



# Cloud Seeding Program

**2021 Operations Report**

Published December 2022









# Introduction

Snowy Hydro Limited (Snowy Hydro) relies on precipitation falling over the catchments of the Snowy Mountains to supply water for the production of hydroelectricity. Cloud seeding over this area is used to enhance snowfall, ultimately leading to increased runoff and water available to produce energy.

Cloud seeding operations undertaken by Snowy Hydro are authorised by the Snowy Mountains Cloud Seeding Act 2004 (NSW) (SMCS Act).

The SMCS Act mandates that cloud seeding operations may only be carried out in accordance with an Environmental Management Plan (EMP) approved by the Minister administering the Environmental Planning and Assessment Act 1979, and the Minister administering Part 4 of the National Parks and Wildlife Act 1974 (the 'relevant Ministers').

In accordance with the SMCS Act, the EMP must be reviewed at least once every five years. The current Cloud Seeding Program EMP was formally approved by the relevant Ministers on 28 June 2018.

The SMCS Act requires Snowy Hydro, by 31 March in each year, to report on cloud seeding operations during the previous year to the relevant Ministers and to the NSW Environment Protection Authority (EPA). The report must include details of compliance with the EMP and details of research monitoring the impact of seeding agents on the environment. The EPA is appointed to review each report on cloud seeding operations, and report the findings of the review and any resulting recommendations to the Board of the EPA and the relevant Ministers.

Snowy Hydro submitted the Cloud Seeding Program 2021 Annual Compliance Report to the relevant Ministers and the EPA in March 2022. The report demonstrated that Snowy Hydro has complied with all obligations set out within the EMP and responsibly carried out cloud seeding operations in accordance with the SMCS Act. Importantly, the 2021 Annual Compliance Report confirmed there continues to be no evidence of any significant adverse environmental impacts associated with cloud seeding activities.

The subsequent EPA review supported these findings.

The key points of the 2021 Annual Compliance Report which are described fully in the following sections of this report:

- Operations, including the duration over which cloud seeding occurred and the total amount of cloud seeding agent released over the season;
- Meteorological monitoring, including controls to ensure precipitation falls as snow to at least 1400 metres during cloud seeding operations and assessment of downwind impacts; and
- Environmental monitoring, including summary statistics of the monitoring program and details of research monitoring the impact of seeding agents on the environment.

Finally, the findings and recommendations of the EPA review are provided.

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<sup>1</sup>Report on the findings of the NSW Environment Protection Authority's review of Snowy Hydro Cloud Seeding Program. 2021 Annual Compliance Report; received November 2022. Available from <https://www.epa.nsw.gov.au/legislation/snowy-hydro-cloud-seed.htm>

# Operations

## Target area

The SMCS Act states that the area primarily targeted for increased precipitation must land within the Snowy water catchment.

An area of approximately 2110 km<sup>2</sup> was targeted during 2021 cloud seeding operations. Figure 1 shows both the target area and the Snowy water catchment boundaries.

## Hours of operation

The SMCS Act stipulates that operations are only to be carried out when precipitation is likely to fall as snow to at least 1400 metres. Consequently, cloud seeding operations take place throughout the cool-season months, typically between May and October.

In 2021, a total of 73 hours and 16 minutes of cloud seeding occurred between 14 May 2021 and 04 August 2021.

## Seeding agent and method of discharge

Silver iodide is the approved seeding agent. Silver is naturally present in the atmosphere, soil and sediments of the Snowy Mountains. Silver iodide is used as the ice nucleating material because it has similar physical properties to an ice crystal. It is also insoluble in water and does not become biologically available in the environment. In 2021, approximately 22.9 kg of silver iodide was dispersed over the 2110 km<sup>2</sup> target area.

Land-based aerosol generators are the approved method to disperse the seeding material. The seeding agent is released by up to 23 ground-based generators located along the western perimeter of the target area when suitable atmospheric conditions are present.

## Operational incidents

There were no accidents or breakdowns resulting in spillage of cloud seeding agents, fuel, or failure of controls specified in the EMP.

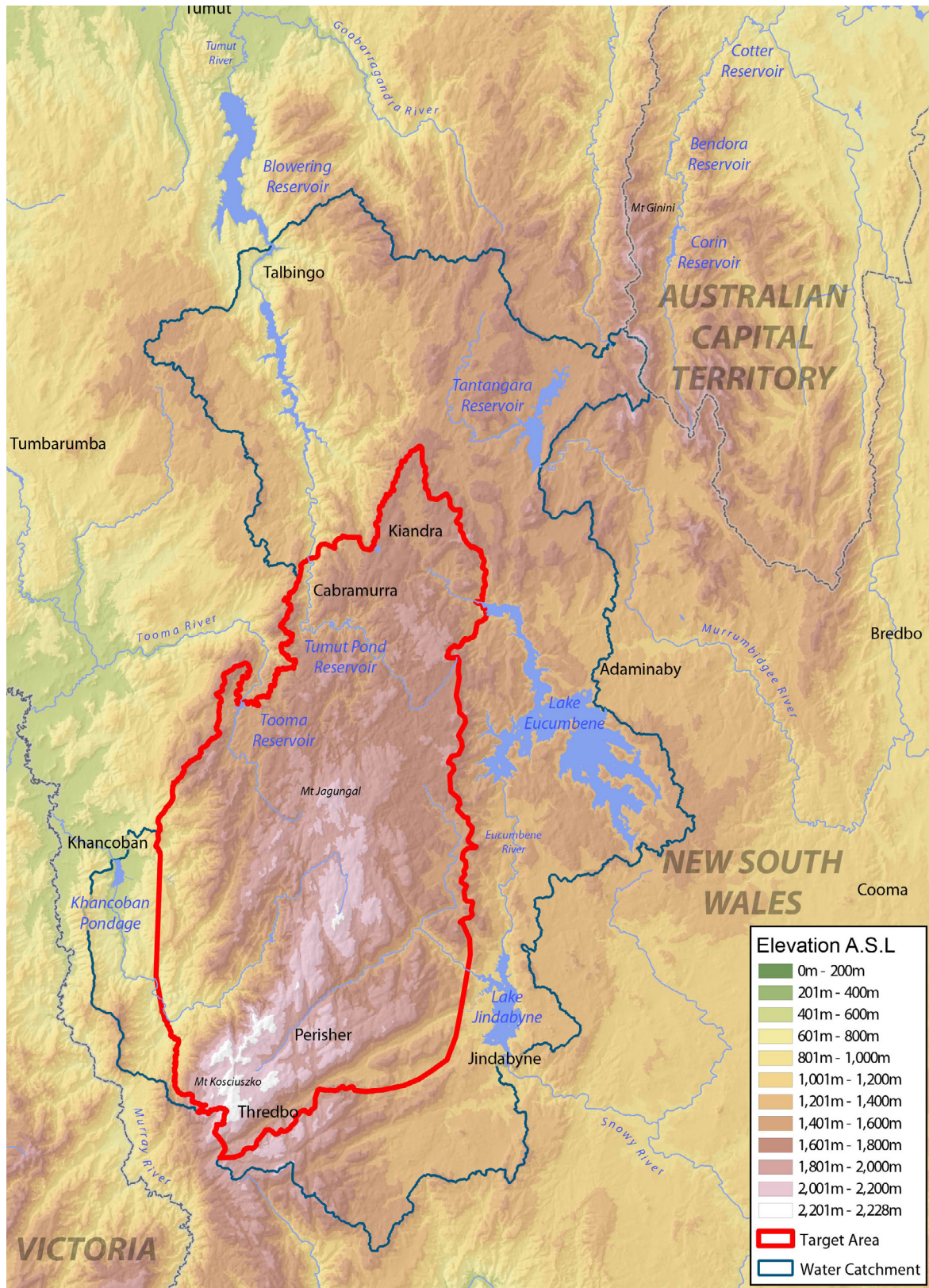


Figure 1: Map showing the Snowy water catchment (the area approved for cloud seeding) and the area which is primarily targeted for increased precipitation from cloud seeding operations (approximately 2110 km<sup>2</sup>)





# Meteorological Monitoring

## Snow level criterion

The SMCS Act mandates that the discharge of the seeding agent is to be carried out at a time when increased precipitation is likely to fall as snow to at least 1400 metres above sea level.

Prior to and during cloud seeding operations, weather balloons are released at intervals of three hours or less to monitor atmospheric conditions. Cloud seeding does not commence, or is suspended, if the freezing level measured over the catchment is higher than 1600 metres. This is to ensure precipitation falls as snow to at least 1400 metres.

Additional controls are implemented if the freezing level is between 1550 and 1600 metres, including monitoring live camera feeds and verifying conditions with personnel within the target area.

During 2021:

- Cloud seeding operations did not commence when the freezing level over the catchment was greater than 1600 m.
- There was one instance where the freezing level rose above 1600 m during operations leading to the suspension or termination of operations.

- There were two instances where the freezing level was between 1550 -1600 m during cloud seeding events. In both instances, the freezing level observations occurred during a break in operations. Operations commenced once temperatures had dropped and precipitation was confirmed as snow via video monitoring and communication with external personnel.

## Potential downwind impact

The cloud seeding program has been designed so that additional precipitation from cloud seeding falls over the target area. A component of the design is routine monitoring of precipitation to identify any possible effects of cloud seeding extending outside the target area.

Data from the Bureau of Meteorology and Snowy Hydro weather stations provide the basis for comparison of the temporal and spatial variability of precipitation across the region during the winter months, both before and after cloud seeding operations commenced in 2004.

Analyses of precipitation amounts over 1990-2021 continue to show no evidence of an effect from cloud seeding on precipitation downwind of the target area. This supports the results of previous, independent analyses by the Natural Resources Commission (NRC)<sup>2</sup>.

<sup>2</sup>NRC Review of SPERP Annual Report 2011 (July 2012), available from <https://www.nrc.nsw.gov.au/completed/cloud-seeding>.

# Environmental Monitoring

## Environmental chemistry

Snowy Hydro has monitored silver concentrations in a range of environmental matrices at potential accumulation zones within and around the target area since the commencement of cloud seeding over the Snowy Mountains in 2004. Analyses of silver concentrations from samples collected prior to the commencement of cloud seeding in 2004 through to 2021 continues to show no evidence that cloud seeding has contributed to increased levels of silver in any of the areas, or in any of the environmental matrices monitored.

The objectives of the monitoring program are to detect increases in the concentrations of silver compared with baseline concentrations, and to assess concentrations of silver compared with agreed guideline values of 0.1 mg/L for potable water and 1 mg/kg for all other matrices.

The EMP prescribes the number of sampling sites for each matrix and area, the replicates collected and analysed for each site and the sampling frequency. Once environmental samples are collected, they are sent to an independent laboratory for chemical analysis. The results are independently audited and analysed statistically.

In accordance with the EMP, potable water was the only matrix sampled following the cessation of the 2021 season. The total number of samples analysed in 2021 along with summary statistics of silver concentrations is shown in Table 1. All measurements are well below the relevant guideline values.

Table 1: Summary of silver concentrations in 2021 potable water samples (ng/L). The guideline value for silver in potable water is 100,000 ng/L

Matrix	Number of samples	Minimum	Mean	Maximum	Guideline value
Potable Water	33	0.09	0.47	3.22	100,000

## Aquatic ecology

Analyses of data collected following the 2018 season showed no evidence of any difference over time in the impairment of the macroinvertebrate assemblages or multivariate structure of edge or riffle assemblages which could be related to cloud seeding. Aquatic macroinvertebrates sampling will therefore take place after the 2023 cloud seeding season, in accordance with the EMP.



# EPA Review

The EPA has undertaken a review of the Cloud Seeding Program 2021 Annual Compliance Report, in accordance with the SMCS Act and the EMP. In completing the review, the EPA consulted with the Department of Planning, and Environment (DPE) Environmental Protection Science section for the review of the report and National Parks and Wildlife Service (NPWS) in respect to cloud seeding operations that took place within Kosciuszko National Park.

The EPA concluded:

- *"SHL has complied with all of its obligations as detailed in the Act.*
- *SHL has complied with all of its obligations as detailed in the EMP for cloud seeding operations approved by the relevant ministers on 28 June 2018.*
- *SHL has complied with all of its obligations as detailed in the Protection of the Environment Operations Act 1997.*
- *Analysis of potable water sampling carried out during the 2021 cloud seeding season showed silver concentrations remain several orders of magnitude below relevant guideline values."*

The recommendations were:

- *"monitoring be continued as per the schedule of the EMP, and data compared over time to identify trends.*
- *future reviews are also undertaken in consultation with input from partner agencies of the NPWS and DPE.*
- *SHL continues to pursue research opportunities on the cloud seeding operations in the Snowy Mountains.*
- *the outcomes of this review are communicated to the relevant ministers."*

# Conclusion

The Cloud Seeding Program 2021 Annual Compliance Report detailing cloud seeding operations and activities through 2021 was submitted to the relevant Ministers and EPA in March 2022. The EPA reviewed the report and confirmed Snowy Hydro has complied with all obligations set out in the SMCS Act and detailed within the EMP through the reporting period. There continues to be no evidence of any significant adverse environmental impacts associated with cloud seeding activities.

For more information on Snowy Hydro's Cloud Seeding Program please refer to our website, <https://www.snowyhydro.com.au/generation/cloud-seeding/>.

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