands for electricity generation and provided water for irrigation.

The Snowy Mountains Rivers

[Diagram of the Snowy River basin]
The Snowy Mountains Hydro-electric Scheme is regarded world-wide as an engineering feat. The electricity it provides typically feeds into the nation’s electricity grid at peak times, when base loads from coal powered generation may struggle to meet demand.

The water diverted for irrigation in the Murray and Murrumbidgee Valleys has enabled the development of industries that underpin many communities in regional New South Wales, Victoria and South Australia. In recent times, the water that has been diverted from the Snowy Scheme into the Murray Valley has been required to secure the critical human needs of these communities, including Adelaide.

However, the reduction of flows to the Snowy River and other man-induced changes has impacted on the health of the river. There has been a build up of sediment in the bed of the river, weed infestation and loss of habitat for native plants and animals.

As a consequence, in 2000 the NSW, Victorian, and Commonwealth Governments agreed to release environmental flows to the Snowy River in four stages. An environmental flow allocation of 21 per cent mean annual natural flow was agreed to be released by year ten, following the first flow release which commenced in August 2002. However, these environmental water allocations are dependent on water savings in the Murray-Darling River Basin.

Since corporatisation of the Snowy Mountains Hydro-electric Scheme in 2002, much of south-eastern Australia has been subject to the worst drought on record. This has reduced water availability for the Snowy River and for the Murray, Murrumbidgee and Goulburn-Murray River systems, making it difficult to meet the water needs of the environment, water users and the communities that depend on these river systems.

This paper provides an overview of the operations of the Scheme relevant to water management and explains the issues concerning the recovery of water and the delivery mechanism for increased environmental flows for the Snowy River below Jindabyne.

The Snowy Mountains Hydro-electric Scheme

The Snowy Mountains Hydro-electric Scheme is a hydro-electricity generation and storage and supply scheme located in south-east New South Wales, mostly within the Kosciuszko National Park. It was jointly built by the New South Wales, Victorian and Commonwealth Governments over a 25 year period from 1949 to 1974. It is now owned and operated by Snowy Hydro Limited.

The Scheme captures the waters of the upper Snowy River and its tributaries in the Great Dividing Range and diverts these waters inland through trans-mountain tunnels into the Murray and Murrumbidgee river valleys. These water diversions produce hydro-electricity through a complex system of infrastructure, which includes 16 major dams, seven power stations, 145 kilometres of interconnected tunnels and 80 kilometres of aqueducts.

The Scheme was designed after one of the worst droughts on record (1939-1945) to provide around 1,000 gigalitres (GL) of water to each of the Murray and the Murrumbidgee river valleys each year. This annual supply of reliable, high-quality water enabled the expansion of irrigation development in inland areas.
Overview of the Snowy Mountains Scheme
Map reproduced from Engineering features of the Snowy Mountains Scheme

*Snowy Mountains Hydro-electric Authority 1993*
Diverting water to the west

The diversion of water into the Murray and Murrumbidgee valleys provides the dual objectives of producing hydro-electric power and providing additional water for irrigation.

Minimum notification releases (now ‘Required Annual Releases’)

Under the *Snowy Hydro Corporatisation Act 1997*, Snowy Hydro Limited is required to release minimum volumes into the Murray and Murrumbidgee valleys each year. These releases were previously referred to as minimum notification releases, and are now referred to as the Required Annual Releases (RARs).

Although Snowy Hydro Limited does not own any of the water in the Scheme, it does have the right to decide on the timing of the release of water, subject to the requirements of the Snowy Water Licence.

Diversion of water to the Murray catchment via Murray 2 Pipelines near Khancoban.
*Photo: Snowy Hydro Limited*

The RAR for the Murray Valley is 1,062 gigalitres (GL) per year (1 May to 30 April) and is diverted into the Swampy Plains River at Murray 2 power station at Khancoban and flows into the Murray River downstream.

Tumut 3 Power Station and releases into the Murrumbidgee catchment.
*Photo: Snowy Hydro Limited*

The RAR for the Murrumbidgee Valley is 1,026 GL per year (1 May to 30 April), the majority of which is diverted into the Tumut River via the Talbingo and Blowering Dams.

Some RAR may come from the Goodradigbee River, or is released from Tantangara Reservoir to achieve environmental benefits.

The RAR can be released at any time during the year. On average, Snowy Hydro Limited releases more than the RAR into each river valley. To return water to the Snowy River, the RAR is reduced each year by the equivalent volume of allocated water savings in the Murray and Murrumbidgee Valleys to allow environmental releases to be made.
Above target water

Above target water is the water available within the Snowy Hydro Scheme that is in excess of the 1,062 GL RAR into the Murray River system and 1,026 GL RAR into the Murrumbidgee River system in the current and subsequent water years.

While generally a Required Annual Release is diverted in any water year, the release of above target water is solely at the discretion of Snowy Hydro Limited.

Dry Inflow Sequence Volumes

When the natural inflows into the Snowy Hydro Scheme water storages are less than those in the drought sequence that was used in the hydrologic design of the Snowy Scheme, Snowy Hydro Limited may reduce its RAR into either or both of the Murray and Murrumbidgee River valleys. This reduction is referred to as a Dry Inflow Sequence Volume (DISV).

Such a reduction in inflows was only expected to occur in about 1 in 100 years when the rules were developed for the Snowy Water Licence (the design drought). Unfortunately, like elsewhere in south eastern Australia, the inflows experienced in the Snowy Scheme since 2006 have been significantly less than those of the design drought, and this has resulted in a reduction to the RAR.

The shortfall in the water available to meet RAR for each of the Murray and Murrumbidgee Valleys (DISV) is calculated retrospectively as it is not possible to know what volume of water will flow into Snowy storages in advance.

When conditions improve, Snowy Hydro is required to ‘make good’ the Dry Inflow Sequence Volume (the difference between the Required Annual Release and the volume actually released) as soon as practicable.

When this occurs, the NSW Office of Water will negotiate the delivery pattern with Snowy Hydro Limited, consistent with the conditions of the Snowy Water Licence. This will consider such things as immediate consumptive needs in the respective valleys, interstate agreements, capacity to store and release these volumes and environmental needs.
Legislation and reforms

The New South Wales, Victorian and Commonwealth Governments agreed to a major program of reform in the 1990s, giving rise to the making of the *Snowy Hydro Corporatisation Act 1997* in New South Wales and concurrent legislation in Victoria and the Commonwealth.

The *Snowy Hydro Corporatisation Act* provides for a corporatised entity to operate and maintain the Snowy Mountains Hydro-electric Scheme through a water licence, a Snowy Water inquiry to examine the environmental impacts of the Scheme and options for dealing with them, and a scientific committee to advise on the pattern of environmental releases.

### Regulation and legislation overview

**Snowy Hydro Corporatisation Act 1997 (NSW)**

Establishes Snowy Hydro Limited as a corporation that is owned by the three governments:

- New South Wales 58 per cent
- Victoria 29 per cent
- Commonwealth 13 per cent

The Act also established the process for participating governments to reach agreement on the outcome and implementation of the Snowy Water Inquiry.

**Heads of Agreement - the agreed outcome from the Snowy Water Inquiry – 6 December 2000**

Outlines the arrangements to implement the outcome of the Snowy Water Inquiry, which was agreed between the New South Wales, Victorian and Commonwealth Governments. This includes the environmental objectives, target levels of water flows to be achieved progressively over a ten year period, the financial commitments by governments, water accounting arrangements and responsibilities of Snowy Hydro Limited.

**Snowy Water Licence – issued 30 May 2002**

Issued under Part 5 of the *Snowy Hydro Corporatisation Act 1997 (NSW)*, the Snowy Water Licence confers the rights of Snowy Hydro Limited and imposes obligations on the licensee, particularly with respect of the Snowy Increased Flows and water release requirements.

**Snowy Water Inquiry Outcomes Implementation Deed (SWIOID) – 3 June 2002**

The SWIOID is a deed entered into by the NSW, Australian and Victorian Governments to give effect to the Heads of Agreement.

**Members Agreement – 19 December 2003**

Establishes the Joint Government Enterprise (JGE) for the purposes of implementing the SWIOID, including expenditure of funds for water recovery projects and the purchase of water entitlement; and establishes the operating rules and requirements for the JGE. This now operates under the name *Water for Rivers*.

### Snowy Water Inquiry

The Snowy Water Inquiry was commissioned in 1998 to investigate ‘the environmental issues arising from the pattern of water flows in rivers and streams…caused by the operation of the Snowy Mountains Hydro-electric Scheme and report on options for dealing with the issues and the environmental, economic, agricultural and other impacts of those options’.

In its Final Report in 1998, the Inquiry identified a series of flow options to address the terms of reference.
The New South Wales, Victorian and Commonwealth Governments then agreed in 2002 to implement the outcomes arising from the Snowy Water Inquiry through a legally binding intergovernmental agreement, the *Snowy Water Inquiry Outcomes Implementation Deed* (SWIOID).

**Snowy Water Licence**

The Snowy Water Licence was issued on 30 May 2002 under Part 5 of the *Snowy Hydro Corporatisation Act*. The licence confers the rights of Snowy Hydro Limited and imposes obligations on the Licensee, particularly in respect of the Snowy River Increased Flows and water release requirements.

Snowy Hydro’s environmental flow obligations which resulted from the Snowy Water Inquiry and the SWIOID are outlined in the Snowy Water Licence.

Under the SWIOID, reviews of the Snowy Water Licence are required on the fifth anniversary of the corporatisation date, and then every ten years thereafter.

**Five year review of the Snowy Water Licence**

The NSW Office of Water (at the time NSW Department of Natural Resources) commenced the first five year review of the Snowy Water Licence in 2007. Consistent with the SWIOID, this review was limited to the provisions of the licence relating to the initial release of environmental water to the Snowy River. The final review report was published in November 2009. It found that Snowy Hydro had complied with its licence conditions, but the prolonged drought had impacted on the success of the environmental flow regime. Representations following public consultations were reported in the review.

As a result of the review, information and communication with the public regarding the licence and implementation of the environmental flow regime will be improved. More detailed information on the Snowy Water Licence and environmental flow regime is available on the NSW Office of Water website and Snowy Hydro Limited will continue to produce an annual water operations report in addition to the information it already makes available on releases via its web site.

Another outcome of the review was the amendment of the Snowy Water Licence to formalise requirements for the release of water from Tantangara Dam for riparian users downstream and require Snowy Hydro Limited to publicly release an Annual Compliance Report.

At the time of publication of this paper the proposed changes were placed on public exhibition to seek feedback from the community before making a decision as to whether they should be adopted.

During the initial public consultation phase of the review a number of submissions and representations recommended that the permanent decommissioning of the Mowamba Aqueduct and removal of the weir would greatly improve environmental outcomes including:

- greater natural flow variation in the Snowy river, particularly at low flow
- water temperature more clearly matching natural conditions
- water chemistry, particularly carbon and silica, more like a natural sub-alpine river rather than dam water
- downward passage of water bugs and algae (both ways if the weir was removed)
- reintroduce natural flow variation into the downstream reach of the Mowamba River below the weir.
Other submissions and subsequent representations sought that no change occur to the Mowamba Weir and aqueduct for other reasons including:

- if flows introduced from the Mowamba River were reduced from the environmental water accounts, there would be insufficient water in many years to provide flushing flows
- there would be a reduction in green hydro electricity generation
- there would be potentially less water available for consumptive use in the Murray and for Murrumbidgee Valleys
- there would be less water in Jindabyne Dam, particularly at low levels
- there should be no change to the infrastructure of the Snowy Hydro Scheme which is a world-wide recognised engineering feat.

A number of submissions also identified that the decommissioning of the Mowamba Aqueduct at the five-year licence review would negate the requirement to pay compensation to Snowy Hydro Limited.

Legal advice was provided to the NSW Office of Water that the licence cannot be varied in a way that would detract from its (SHL) rights under Section 23 of the Snowy Corporatisation Act 1997.

After considering all of these issues, the NSW Government decided that for the purposes of the five year licence review, the requirement of the SWIOID to release Snowy River Increased Flows through the outlet works at Jindabyne Dam should be maintained and the Snowy Water Licence not amended for this purpose.

At the same time, the NSW Government has agreed that the decommissioning of the Mowamba Aqueduct should be considered by 2012. This would allow sufficient time to undertake studies to determine the importance of inflows from the Mowamba River to the restoration of the uppermost reaches of the Snowy River.

This timeframe will also allow for completion of the Water for Rivers water recovery program and to undertake a cost-benefit analysis of the potential decommissioning and/or removal of the Mowamba Weir and Aqueduct.

The current environmental flow regime was developed as a result of extensive scientific review and public consultation as part of the Snowy Water Inquiry. Any significant changes to the current flow regime would need to be based on recommendations arising out of further scientific studies. These studies would require a considerable amount of time and could not have been concluded before the finalisation of the [five year] review.

The NSW Office of Water will undertake further scientific studies aimed at identifying better ways of achieving environmental objectives. It is proposed that the environmental flow regime will again be considered when these further studies have been completed and the results of the current water recovery program are known.
How the Snowy Mountains Scheme affected the Snowy River

The Snowy Mountains Scheme has had a significant impact on the water quality and ecology of the upper reaches of the Snowy, Murray and Murrumbidgee Rivers.

What are the impacts?

The main impacts of changed flows in the Snowy River include:

- **Changed water temperature**

  Until the construction of a multi-level offtake at Lake Jindabyne, water was released to the river from the bottom of the dam. This meant the water was of considerably lower temperature than would have occurred naturally, particularly in warmer months. This would typically impact on species where water temperature triggers breeding cycles.

  The multi-level offtake at Lake Jindabyne has significantly reduced the impacts of cold water releases but water temperatures downstream of the dam may still be up to 4°C higher than normal in winter.

- **Loss of medium and high flows**

  Just about all medium and high flow events in the Snowy River are captured by the Snowy Scheme. High flows associated with spring snow melt would have provided a trigger for fish migration and breeding, although this would have been progressively reduced further downstream of Jindabyne Dam. In addition, medium and high flow events would have been necessary to enable native species to move over natural barriers.

- **Reduced flow variability**

  One of the most significant impacts has been the reduction in flows that enable flushing of sediment, prevent the development of higher surface water temperatures in shallow reaches and the mixing of water in pools downstream of the dams that have been subject to thermal stratification.

  This has had a significant impact on the habitat for aquatic species and water quality, particularly in the reaches immediately downstream of the dams.

- **Changes to the physical characteristics of the river**

  Reduced flows have caused a contraction in the natural river channel, increased the deposition of sand and silt and the loss of the diversity of physical in-stream habitat.

  This has also caused a dramatic increase in the abundance of periphytic algae which are the algae on the bed of the Snowy River.
Rivers in the Snowy Mountains Scheme have been impacted by physical barriers including large dams, weirs and smaller diversion structures, and the loss of flow events that allow aquatic animals to move over natural barriers.

What are the effects?

The impacts of changes to flow regimes and water temperatures are reflected in changes to the vegetation and to composition and distribution of aquatic species including fish, frogs and macro-invertebrates.

Vegetation
Terrestrial vegetation has colonised the river bed. Reduced flows and increased sedimentation has led to willow invasion.

Macrophytes (common reeds) have choked shallow and slow flowing areas and there has been an excessive increase in algae.

Macro-invertebrates
Aquatic invertebrates that prefer slow moving or still, and warmer shallow water conditions have taken over from those which were better suited to faster flows and cooler water, particularly in warmer months.

Frogs
The changes to in-stream and riparian habitat has had an impact on the presence and abundance of frog species that breed in the flowing water and in pools and ephemeral ponds adjacent to the main stream.

Fish
The reduction in flows as a consequence of the Snowy Mountains Scheme has resulted in a decline in native fish biodiversity and abundance due to habitat alteration, disruption of life history processes and recruitment, loss of connectivity and invasion of native species.

Mammals
Platypus and the water rat have been regularly observed in the Snowy River but are probably affected by changes in macro-invertebrates and increase in algae on the bed of the river. Platypus, in particular, need shallow running water to increase food availability and to reduce the risk of terrestrial based predation.

Waterbirds
The impacts on waterbird species has been through the reduction in the water available from medium and high flow events, reducing the extent of floodplain channels, swamps and marshes, and where floodplains move toward terrestrial habitat.
Environmental objectives for the Snowy River

The environmental objectives for the Snowy River and for the Snowy montane rivers are defined in the Snowy Water Inquiry Outcomes Implementation Deed (SWIOID).

For the Snowy River (SWIOID Annexure One: 1.1) the environmental objectives for the increased flows is to improve the habitat for a diverse range of plant and animal species through a combination of:

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

For the Snowy montane rivers (SWIOID Annexure Two: 2.1) the environmental objectives for the increased flows are, in order of priority:

- to protect endangered/threatened species
- to maintain natural habitats
- to maintain wilderness and national park values.
What has been achieved so far?

- **Completion of the upgrade of outlet works at Jindabyne Dam**

  To facilitate the release of Snowy River Increased Flows, Snowy Hydro Limited completed the upgrade of outlet works at Jindabyne Dam.

  The outlet works, that includes a multi-level level offtake, allow sufficient volumes of water to be released to allow scouring of the river bed (channel maintenance and flushing flows) and improve the water quality of the water released to the Snowy River. Additionally, a mini hydro-power generator was installed to generate hydropower.

  The total investment in these upgrade works was about $92 million.

- **Minimum releases since 2002 have increased from 9GL per year to 38GL per year**

  Although the amount of water available for release to the Snowy River has been limited because of the drought, the minimum releases since 2002 have increased four fold from 9 GL per year to 38 GL per year.

- **Water for Rivers is on target**

  The Joint Government Enterprise established to implement water savings under the SWIOID, including the recovery of water entitlements, operates as Water for Rivers. Water for Rivers is on target to recover sufficient water entitlements to meet the targets outlined in the Heads of Agreement and SWIOID.

  As at 31 December 2009 Water for Rivers had recovered 217 GL of entitlements, of which 136 GL had been recovered from within New South Wales and 81 GL had been recovered from within Victoria. Of the water available, two-thirds is provided for Snowy River Increased Flows while one-third is retained for environmental flow to the Murray Valley. This means that 145 GL of the recovered water entitlements are apportioned to the Snowy River.

- **Establishment of the Snowy Scientific Committee**

  The Snowy Scientific Committee has been established, and commencing in 2008-09 has been working with the NSW Office of Water and Snowy Hydro Limited to advise on the best way to ensure that the water available for release to the Snowy River maximises beneficial environmental outcomes.
Increased flows and willow removal in the Snowy River downstream of Blackburn Creek (downstream of Dalgety). Environmental water releases to date have been within the flow range identified below. Note the minor improvement in wetted area in the old river bed. Flows between 130 MLd\(^{-1}\) and 300 MLd\(^{-1}\) start to inundate the lower benches at this location.

- 53 megalitres per day
- 100 megalitres per day
- 133 megalitres per day
- 300 megalitres per day. Lower river benches are inundated, with flowing section of water.

**Improving the temperature regime of river water**

The newly constructed multi-level level offtake has now been built.

When sufficient water is recovered, the flow release patterns will aim to break down thermal stratification that occurs in deeper pools downstream of Jindabyne Dam, particularly in the Jindabyne Gorge.

**Achieving channel maintenance and flushing flows within rivers**

The SWIOID requires Snowy River Increased Flows to be stored and diverted through the Jindabyne outlet regulator.

To date, due to the drought, increased flow releases from the Scheme have not been big enough or for long enough to provide effective flushing and channel maintenance. The Snowy Scientific Committee has reported that ‘channel maintenance flows of about 12,000 ML/d should occur every year, and last for about one week during the spring snow melt period’\(^b\).

\(^b\) Snowy Scientific Committee. 2008.
Restoring connectivity within rivers for migratory species and for dispersion

The increased releases to the Snowy River since 2002 have provided more water than previously. However, rehabilitating connectivity within the rivers for migratory species and for dispersion will only be achieved with the higher flows anticipated with additional water recovery and easing of the drought conditions.

As more water becomes available, a flow strategy will be developed that allows for greater movement of aquatic fauna in the Snowy River and montane streams. The main components of this strategy will include:

- introducing smaller flow events for localised movements over natural flow barriers such as riffles
- introducing larger flow events to allow for large scale movements over flow induced barriers such as waterfalls.

Improving triggers for fish spawning

Alterations to the natural flow regime in regulated rivers can disrupt cues that initiate the maturation and spawning of fish, or they can change the conditions which are suitable for the recruitment of larvae into juvenile populations.

In the case of the Snowy River, the cues for native fish spawning are still unclear but are likely to be a combination of a number of factors including flow, temperature, and habitat condition/availability.

It is expected that future releases of Snowy River Increased Flows will include releases of higher flows to allow movement of fish which, together with in-stream and bank vegetation works to improve habitat, will improve the triggers for fish spawning.

The NSW Office of Water will continue to work with the Snowy Scientific Committee and Snowy Hydro Limited to manage the Snowy River Increased Flows to achieve the best environmental outcomes.

Improving the aesthetics of currently degraded riverine environments

The Southern Rivers Catchment Management Authority (CMA) has been undertaking extensive works to improve the environment of the Snowy River downstream of Lake Jindabyne to the Victorian border. The CMA’s Snowy River Rehabilitation Project aims to improve the health of the Snowy River and maximise the ecological benefits that will result from the planned release of Snowy River Increased Flows. So far the Southern Rivers CMA has:

- completed 186 kilometres of willow control and 135 kilometres of willow follow up treatment
- constructed fourteen in-stream structures along an 8 kilometre reach of the River to assist channel scouring and to improve fish habitat
- conducted fish habitat surveys on major Snowy River tributaries (the Pinch, Jacobs and Delegate Rivers)
- undertaken blackberry control along 72 kilometres of riverbank
- established 70,000 native riparian plants to improve the condition of the streamside vegetation.
The Snowy River at Biddi before and after willow control by the Southern Rivers CMA.

Before willow eradication – Snowy River at Biddi
Photo D. Henderson

After willow eradication – Snowy River at Biddi
Photo D. Henderson

The Snowy River downstream of Blackburn Creek, before and after willow control.
Photos: Southern Rivers CMA.

Before

After
**Water recovery**

**Water for Rivers**

The Snowy Water Inquiry Outcomes Implementation Deed and Members Agreement also sets out requirements for the creation and funding of a joint government enterprise (i.e. Water for Rivers) to pursue water efficiency and savings measures in the western rivers.

In 2002 the New South Wales and Victorian Governments each committed $150 million to the recovery of water entitlements in the Murray, Murrumbidgee and Goulburn-Murray River systems to enable volumes of water to be accumulated and released to the Snowy River to meet agreed environmental objectives.

At the same time, the Commonwealth Government agreed to contribute $75 million to recover additional water for environmental releases to the Murray River.

**Water for Rivers**, was established with a charter to acquire water primarily through water savings projects and, if necessary, though the purchase of water entitlements and water rights.

Subsequently, in 2009-10 the Commonwealth Government agreed to provide an additional $50 million to **Water for Rivers** to assist in the recovery of water for the Snowy River.

Up to date information on water savings projects and volumes of entitlement recovered is available from the **Water for Rivers** website at [www.waterforrivers.org.au/snowy/](http://www.waterforrivers.org.au/snowy/).

However, the continuing drought since 2002 has meant that the annual volumes of water allocated to the entitlements purchased for Snowy River Increased Flow have not been sufficient to meet the volumetric targets.

As at December 2009, **Water for Rivers** had recovered 217 GL of entitlements. Of this total, 136 GL of entitlements (63 per cent) were contributed from New South Wales. Under the terms of the Snowy Water Inquiry Outcomes Implementation Deed, two thirds of the recovered entitlements are apportioned to the Snowy River, and the remaining one third is apportioned to the Murray River. This results in 145 GL being apportioned to the Snowy River, comprising of 91 GL from NSW and 54 GL from Victoria.

**Water recovery targets**

Under the Heads of Agreement (Section 1.2) and the SWIOID (Section 7.1) the New South Wales, Victorian and Commonwealth Governments adopted target levels of water flows to be achieved progressively within 10 years from the date of the corporatisation of Snowy Hydro Limited. These are:

- total average annual flows equivalent to 21 per cent of Average Natural Flow (ANF)
- increased flows equivalent to 150 gigawatt-hours of foregone electricity generation for the Snowy montane rivers, including the upper Murrumbidgee River
- dedicated environmental flows allocated to the River Murray of 70 gigalitres per annum.

The targets are to return 142 GL per year to the Snowy River and 70 GL to the Murray River by June 2009 with a further 70 GL to the Snowy River by June 2012.

There is provision to provide an additional 7 per cent of Average Natural Flow to the Snowy River through additional capital works in the Murray, Murrumbidgee and Goulburn-Murray River systems through public-private partnerships where the water saved is shared between the partners.

The 142 and 212 GL annual targets, when added to the base passing flow of 9 GL per water year, reflect the annual equivalent of 15 per cent and 21 per cent of average natural flow of the Snowy River downstream of Jindabyne Dam.
Reliability of water entitlements required to achieve these targets

All increased flows in the Snowy River and dedicated environmental flows allocated to the River Murray were to be recovered through water savings projects in the Murray, Murrumbidgee and Goulburn-Murray systems and, if necessary, through the purchase of water entitlements in these areas (Heads of Agreement section 1.4).

Each water savings project and the entitlements that are created as an outcome of the project have a level of reliability at the point of acquisition or purchase.

In the NSW Murray and Murrumbidgee River valleys, there are two levels of reliability for water entitlements:

**High security** where licensed entitlement holders may usually expect to receive 100 per cent of their entitlement in each year, albeit that this is not guaranteed.

**General security** where licensed entitlement holders will receive a proportion of their entitlement in any year depending on water availability in that year, that in-turn depends on seasonal climatic conditions.

In addition to the high and general security entitlement, Irrigation Corporations in NSW are issued ‘conveyance’ licences, which is the volume required in any year to deliver entitlements through their extensive channel systems. Where water savings are made that can reduce conveyance requirements, these savings will have a reliability similar to that of a high security entitlement.

In the Victorian Goulburn-Murray River systems, there are also two levels of reliability for water entitlements:

**High Reliability** where licensed entitlement holders may expect to receive 100 per cent of their entitlement in 96 per cent of years, but less in severe drought (4 per cent of the time)

**Low Reliability** available when there is 100 per cent High Reliability in the current year and reserves for the following year are met.

While all entitlements of varying reliability are to be recovered from the Murray, Murrumbidgee and Goulburn-Murray systems, the SWIOID specifies the level of reliability for the delivery of entitlements to the Snowy River.

Section 17 of the SWIOID requires that, unless agreed otherwise, around the 10th anniversary of corporatisation (2012) the NSW and Victorian Governments are to convert sufficient water recovered from water savings and water purchases to achieve a volume equal to 142 GL of water equivalent to the reliability of the entitlement received by South Australia under the Murray-Darling Basin Agreement (MDBA).

The reliability of the South Australia entitlement under the MDBA has been shown in the past three years of drought, 2006-2009, to be well less than 100 per cent in each year (see Table 1, p19).

The SWIOID allows for the possible conversion of water entitlements recovered for the Snowy River on the tenth anniversary of Corporatisation, to provide a volume of 142 GL of entitlements at the same reliability as the South Australian water entitlements. As an outcome of the recent drought, consideration is being given to conversion of entitlements to a reliability equivalent to NSW high security entitlement.
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The relationship between reliability of entitlements and target volumes

The SWIOID (s 17) requires that once a flow of 15 per cent Average Natural Flow (142 GL) is achieved in the Snowy River, the security of the further offset water required to achieve 21 per cent ANF in the Snowy River will be at the reliability measured at the point of acquisition or purchase, not at the reliability of level for annual inflows to the Snowy River.

This is an important clause in the agreement to recover water for the Snowy River.

The June 2009 target for water recovery by Water for Rivers was 15 per cent of average natural flow, equal to 142 GL. As at December 2009, Water for Rivers had recovered 217 GL of entitlements, of which 136 GL (63 per cent) was contributed from New South Wales. Under the terms of the Snowy Water Inquiry Outcomes Implementation Deed, two thirds of the recovered entitlements are apportioned to the Snowy River, resulting in 145 GL being apportioned to the Snowy River - consisting of 91 GL from NSW and 54 GL from Victoria.

Once a water efficiency project is completed, the recovered water is converted into a water entitlement. These entitlements have volumes credited into the relevant water accounts when available water determinations (or allocation announcements) are made in each river system. The available water determination is a proportion (per cent) of the entitlement based on real-time water availability. The water available in these accounts provides the volumes of environmental releases for the Snowy and Murray Rivers.

While entitlements of up to 145 GL have been recovered for the Snowy River, this does not directly equate into volumes of water available for release into the Snowy River as the water for release is determined by the available water. This means that the volume of water available in a year may be significantly lower than the total of entitlements.

Impact of the drought

When the recovery of water was being considered in the 1990s, south-east Australia, including the Snowy, Murray, Murrumbidgee and Goulburn river catchments had not been subject to an extended drought of the severity as that which has been experienced since 2002.
Returning environmental flows to the Snowy River  
An overview of water recovery, management and delivery of increased flows

The proportion (per cent) of water available to licensed entitlement holders each year prior to 2002, called allocation, was considerably higher than the water which has since been available, as shown in Table 1 below.

### Table 1: Total annual percentage of entitlement (allocation) announced at 30 June

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1992-93</td>
<td>100</td>
<td>130</td>
<td>100</td>
<td>120</td>
<td>200</td>
<td>200</td>
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</tr>
<tr>
<td>1993-94</td>
<td>100</td>
<td>130</td>
<td>100</td>
<td>120</td>
<td>200</td>
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<td>1996-97</td>
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<td>100</td>
<td>200</td>
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<td>1997-98</td>
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<td>100</td>
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<td>1999-00</td>
<td>100</td>
<td>35</td>
<td>100</td>
<td>78</td>
<td>190</td>
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<tr>
<td>2000-01</td>
<td>100</td>
<td>95</td>
<td>100</td>
<td>90</td>
<td>200</td>
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<td>100</td>
</tr>
<tr>
<td>2001-02</td>
<td>100</td>
<td>105</td>
<td>100</td>
<td>72</td>
<td>200</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td><strong>AVERAGE 1992-2002</strong></td>
<td><strong>100</strong></td>
<td><strong>97</strong></td>
<td><strong>100</strong></td>
<td><strong>96</strong></td>
<td><strong>192</strong></td>
<td><strong>147</strong></td>
<td><strong>100</strong></td>
</tr>
<tr>
<td>2002-03</td>
<td>100</td>
<td>10</td>
<td>100</td>
<td>38</td>
<td>129</td>
<td>57</td>
<td>100</td>
</tr>
<tr>
<td>2003-04</td>
<td>100</td>
<td>55</td>
<td>100</td>
<td>41</td>
<td>100</td>
<td>100</td>
<td>95</td>
</tr>
<tr>
<td>2004-05</td>
<td>97</td>
<td>49</td>
<td>95</td>
<td>40</td>
<td>100</td>
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<td>95</td>
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<td>2005-06</td>
<td>97</td>
<td>63</td>
<td>95</td>
<td>54</td>
<td>144</td>
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<tr>
<td>2006-07</td>
<td>(equivalent)</td>
<td>0</td>
<td>95</td>
<td>(equivalent)</td>
<td>10</td>
<td>95</td>
<td>28</td>
</tr>
<tr>
<td>2007-08</td>
<td>97</td>
<td>0</td>
<td>95</td>
<td>13</td>
<td>43</td>
<td>57</td>
<td>32</td>
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<tr>
<td>2008-09</td>
<td>97</td>
<td>9</td>
<td>95</td>
<td>21</td>
<td>35</td>
<td>33</td>
<td>18</td>
</tr>
<tr>
<td><strong>AVERAGE 2002-2009</strong></td>
<td><strong>98</strong></td>
<td><strong>27</strong></td>
<td><strong>96</strong></td>
<td><strong>31</strong></td>
<td><strong>92</strong></td>
<td><strong>68</strong></td>
<td><strong>71</strong></td>
</tr>
</tbody>
</table>

Snowy Hydro may also reduce its Required Annual Release into either or both the Murray and Murrumbidgee River valleys under arrangements for Dry Inflow Sequence Volumes.

When developing the agreements for the recovery of water for the Snowy River, there would clearly have been an expectation that the proportion of entitlement available to water entitlements in the southern Murray-Darling Basin would have been far higher than has occurred in the past ten years as a consequence of continuing drought.
Providing environmental releases

In determining how to use the environmental water in the Snowy River, the three Governments agreed that the best environmental outcome would be achieved by storing and then releasing sufficient volumes to provide 'flushing flows'. These flows facilitate the reworking of the channel of the Snowy river, including the transport of sediment which was identified as a priority for the environment during the Snowy Water Inquiry.

To provide the 'flushing flows' to the Snowy River outlet works at Jindabyne Dam were constructed between 2003 and 2006. While this work was occurring, the initial three years of releases from 2002 to 2005 were made via the Mowamba River and Cobbon Creek. These initial releases occurred prior to water savings being achieved and water was ‘borrowed’ from the Snowy Hydro Scheme to be repaid in accordance with the SWIOID.

Water available for release

Between 2002 and 2008 the increased releases into the Snowy have not exceeded 38 GL per year, although the original average annual target volume in the SWIOID was 120 GL by 2008. This is the result of a number of factors.

Over the last few years, the amount of water made available as a proportion of entitlements has been at very low levels as a consequence of drought. For example, the allocation for NSW general security entitlements in the Murray River in 2006-07 and 2007-08 has been zero (refer Table 1). This means that no water was allocated to NSW Murray general security entitlements in those drought years and therefore no water was allocated to this type of entitlement held for the Snowy Initiative.

The Snowy Water Inquiry Outcomes Implementation Deed (SWIOID) provides that the volumes required to make the initial releases to the Snowy River in 2002 to 2005 must be repaid as they would otherwise reduce the volume of water available for consumptive water users and the environment in the Murray and Murrumbidgee Valleys. This is known as the Mowamba Borrowings Account.

Finally, the targets are long-term average targets. Continuing drought conditions have meant that the water available has been significantly below average since 2002. Over the longer period, water availability is expected to improve and greater quantities of water will be available for release into the Snowy River.

Annual allocation of Snowy River environmental flow and payback of Mowamba Borrowings Account

The allocation of water for environmental flows in the Snowy River in any year is prescribed in the SWIOID. Effectively this requires that, of the water available in the coming year, two-thirds is apportioned to the Snowy River and one-third is apportioned to the Murray River.

The water allocated to the Snowy River is shared equally between the ‘Snowy River Increased Flows’ (SRIF) account for actual release and the ‘Mowamba Borrowings Account’, under Clause 19.5 of the SWIOID.

However, if this distribution results in less than 38,000 megalitres being allocated for the SRIF account, water is required to be redistributed between the SRIF and the Mowamba Borrowings Account under Clause 19.6 (3) of the SWIOID. This requires that the SRIF is provided with the first 38,000 megalitres (ML) available to the Snowy River, and the next 38,000 is provided to the Mowamba Borrowings Account. This redistribution has occurred every year since 2004/05.

Additional water over and above these volumes, collectively 76 GL, is to be shared equally until the Mowamba Borrowings account is paid off.

Due to the limited water available to the Snowy River in the past five years, the volume available for release as environmental flow has been limited to 38 GL per year. The volume repaid to the Mowamba Borrowings Account is only 8.6 GL and 56.3 GL remains outstanding in the Account.
When the drought eases and ‘normal’ water allocations for the entitlements held for the Snowy Initiative increase, the Mowamba Borrowings Account will begin to be repaid faster.

A summary of the allocations to the individual savings measures, the cumulative volumes that have been apportioned to the Snowy and Murray Rivers, and the volumes that have been apportioned to repay the Mowamba Borrowings Account are shown in the Snowy Water Savings Summary Table at Appendix 2.

This advice is given to Snowy Hydro Limited in February each year, together with advice on the pattern of releases, for inclusion in the Annual Water Operating Plan for the Snowy Scheme which commences on 1 May each year.

An overall summary is provided below.

**Summary of Snowy River environmental entitlements and releases**

![Graph showing Snowy River environmental entitlements and releases from 2002/03 to 2009/10](image)

*Note: figures subject to minor operational variations.*
A summary showing the sequence of steps - legal, administrative and water management – from procuring water to its delivery to the Snowy River, showing the responsible authorities/agencies*. Adapted from [www.snowyssc.org](http://www.snowyssc.org)

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Year 1</th>
<th>Step 2</th>
<th>Year 1</th>
<th>Step 3</th>
<th>Year 1</th>
<th>Step 4</th>
<th>Year 1</th>
<th>Step 5</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Procuring Entitlements</strong>&lt;br&gt;Water for Rivers&lt;br&gt;Water for Rivers locates possible water savings projects and/or purchases, and organizes these using funds from partner governments.&lt;br&gt;Total volume procured to date are referred to as Recovered Entitlements <strong>Verification, Legal &amp; Licence Arrangements</strong>&lt;br&gt;DWE in NSW, DSE in Vic&lt;br&gt;State agencies confirm (following required audit) and formalise the estimates of Recovered Entitlements. States arrange transfer of entitlements and associated licences.&lt;br&gt;The confirmed volumes are Verified Water Savings or was Verified Entitlements <strong>Distribution of Entitlements</strong>&lt;br&gt;DWE in NSW, DSE in Vic&lt;br&gt;Licences (NSW) and bulk entitlements (VIC) making up the Verified Water Savings or Entitlements are collectively the Environmental Entitlements.&lt;br&gt;Environmental Entitlements are then apportioned in ratio 2:1 between the Snowy and Murray rivers, as Snowy River Apportioned Entitlement and Murray River Apportioned Entitlement <strong>Calculating the Snowy Allocation</strong>&lt;br&gt;DWE in NSW&lt;br&gt;The volume attached to each licence and to each bulk entitlement varies from year to year, depending on seasonal conditions.&lt;br&gt;The volume attached to every licence &amp; every bulk entitlement making up the Snowy River Apportioned Entitlement is re-calculated every year. The sum is the Snowy River Annual Allocation.&lt;br&gt;This is the water available to the Snowy River <strong>Releases to Snowy River</strong>&lt;br&gt;Snowy HL&lt;br&gt;DWE advises Snowy HL (in February):&lt;br&gt;what the uncommitted SRIF is for Year 2&lt;br&gt;what the debit volume is for the Monorauma Borrow is for Year 2&lt;br&gt;Snowy HL advises DWE and SSC (in May):&lt;br&gt;what the volume is for OversUnders, Year 1&lt;br&gt;Volumes for Snowy River Increased Flows (SRIF) are finalised&lt;br&gt;DWE advises SHL: how to release the SRIF (based on SnowySC advice)&lt;br&gt;Snowy HL releases SRIF according to instructions.</td>
<td></td>
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</tr>
</tbody>
</table>

Compiled by Jane Rubers (SSC)<br>With advice from<br>Paul Simpson (DWE), Graeme Turner (DSE), David Hans (SHL)<br>27 March 2009

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* The Department of Water and Energy (DWE) was abolished and the functions relating to water transferred on 1 July 2009 to the NSW Office of Water, within the NSW Department of Environment, Climate Change and Water.

DSE – Department of Sustainability and Environment (Victoria)

Snowy HL and SHL – Snowy Hydro Limited
The Mowamba River and Mowamba Aqueduct

Mowamba Weir, showing the base-passing flow.
The base passing flow of 0.5 GLy-1 is provided downstream of the weir.

The Mowamba River is a sub-alpine tributary of the Snowy River that rises in the Snowy Mountains near Dead Horse Gap and joins the Snowy about 4 km downstream of Jindabyne.

The Mowamba Weir was constructed across the Mowamba River about 4.5 km upstream of the confluence with the Snowy River and an aqueduct was built to divert the flow of the Mowamba River into Lake Jindabyne. The Mowamba Weir was completed in July 1967.

The weir and aqueduct have a maximum diversion rate of 523 ML per day, with greater flows typically passing over the top of the weir to the Snowy River. Within the weir is a low-level pipe that enables a base flow of 0.5 GL per year to pass downstream.

For the first three years following completion (2002-2005) environmental flows were allowed to pass to the Snowy River via the Mowamba River. This was enabled by temporarily decommissioning the aqueduct and to allow natural flows to pass over the Mowamba Weir, to provide immediate environmental benefits.

During this time Snowy Hydro Limited undertook the construction of major work to allow future releases of environmental flows to come from Jindabyne dam. These works included the outlet works and multi level offtake. A dam safety upgrade became necessary because of the outlet work.

It was always intended that environmental flow releases for the Snowy River would come from Lake Jindabyne.

SWIOID Section 8.2
Release Requirements

Despite any other provision in this deed: (4) ‘Snowy River Increased Flows to be made by the Licensee from Jindabyne Dam………….’

and:

SWIOID Section 31.1
New South Wales to Procure the Making of Snowy River Increased Flows from Jindabyne Dam

‘If Jindabyne Dam and its associated works are being operated, New South Wales must procure the owner or operator of Jindabyne Dam to make the Snowy River Increased Flows.’
Mowamba River and Aqueduct
Snowy Flow Response Monitoring and Modelling Program

The NSW Office of Water manages a long term river science program as a consequence of the inter-governmental agreement on the outcomes of the Snowy Water Inquiry. This program also utilises data collected by Snowy Hydro Limited under conditions of its licence and by the Victorian and Commonwealth Governments.

The Snowy Flow Response Monitoring and Modelling program has four key aims:

- Assess the changes in river conditions that could be attributed to the new environmental flow regime. Key river attributes that are assessed include riverflow; geomorphology; water quality; plants; water bugs; and fish.
- Develop decision support tools such as hydrological and hydraulic models
- Assist in the analysis of proposed flow options
- Undertake research to better understand river process in the Snowy Mountains.

A series of technical reports that provide advice to Snowy stakeholders are available at [www.water.nsw.gov.au](http://www.water.nsw.gov.au). Findings of these studies are also provided to the Snowy Scientific Committee.

The Snowy Scientific Committee

The Snowy Scientific Committee was established in 2008 by the NSW and Victorian Governments under the *Snowy Hydro Corporatisation Act 1997 (NSW)*. The role of the Committee is to advise the NSW Government on the regime for the release of environmental flows from the Snowy Hydro Scheme.

In October 2008 the Snowy Scientific Committee completed a report into the adequacy of environmental releases to the Snowy River downstream of Jindabyne Dam from 2002 to 2008.

In February 2009 the former Department of Water and Energy prepared a *Response to the Snowy Scientific Committee report on ‘Adequacy of environmental releases to the Snowy River’*.

In June 2009 the Committee released its report: *Environmental Releases from Jindabyne Dam: Recommendations for 2009-2010*. The NSW Office of Water has incorporated the Committee’s recommendations into Snowy Hydro's Annual Water Operating Plan for 2009/10.

Snowy Scientific Committee functions and membership

Under the s 57 of the *Snowy Hydro Corporatisation Act 1997 (NSW)*:

(3) The principal functions of the Committee are as follows:

(a) to advise the Water Administration Ministerial Corporation each year on the regime for the release of water for environmental reasons under the Snowy Water Licence,

(b) to advise that Corporation from time to time on the adequacy of those releases and the programs for management and restoration of the catchments (and the Snowy River and other rivers and streams) receiving water from those releases, including the arrangements for consultation, monitoring and on-going research about those programs.

Under the s 57 of the *Snowy Hydro Corporatisation Act 1997 (NSW)* membership of the Snowy Scientific Committee is as follows:

(5) The Committee is to consist of six members appointed by the Minister.
Of the members of the Committee:

(a) one is to be nominated by the [NSW] Environment Protection Authority, and

(b) one is to be nominated by the Director-General of [NSW] National Parks and Wildlife, and

(c) one is to be nominated by the catchment management authority under the [NSW] Catchment Management Authorities Act 2003 whose area of operations includes the Snowy Mountains area, and

(d) two are to be nominated by a Minister of the State of Victoria (one being a person nominated to represent environmental interest groups), and

(e) one is to be an independent scientist with expertise in aquatic environments nominated by the Minister for the Environment.

The Chairperson of the Committee is the member referred to in paragraph (e).

Members of the Snowy Scientific Committee are:

- Dr Jane Roberts (Chair)
- Dr Mike Curll (NSW nomination)
- Professor Wayne Erskine (NSW nomination)
- Mr Noel Kesby (NSW CMA nomination)
- Dr Arlene Buchan (Victorian nomination representing environmental interest groups)
- Professor Sam Lake (Victorian nomination)

Alternate member:

- Mr Brett Miners (alternate to Noel Kesby)

The Scientific Committee is supported by the NSW Office of Water, while Snowy Hydro Limited provides information required by the Committee whenever possible.

More information about the Committee and the members is on the web at www.snowyssc.org
What’s next?

In the coming two years the following actions will be undertaken:

**Snowy Water Licence 5-year Review**

Consistent with the requirements of the Snowy Water Inquiry Outcomes Implementation Deed (SWIOID), the NSW Office of Water has completed the first 5-year review of the Snowy Water Licence.

Public submissions were called for during 2008-09 and the final report, with the findings of the review and recommendations for changes to the licence published in November 2009.

Following publication of the report, further submissions were invited in response to proposed licence amendments. These submissions were initially required to be provided by the 18 December 2009. However, following a number of requests for an extension of time to make a submission, the time frame was extended for a further six weeks until 29 January 2010.

**Water recovery**

Water for Rivers will continue its water recovery program to achieve the volume of entitlements required to meet the flow targets in the SWIOID.

On or about the 10th anniversary (2012) unless agreed otherwise, the NSW and Victorian Governments will convert water entitlements recovered for the Snowy River Increased Flows to achieve an entitlement of 142 GL equivalent to the reliability of a South Australian water entitlement. Given the reductions in reliability of a South Australian water entitlement from the time of corporatisation as a consequence of drought, the NSW and Victorian Governments will consider a conversion to the equivalent of a NSW high security entitlement that increases the reliability of increased flows to the Snowy River.

As Water for Rivers recovers additional entitlements, the volume of water available for Increased Flows will also increase, even if allocations remain low. In 2010-11 it is expected that a minimum of 20 GL will be repaid to the Mowamba Borrowings Account; more if allocations increase in the Murray, Murrumbidgee and Goulburn River valleys in this year.

**Increased flow releases**

The NSW Office of Water, Snowy Hydro Limited and the Snowy Scientific Committee will continue to work together to manage the release of increased flows to the Snowy river to achieve the best environmental outcomes possible.

As the recovery of water for environmental flows has been limited by the impacts of drought, the NSW and Victorian Governments will consider a request by the Snowy Scientific Committee to increase the releases of increased flows to a minimum of 55 GL in 2010-11.

**Mowamba River**

The NSW Office of Water, together with the Snowy Scientific Committee will undertake a targeted investigation to determine the importance of in-flows from the Mowamba River to the restoration of the uppermost reaches of the Snowy River, consistent with the recommendations of the 1st report of the Snowy Scientific Committee (October 2008). To this end, the NSW Office of Water and Snowy Scientific Committee are designing the sampling strategy that will occur over the coming 12 months.

When these investigations are completed, the NSW Office of Water will undertake a cost-benefit analysis of options for improved flow management for environmental purposes that may include decommissioning the Mowamba Aqueduct and the potential removal of the Mowamba Weir.

**Reporting**

Snowy Hydro Limited will prepare and release an annual compliance report. Extensive information regarding the operations of Snowy Hydro Limited is available at www.snowyhydro.com.au.

The NSW Office of Water has established a section relating to the Snowy River on its website which can be found at www.water.nsw.gov.au.

The Snowy Scientific Committee has also established its own web address and copies of its reports are available at www.snowyssc.org.
## Appendix 1: Agreed Snowy Water Inquiry outcomes


### PART TWO: AGREED SNOWY WATER INQUIRY OUTCOMES

#### 7. INCREASED FLOWS

#### 7.1 Target Levels of Increased Flows

The parties acknowledge that the arrangements and actions contemplated under this Deed are intended to achieve the following target flows and allocations progressively in tandem with increases in the volume of Water Savings.

<table>
<thead>
<tr>
<th>TIMING</th>
<th>INCREASED FLOW</th>
<th>TARGET VOLUME</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STAGE ONE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During the 12 Months from the Corporatisation Date until the first anniversary of the Corporatisation Date</td>
<td>Snowy River Increased Flows from either or both of the Mowamba River and Cobbon Creek</td>
<td>Target flow up to maximum of 38 GL per Water Year.</td>
</tr>
<tr>
<td><strong>STAGE TWO</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During the period from the first anniversary of the Corporatisation Date until the seventh anniversary of the Corporatisation Date</td>
<td>Snowy River Increased Flows including, up until the third anniversary of the Corporatisation Date, a target flow up to a maximum of 38 GL per Water Year from either or both of the Mowamba River and Cobbon Creek</td>
<td>Target average annual flow of 142 GL per Water Year.</td>
</tr>
<tr>
<td></td>
<td>Snowy Montane Rivers Increased Flows</td>
<td>Target average annual flow up to maximum volume equivalent to 100 GWh per annum of forgone electricity generation.</td>
</tr>
<tr>
<td></td>
<td>River Murray Increased Flows</td>
<td>Target allocation of 70 GL per Water Year.</td>
</tr>
<tr>
<td><strong>STAGE THREE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>From the seventh anniversary of the Corporatisation Date until the tenth anniversary of the Corporatisation Date</td>
<td>Snowy River Increased Flows</td>
<td>Target average annual flow of 212 GL per Water Year.</td>
</tr>
<tr>
<td></td>
<td>Snowy Montane Rivers Increased Flows</td>
<td>Target average annual flow up to maximum volume equivalent to 150 GWh per annum of forgone electricity generation.</td>
</tr>
<tr>
<td></td>
<td>River Murray Increased Flows</td>
<td>Target allocation of 70 GL per Water Year.</td>
</tr>
</tbody>
</table>
### Table: Timing, Increased Flow, Target Volume

<table>
<thead>
<tr>
<th>STAGE FOUR</th>
<th>INCREASED FLOW</th>
<th>TARGET VOLUME</th>
</tr>
</thead>
<tbody>
<tr>
<td>From the tenth anniversary of the Corporatisation Date</td>
<td>Snowy River Increased Flows</td>
<td>Target average annual flow:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(a) of 212 GL per Water Year; or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) if applicable under clause 5 of Annexure One, from 212 GL up to 294 GL</td>
</tr>
<tr>
<td></td>
<td>Snowy Montane Rivers Increased</td>
<td>Target average annual flow up to maximum volume equivalent to 150 GWh per</td>
</tr>
<tr>
<td></td>
<td>Flows</td>
<td>annum of forgone electricity generation.</td>
</tr>
<tr>
<td></td>
<td>River Murray Increased Flows</td>
<td>Target allocation of:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(a) 70 GL per Water Year; or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) more than 70 GL per Water Year if agreed between the parties.</td>
</tr>
</tbody>
</table>

#### 7.2 Release Patterns of Increased Flows

The parties acknowledge that, in the case of Snowy River Increased Flows and Snowy Montane Rivers Increased Flows, the arrangements and actions contemplated under this Deed are intended to ensure that water releases will to the extent possible mimic seasonal natural flows under prevailing climatic conditions subject to the size of the relevant outlet.

#### 7.3 Derivation of Increased Flows Volumes

1. The parties acknowledge that, in the case of Snowy River Increased Flows, the volumes referred to in clause 7.1 were calculated for the purposes of the Snowy Water Inquiry and:

   (a) in the case of references to 142 GL: when added to the Base Passing Flow of the Snowy River, was the annual equivalent to 15% of the average natural flow of the Snowy River;

   (b) in the case of references to 212 GL: when added to the Base Passing Flow of the Snowy River, was the annual equivalent to 21% of the average natural flow of the Snowy River; and

   (c) in the case of references to 294 GL: when added to the Base Passing Flow of the Snowy River, was the annual equivalent to 26% of the average natural flow of the Snowy River.

2. This clause 7.3 is inserted for the avoidance of doubt and does not affect the interpretation of this Deed.
Appendix 2: Snowy water savings summary table

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
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<th></th>
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<tbody>
<tr>
<td>Victorian Government - Nomenville</td>
<td>3,650</td>
<td>Goulburn Valley, High Reliability</td>
<td>2004/05</td>
<td>7,200</td>
<td>3,600</td>
<td>24%</td>
<td>864</td>
<td>52%</td>
<td>1,872</td>
<td>39%</td>
</tr>
<tr>
<td>Nomenville Additional</td>
<td>300</td>
<td>Goulburn Valley, High Reliability</td>
<td>2006/07</td>
<td>24%</td>
<td>72</td>
<td>52%</td>
<td>156</td>
<td>39%</td>
<td>117</td>
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<td>Victorian Government - GMD/NSW - Sowburn</td>
<td>10,912</td>
<td>Goulburn Valley, High Reliability</td>
<td>2004/05</td>
<td>10,782</td>
<td>10,912</td>
<td>24%</td>
<td>2,619</td>
<td>52%</td>
<td>5,874</td>
<td>39%</td>
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<td>Victorian Government Strategic Measurement</td>
<td>2,000</td>
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<td>2007/08</td>
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<tr>
<td>Goulburn Licence Purchase</td>
<td>15,435</td>
<td>Goulburn Valley, Various</td>
<td>2009/10</td>
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<td></td>
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<td></td>
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<tr>
<td>Victorian Government - GMD/NSW - Murray</td>
<td>5,488</td>
<td>Goulburn Valley, High Reliability</td>
<td>2004/05</td>
<td></td>
<td>5,488</td>
<td>95%</td>
<td>5,214</td>
<td>64%</td>
<td>1,866</td>
<td>44%</td>
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<tr>
<td>Victorian Government - Woorinen</td>
<td>1,500</td>
<td>Goulburn Valley, High Reliability</td>
<td>2004/05</td>
<td></td>
<td>3,000</td>
<td>95%</td>
<td>1,425</td>
<td>34%</td>
<td>510</td>
<td>44%</td>
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<tr>
<td>Vic Murray Licence Purchase</td>
<td>11,431</td>
<td>Goulburn Valley, High and Low Reliability</td>
<td>2009/10</td>
<td></td>
<td></td>
<td>34%</td>
<td>240</td>
<td>44%</td>
<td>288</td>
<td></td>
</tr>
<tr>
<td>Vic Murray On-Farm Reconfiguration</td>
<td>7,868</td>
<td>Goulburn Valley, High and Low Reliability</td>
<td>2009/10</td>
<td></td>
<td></td>
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<tr>
<td>Victorian Government, Lake Mulka Project Stage 1.2</td>
<td>22,100</td>
<td>Broken River System (Goulburn Valley), Various</td>
<td>Various</td>
<td>990</td>
<td>71%</td>
<td>703</td>
<td>62%</td>
<td>614</td>
<td>15%</td>
<td>149</td>
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<td>Edward River Wetland Savings (Temporary to 2008/09)</td>
<td>7,100</td>
<td>Murray, Temporary Transfer</td>
<td>2004/05</td>
<td>10,200</td>
<td>7,100</td>
<td>100%</td>
<td>7,100</td>
<td>100%</td>
<td>7,100</td>
<td>100%</td>
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<td>Murray SG Purchase (including On-Farm Reconfiguration)</td>
<td>21,911</td>
<td>Murray, General Security</td>
<td>Various</td>
<td>1,750</td>
<td>0%</td>
<td>231</td>
<td>0%</td>
<td>194</td>
<td>9%</td>
<td>1,748</td>
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<td>NSW Government - Forest Creek Stage 1</td>
<td>11,350</td>
<td>Murumbidgee, High Security</td>
<td>2004/05</td>
<td>11,300</td>
<td>11,300</td>
<td>100%</td>
<td>11,300</td>
<td>100%</td>
<td>11,300</td>
<td>100%</td>
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<td>NSW Government - Forest Creek Stage 2</td>
<td>23,350</td>
<td>Murumbidgee, High, Mid, and Low Security</td>
<td>2007/08</td>
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<td>Murumbidgee SG Purchase (including On-Farm Reconfiguration)</td>
<td>33,539</td>
<td>Murumbidgee, General Security</td>
<td>Various</td>
<td>13%</td>
<td>1,907</td>
<td>21%</td>
<td>2,251</td>
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<td>Irrigation Corporation On-Farm Reconfiguration - CCL</td>
<td>21,548</td>
<td>Murumbidgee, CCL Share</td>
<td>Various</td>
<td></td>
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<tr>
<td>Hay PPU Conveyance</td>
<td>1,000</td>
<td>Murumbidgee Conveyance</td>
<td>2009</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Murumbidgee Irrigation Conveyance (Harran Box Snowy Works)</td>
<td>20,000</td>
<td>Murumbidgee, MI Conveyance</td>
<td>2006</td>
<td>20,000</td>
<td>100%</td>
<td>20,000</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
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<td>Murumbidgee CCL, Conveyance Purchase</td>
<td>3,000</td>
<td>Murumbidgee, CCL Conveyance</td>
<td>2006</td>
<td>0%</td>
<td>0</td>
<td>86%</td>
<td>3,005</td>
<td>0%</td>
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<tr>
<td>Snowy - Murray Diversion (Victoria)</td>
<td>86,634</td>
<td></td>
<td></td>
<td>36,050</td>
<td>26,040</td>
<td>14,446</td>
<td>14,482</td>
<td>12,838</td>
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<tr>
<td>Snowy - Murray Diversion (NSW)</td>
<td>21,911</td>
<td></td>
<td></td>
<td>9,600</td>
<td>5,500</td>
<td>3,781</td>
<td>3,744</td>
<td>5,298</td>
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<tr>
<td>Total Snowy - Murray Diversion</td>
<td>102,545</td>
<td></td>
<td></td>
<td>45,650</td>
<td>31,340</td>
<td>18,226</td>
<td>18,226</td>
<td>18,138</td>
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<tr>
<td>Snowy - Tumut Diversion</td>
<td>114,236</td>
<td></td>
<td></td>
<td>11,300</td>
<td>31,300</td>
<td>31,300</td>
<td>39,852</td>
<td>44,485</td>
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<tr>
<td>GRAND TOTAL</td>
<td>216,780</td>
<td></td>
<td></td>
<td>56,900</td>
<td>62,640</td>
<td>49,528</td>
<td>57,877</td>
<td>62,621</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

KEY
- Victoria
- NSW and Victoria
- New South Wales

3 www.water.nsw.gov.au This table summarises savings measures as at 31 December 2010, and will be updated in February each year.
Summary table notes

**Water year**

The water year for regulated river systems within the Murray-Darling Basin run from July to the following June. However, water savings are notified to Snowy Hydro Limited at the start of February each year, to be incorporated into the Annual Water Operating Plan for their coming water year (May to April). This means that savings volumes notified to Snowy Hydro Limited will include allocations up to January in that water year, together with any allocations that accrued after January in the previous water year.

**Purchase and reconfiguration projects**

These projects have been acquiring entitlements over time, and individual entitlement purchases will only have acquired allocations after their purchase in that water year. Additionally, some entitlements may have been purchased together with account water from the previous owner. In some cases, temporary transfers of account water have been undertaken to effect savings where contractual arrangements had been entered into, but the transfer of entitlements was delayed due to annual trading limits. For these reasons, the volumes allocated for savings will not correspond precisely with announced allocations multiplied by entitlements.

**Allocation of water to the Snowy and Murray Rivers**

Two thirds of water allocations are apportioned to the Snowy River, and one third of water allocations are apportioned towards the Murray River each year. The water allocated to the Snowy River is shared equally between the "Snowy River Increased Flows" (SRIF) account for actual release and the "Mowamba Borrowings Account", under Clause 19.5 of the SWIOID. However, if this distribution results in less than 38,000 megalitres being allocated to the SRIF account, water is required to be redistributed between the SRIF and the Mowamba Borrowings Account under Clause 19.6 (3) of the SWIOID. This requires that the SRIF is provided with the first 38,000 ML available to the Snowy River, and the next 38,000 ML is provided to the Mowamba Borrowings Account.

This redistribution has occurred every year since 2004/05.

**Updates to this summary table**

This table represents the information as notified to Snowy Hydro Limited in February each water year since 2004/05. It will be updated to include further entitlements recovered by Water for Rivers following the next notification of savings to Snowy Hydro Limited in 2010.

**Drought contingency measures**

Since 2006/07, inflows to the Murray and Murrumbidgee Rivers, and to the Snowy Scheme, have been the lowest every recorded. To ensure that sufficient water was available to meet critical water requirements (including towns and cities, rural domestic, and stock supplies), and to prevent critical impacts to major industries in the region, a range of contingency measures have been necessary.

The NSW Office of Water has been adaptively managing the extreme drought conditions across the southern Murray-Darling Basin. The Office's priority is to balance the needs of the community with the needs of the environment, when making these allocations. This involves assessing the volume water available, and considering the critical water needed by communities through consultation with critical water advisory groups. NSW Office of Water has "Critical Water Planning" strategies that use this information to target water to meet critical needs as efficiently as possible. Ultimately this results in allocations to individual licences, with the most critical uses receiving higher priority.

NSW Office of Water's role is to ensure these allocations have collectively struck an appropriate balance between water to provide critical support for communities in the Murray and Murrumbidgee Valleys, and water for environmental flows to the Snowy River during the worst drought conditions recorded in the southern Murray Darling Basin. The extreme drought conditions across the southern Murray-Darling Basin have forced the suspension of the environmental flows and environmental allocations in Water Sharing Plans across southern NSW. Without this vital step, many communities would have been critically impacted. Despite the severe drought and record low allocations, NSW managed to contribute 50,000 ML of water savings in 2008/09 to the Snowy River and the Murray River for the environment. This represents approximately 80 per cent of the total savings made to the Snowy River by NSW and Victoria in 2008/09. For the Murrumbidgee Irrigation Conveyance entitlement, an allocation of 13,400 megalitres was made in 2008/09, but was not effective until after the notification date to Snowy Hydro Limited at the end of January. Thus, this allocation will form part of the next notification of savings to SHL in February 2010.
## Appendix 3: Environmental changes to reaches in the Snowy and Montane Rivers as a result of the Snowy Mountains Scheme

<table>
<thead>
<tr>
<th>River Reach</th>
<th>Flow Regime</th>
<th>Geomorphology (impact)</th>
<th>Water Quality</th>
<th>Flora/Fauna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snowy River d/s Jindabyne Dam</td>
<td>The dam originally diverted 96% MAF measured at Dalgety to Snowy River. The small increase in flow releases has been implemented since 2002 and up to 28% MAF may be released into the system. Hydrological impacts lessen downstream.</td>
<td>Channel contraction Reduction of high flow environments Establishment of natural features as barriers due to reduction of flows (e.g. Snowy and Pinch Falls) Changes in sedimentation and scouring processes Shallow pool water bodies Decrease in wetted area and diversity</td>
<td>Thermal stratification Increased water temperatures during summer Increase thermal variation Reduction in dissolved oxygen Minor increase electrical conductivity</td>
<td>Increase in algal growth Encroachment of vegetation into river channel Dominance of warm water specialists, including warmer water macroinvertebrate communities Increase in exotic fish Decrease in native fish</td>
</tr>
<tr>
<td>Snowy River estuary</td>
<td>Increased upstream extent of estuarine salt wedge</td>
<td>Reduction of sand transport through the estuary to the sea Increased frequency and duration of estuary mouth closure</td>
<td>Increased upstream penetration of sea water between Marlo and Orbost</td>
<td>Limited/no opportunities for Australian bass recruitment due to unfavourable salinity structure in the estuary, both spatially and temporally.</td>
</tr>
</tbody>
</table>

---

4 modified from Rose and Bevitt unpublished
Selected bibliography

In chronological order:


NSW Office of Water. Proposed variation of the Snowy Hydro Water Licence In accordance with clause 26(1)(b), and (e) of the Snowy Hydro Corporatisation Act 1997 (NSW). Department of Environment, Climate Change and Water. Sydney.

Snowy Mountains Hydro-electric Authority. 1993. Engineering features of the Snowy Mountains Scheme. Snowy Mountains Hydro-electric Authority. Cooma NSW.

Snowy Flow Response Monitoring and Modelling program reports:

Note: The following reports can be found on the NSW Office of Water website www.water.nsw.gov.au


