



**PROGRESS REPORT ON THE
SNOWY MOUNTAINS CLOUD
SEEDING TRIAL**

April 2009



PROGRESS REPORT ON THE
SNOWY MOUNTAINS CLOUD
SEEDING TRIAL

April 2009

Enquiries

Enquiries about this report should be directed to:

Dianne Flett

Phone (02) 8227 4300

E-mail dianne.flett@nrc.nsw.gov.au

Postal address GPO Box 4206, Sydney NSW 2001

List of acronyms

BACI	'before, after, control, impact'
DECC	Department of Environment and Climate Change
EMP	environmental management plan
GTV	guideline trigger value
NOx	oxides of nitrogen
NRC	Natural Resources Commission
NSW	New South Wales

This work is copyright. The *Copyright Act 1968* permits fair dealing for study, research, news reporting, criticism and review. Selected passages, table or diagrams may be reproduced for such purposes provided acknowledgement of the source is included.

Document No. D08/4086

ISBN: 978 1 921050 44 2

Table of Contents

1	Introduction and executive summary	1
1.1	Summary of findings	1
1.2	Structure of this report	3
2	Conduct of the trial	4
2.1	Progress of the trial	4
2.2	Amendment of the trial	4
3	Environmental information reported and whether this shows the trial is having significant impacts	5
3.1	Impact on precipitation	5
3.2	Impact on montane riverine ecosystems	6
3.3	Impact on habitat for snow-dwelling fauna	6
3.4	Ecotoxicity impacts	7
4	Suggestions for future monitoring and reporting	10
4.1	Reporting on the revised EMP	10
4.2	Reporting on ecotoxicity	10
4.3	Reporting on impacts on downwind precipitation and inflows to storages	11

1 Introduction and executive summary

Snowy Hydro Limited (Snowy Hydro) is conducting a cloud seeding trial in the Snowy Mountains to understand whether cloud seeding can successfully increase snowfall in this area. The conduct of the trial is authorised under the *Snowy Mountains Cloud Seeding Trial Act 2004*¹ (the Act), subject to certain conditions. The Natural Resources Commission (NRC) is responsible under the Act for supervising Snowy Hydro's cloud seeding operations during the trial period and for reporting on the environmental impact of those operations.²

The Act was amended in 2008 to extend the duration of trial and area of the trial. Its length was increased by an additional five years (taking the total trial period to 11 years). Its target area was expanded by more than 1000 square km (taking the total area to around 2000 square km). To reflect these changes, Snowy Hydro made revisions to its Environmental Management Plan³ (EMP) for the trial.

During 2007 and 2008, the NRC visited cloud seeding sites in the Snowy Mountains, consulted with Snowy Hydro and other key stakeholders, and reviewed the environmental information included in Snowy Hydro's 2007⁴ and 2008⁵ annual reports.

This report has been prepared for the Minister for Climate Change and the Environment and the Minister for Planning. It presents and explains the NRC's findings on the conduct of the trial over the winters of 2007 and 2008, since our last progress report.⁶

1.1 Summary of findings

To meet our responsibilities under the Act, the NRC focused its supervisory activities on answering three key questions:

- whether Snowy Hydro is conducting the cloud seeding trial in compliance with the Act
- whether Snowy Hydro is reporting information annually on an appropriate range of environmental impacts, and
- whether the information Snowy Hydro reported for 2007 and 2008 indicates that the trial has had a significant environmental impact to date.

Snowy Hydro has developed an innovative technology for ground-based cloud seeding operations and continues to employ the best available meteorological science to select clouds for seeding. The NRC found that Snowy Hydro is conducting the trial in compliance with the Act and has made progress in most areas previously identified by the NRC for improvement.

¹ *Snowy Mountains Cloud Seeding Trial Act 2004 No. 19* (New South Wales), at s. 4 (1).

² Section 8(1) of the Act.

³ Snowy Hydro Limited (2008), *Snowy Precipitation Enhancement Research Project – Environmental Management Plan*, June 2008.

⁴ Snowy Hydro Limited (2008), *Snowy Precipitation Enhancement Research Project – Annual Report 2007*.

⁵ Snowy Hydro Limited (2009), *Snowy Precipitation Enhancement Research Project – Annual Report 2008*.

⁶ Natural Resources Commission (2007), *Progress Report on the Snowy Mountains Cloud Seeding Trial, June 2007*.

Though the NRC found no evidence that the trial has had a significant environmental impact to date from the aspects that are monitored and reported annually, the NRC has recommended that Snowy Hydro:

- consider how the removal of potential control area will affect the experimental design and its ability to determine in 2010 whether the trial has been successful or not
- strengthen the ecotoxicity survey to assess the impact of silver contamination on benthic invertebrates and the accumulation of that contamination up food chains, across the broader catchment
- review the methodology for assessing snow density, as denser seeded snow may impact on the habitat of snow-dwelling fauna.

The mid-trial evaluation planned by Snowy Hydro for 2010 is the first time that evidence will be available to the NRC and the public on the affect of cloud seeding on downwind precipitation, stream flow and inflows to storages.

We found that Snowy Hydro's revisions to the Environmental Management Plan (EMP) have improved and broadened the environmental monitoring and reporting program for the trial. Snowy Hydro has released its Evaluation Plan⁷ for the original trial period and this plan augments the EMP by including peer reviewed methods for assessing the impacts of cloud seeding on downwind precipitation, and on stream flow and inflows to storages.

The NRC has sought assessment of these impacts as they are critical for determining whether or not cloud seeding is successful in producing additional water for power generation, irrigation and environmental flows in the Snowy, Murray and Murrumbidgee Rivers, and they remain of concern to the community. Snowy Hydro will report on these impacts twice: first in 2010 (after the completion of the original trial period) and then again in 2015 (after the completion of the extended trial period).

Recognising the progress that Snowy Hydro has already made to improve the conduct of the trial, this report also identifies some further improvements for Snowy Hydro to consider for future monitoring assessment and the mid-trial evaluation.

As previously recommended by the NRC, Snowy Hydro plans to use a 'before-after-control-impact' (BACI) approach to assess the impact of cloud seeding on stream flow and inflows to storages. However, Snowy Hydro should consider how extension of the trial area and removal of the control area in the experiment will affect the feasibility of using this approach.

Our review of Snowy Hydro's environmental reporting has identified that while the NRC found no evidence of a significant environmental impact, silver concentrations at generator sites are approaching the guideline trigger value and this limit may be exceeded within the duration of the trial. Given this trend, Snowy Hydro should consider methods to limit the build up of potential contaminants at generator sites.

Finally, two areas of assessment could be further improved. The NRC found that the design of the survey used to monitor silver and indium levels does not appear to have adequate statistical power to credibly support a conclusion that cloud seeding has had no 'significant adverse environmental impacts' across the entire trial area (beyond the generator sites). It is important that such strong claims be based on sufficient sampling. Snowy Hydro has already established

⁷ Snowy Hydro Limited (2009), *Snowy Precipitation Enhancement Research Project – Evaluation Plan*.

that the statistical power at generator sites is sufficient to detect significant increases in silver or indium concentrations at generator sites.

We have requested that the methodology for investigating snow density should be peer-reviewed, as most other aspects of the environmental reporting have been. Snow density is an important parameter because there is some evidence that seeded snow tends to be denser than unseeded snow and have smaller particles and this may impact on the habitat of snow-dwelling fauna.

1.2 Structure of this report

The remainder of this report discusses the NRC's findings in more detail:

- Chapter 2 focuses on the conduct of the trial, and describes the progress to date and the amendments to the trial
- Chapter 3 discusses what environmental impact information Snowy Hydro has reported on, and whether this information provides evidence that the trial is having adverse environmental impacts, and
- Chapter 4 discusses the NRC's suggestions for improving Snowy Hydro's environmental monitoring and reporting program.

2 Conduct of the trial

The NRC has reviewed Snowy Hydro's cloud seeding operations during the 2007 and 2008 winter seeding seasons to assess whether its conduct of the trial complies with the Act. We found that these operations did comply with the Act.

As Chapter 1 noted, the Act authorises Snowy Hydro to conduct a cloud seeding trial in the Snowy Mountains. The trial is designed to increase precipitation within a designated target area by discharging a seeding agent into passing clouds for a limited period. The Act sets out conditions related to the conduct of the trial, including what seeding agent can be used, when it can be used, where and how this agent may be discharged, and requirements to monitor and report on the cloud seeding operations and their effects on precipitation and the environment.

The sections below summarise the progress of the trial to the end of 2008, and explain the authorised amendments to the trial.

2.1 Progress of the trial

At the end of 2008, Snowy Hydro was five-sixths of the way through the original six-year period for the trial. It had completed 103 of the experimental units to evaluate the effectiveness of the original six-year trial. The NRC considers it is on track to complete the targeted number of 110 experimental units by the end of this period.

Snowy Hydro has not yet advised the NRC on how many experimental units will be required to evaluate the effectiveness of the extended 11-year trial.

2.2 Amendment of the trial

The NSW Parliament passed the *Snowy Mountains Cloud Seeding Trial Amendment (Extension) Act 2008* in May 2008. This amendment extended the period over which Snowy Hydro is authorised to conduct the trial from six to eleven years. It also extended the area over which cloud seeding activities can be undertaken by more than 1,000 square km, taking the total target area to around 2,000 square km.

These were the only amendments to the Act. All other conditions remain the same, including the circumstances in which the relevant Ministers⁸ may suspend or terminate Snowy Hydro's authorisation to conduct the trial.⁹

From a scientific point of view, the potential control area for the trial has now become part of the extended area of the trial. In the absence of a control in the trial, the feasibility of the before-after-control-impact (BACI) approach needs to be assessed.

⁸ Section 3 of the Act defines the relevant Ministers as the Ministers administering the *Environmental Planning and Assessment Act 1979* and Part 4 of the *National Parks and Wildlife Act 1974*. The relevant Ministers are currently the Minister for Climate Change and the Environment and the Minister for Planning.

⁹ Section 6(2)(a), (b) and (c).

3 Environmental information reported and whether this shows the trial is having significant impacts

The environmental impacts of cloud seeding are largely unknown as limited environmental monitoring has been undertaken for other cloud seeding trials around the world. Some of the potential impacts include altered snowfall and rainfall patterns, a build up of potentially toxic cloud seeding chemicals within the environment, and disturbance of the natural environment due to the installation and removal of cloud seeding infrastructure. For this reason, Snowy Hydro is required to implement an environmental management plan, including a monitoring program that covers a sufficient range of indicators to allow any adverse impacts to be detected. It is also required to report against these indicators annually.

The NRC has reviewed the environmental information Snowy Hydro provided in its 2007 and 2008 annual reports to assess whether it reported on an appropriate range of environmental impacts, and whether this information indicates that the trial has had a significant environmental impact to date. We found that the information covered a broader range of impacts than in previous years, and was transparent and consistent with the NRC's observations within Kosciuszko National Park. We also found that Snowy Hydro has addressed many of our previous recommendations.

The impacts reported on included those on precipitation, montane riverine ecosystems, habitat for snow-dwelling fauna, ecotoxicity levels, and ammonia and oxides of nitrogen pollution. Impacts on downwind precipitation and inflows to storages were not reported as Snowy Hydro will report on these impacts twice during the trial: first following the end of the original trial period (2010) and again at the end of the extended trial period (2015). The details of the proposed methodologies for these assessments are included in the Evaluation Plan for the original trial period.

We also found that the information provided in the 2007 and 2008 annual reports contains no evidence to suggest the cloud seeding trial has resulted in a significant environmental impact within the Snowy Mountains to date. However, we suggest peer review of the methodology for investigating snow density, and greater sampling and assessment of cumulative impacts of silver contamination on benthic invertebrates and in food chains across the wider catchment and target area.

The sections below discuss each of the impacts reported on, and what the information provided indicates about this impact.

3.1 Impact on precipitation

One of the conditions specified in the Act is that precipitation resulting from cloud seeding operations must fall as snow (not rain) to ensure the operations do not adversely affect resort operators during the ski season. Snowy Hydro must report on its monitoring of this requirement within each annual report.

The 2007 and 2008 reports provide information about the monitoring undertaken during these seasons. These data suggest that precipitation during seeding events did fall as snow and not rain.

3.2 Impact on montane riverine ecosystems

Snowy Hydro's cloud seeding operations could potentially have a beneficial impact (if it improves stream flow) and/or an adverse impact (if it causes ecotoxicity) on riverine ecosystems in the Snowy Mountains. If so, this impact may result in changes in macroinvertebrate and fish communities in alpine and montane streams. To monitor the impact on these ecosystems, Snowy Hydro commissioned The Ecology Lab Pty Ltd (the Ecology Lab) to undertake studies of macroinvertebrate and fish communities in these streams. It reported the findings of these studies in the 2007 and 2008 annual reports.

The macroinvertebrate studies undertaken during 2007 and 2008 did not indicate any evidence of impacts due to the cloud seeding trial. The NRC commissioned a peer review of the macroinvertebrate study¹⁰ included in the 2007 annual report, which found that the methodology and analysis undertaken for this study were sound and supported the findings of no impact on stream macroinvertebrate populations. The NRC did not commission a peer review for the macroinvertebrate report included in the 2008 annual report as we have a high level of confidence in the work reported.

The desktop fish study was undertaken for the 2007 season and did not reach any concrete conclusions about the impact of cloud seeding on the abundance and distribution of fish populations. However, it noted that it is difficult to assess the impact of cloud seeding on fish populations due to the lack of knowledge about native fish populations and the historic and current distribution of these fish populations. It also acknowledged that previous anthropogenic influences and the introduction of alien fish species have had a major effect of fish populations within the study area.

3.3 Impact on habitat for snow-dwelling fauna

Snowy Hydro monitored several first order impacts that may affect the habitat of snow-dwelling fauna. Its 2007 and 2008 annual reports provided data and analysis on the impact on snow density and late season snowfall.

3.3.1 Snow density

There is anecdotal evidence that seeded snow tends to be denser than unseeded snow and have smaller particles.¹¹ This may reduce subnivean space¹² which may impact on the habitat of snow-dwelling fauna. Snowy Hydro is monitoring snow density in the trial target area, and engaged the Ecology Lab to do a statistical evaluation of snow density data to evaluate the density of seeded and unseeded snowfall.

Ecology Lab found that in 2007 there was no significant difference between the density of seeded and unseeded snowpack. In 2008, it found that the density of seeded snowfall was marginally greater than unseeded snowfall. The results of the 2008 investigation infer that the density differences were small and within the range of natural variation.

¹⁰ Peer review undertaken by Professor Gary Jones and Professor Richard Norris of eWater CRC.

¹¹ Refer to Section 12.16.2 Effects of Seeding on Snow Density, of *Expert Panel Assessment of Snowy Precipitation Enhancement Trial, Report for Snowy Hydro Limited, Cooma, Environ (2003)*.

¹² Subnivean space is the space between the ground and the underside of the snowpack.

The NRC commissioned a peer review of the 2007 snow density investigation.¹³ The review concluded that the results of the Ecology Lab's snowy density investigation are not valid. This is because the data for the investigation were unbalanced and pooled, and there was a lack of measurement of other variables. The peer reviewers noted that snow density is measured as the ratio of the volume of melt water that can be derived from a sample of snow to the original volume of the sample – that is, it is the specific gravity of the snow sample. They also noted that snowpack density depends on the snowflake characteristics, as well as the temperature and other variables.

Subsequently, we suggest that the methodology for investigating snow density be peer-reviewed. This would ensure that snow density investigations would have a level of credibility on par with other aspects of the environmental reporting, which have mostly been peer reviewed. Snow density is an important parameter because there is anecdotal evidence that seeded snow tends to be denser than unseeded snow and have smaller particles and this may impact on the habitat of snow-dwelling fauna.

3.3.2 Late season snowfall

In recent years the snowpack has tended to melt relatively early in the season, and be followed by one or more snow events late in the season. Cloud seeding could be beneficial if it delays early season snow melt. Alternatively, it could be detrimental to the hibernation patterns of small mammals if it contributes to late season snow events following significant snow melt.

Snowy Hydro analysed snow course data from Spencers Creek and White's River. This shows that cloud seeding has not occurred after snow has completely melted at Spencer's Creek. It also found that there has only been one occasion recorded where complete snow melt has occurred before cessation of cloud seeding operations at White's River, however this was during a season of extremely low snow fall. Consequently, cloud seeding so far has not delayed snow melt or induced re-hibernation at Spencers Creek, and it is unlikely to have done so at White's River. It is unlikely to have had either a beneficial or a detrimental affect on hibernation patterns.

Snowy Hydro notes that it is not possible to reliably determine statistically significant patterns at White's River given the limited period of data on record. In addition, it notes that an objective assessment of impacts on precipitation patterns can only be undertaken following evaluation of the trial, and an effect of cloud seeding as been demonstrated.

3.4 Ecotoxicity impacts

Snowy Hydro uses silver as the cloud seeding agent and indium as the tracer agent. It is possible that these chemicals may build up in the environment at the generator sites and other areas impacted by cloud seeding. If they reached sufficient concentrations they could have adverse environmental effects. Snowy Hydro monitors the levels of each chemical through an ecotoxicity survey. This involves taking and analysing soil and water samples from a number of sites across the cloud seeding areas to measure the silver and indium concentrations.

3.4.1 Silver and indium concentrations

The information provided in the 2007 and 2008 annual reports indicates that Snowy Hydro has not detected a significant ecotoxic impact from cloud seeding to date. Concentrations of silver and indium in both soils and potable water from sampling undertaken following the 2007 and

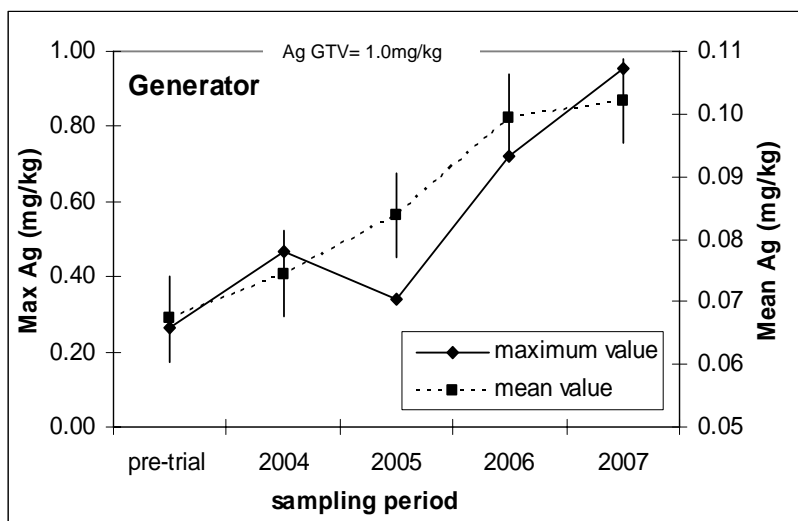
¹³ Peer review undertaken by Dr Roger Stone and Dr Peter Moulds of the University of Southern Queensland.

2008 seeding seasons were below the relevant GTVs. Concentrations of silver and indium in soils and water from the 2008 and season were also below the relevant GTVs, except for two soil samples collected from the Granite Knob generator site, which were above the GTV for silver. Bioavailability analysis was undertaken on these samples and the bioavailable silver was found to be well below the GTV.

From its analysis, Snowy Hydro notes that there are some increasing trends for concentrations of silver and indium through time. This is evident in soil samples collected from generator sites and is mostly notable at the Granite Knob generator site. The strongest increasing trends are for silver concentrations in soil at generator sites, however we also noted that indium appears to be accumulating at generator sites at a faster rate than within other areas. If this rate of accumulation continues, the soil silver GTV will be exceeded at certain generator sites before the end of the trial.

We suggest that Snowy Hydro should carefully examine this contamination issue, especially given that the cloud seeding trial will now continue for an additional five years. It should develop procedures to minimise localised deposition of silver from generators. It should also investigate the impacts of localised silver contamination, and how to address them. For example, the impact of silver contamination on benthic invertebrates that provide a critical link in the food chain by supporting higher organism like fish and birds.

Figure 3.1 Trends in the concentration of silver in soil at generator sites*



* The mean and maximum concentrations for silver in 2008 have not been included in the above graph as NRC did not have electronic access to the raw data at the time of finalising this report.

3.4.2 Ammonia and oxides of nitrogen pollution in alpine lakes

The Department of Environment and Climate Change (DECC) recently undertook research that identified elevated concentrations of ammonia in some alpine lakes within the Snowy Mountains but the cause of increased concentrations was unclear.

Snowy Hydro engaged the Ecology Lab to undertake a study of ammonia and oxides of nitrogen (NOx) concentrations in seeded and unseeded snow samples. A report on the findings was included in the 2007 annual report. This analysis did not detect a difference in ammonia and NOx concentrations in modified and natural snowfall and concluded that cloud seeding is not increasing nitrogen deposition in alpine lakes.

The NRC commissioned a peer review of the Ecology Lab's investigation¹⁴ which found that the methods for sample analysis, statistical analysis and interpretation appear to be appropriate and supported the findings of the investigation.

¹⁴ Peer review undertaken by Professor Gary Jones and Professor Richard Norris of eWater CRC.

4 Suggestions for future monitoring and reporting

As Chapter 1 noted, Snowy Hydro has addressed many of our previous recommendations and has revised its EMP in response to the extension of the trial. The revised EMP improves and broadens the environmental monitoring and reporting program for the trial. The NRC considers that the revised EMP provides a reasonable framework for measuring and reporting on the environmental impact of the cloud seeding trial, and we support the full implementation of this plan. Snowy Hydro has released its Evaluation Plan¹⁵ for the original trial period and this plan augments the EMP by including peer reviewed methods for assessing the impacts of cloud seeding on downwind precipitation, and on stream flow and inflows to storages.

We have made some suggestions for Snowy Hydro to consider that may further enhance implementation of, and reporting on the EMP. These relate to the design of the ecotoxicity survey, and the methodologies for monitoring impacts on stream flow and inflows to storages. The sections below discuss these suggestions in more detail.

4.1 Reporting on the revised EMP

The revised EMP requires Snowy Hydro to continue monitoring and reporting on the environmental impacts covered by the existing EMP, as well as on some additional impacts. It also specifies improvements to some elements of the monitoring program. In particular, the revised EMP:

- Enhances the ecotoxicity monitoring program. These enhancements are discussed further in section 4.2 below. While the NRC still has some concerns about this program, it notes that Snowy Hydro has committed to working with DECC to further improve it.
- Includes a new aquatic ecology monitoring program. Snowy Hydro will undertake ongoing monitoring of aquatic ecology (macroinvertebrates) in collaboration with DECC.
- Enhances the potable water monitoring program, which will now include additional sampling following major run-off events impacting on potable water supply storages.
- Enhances the analysis of late season snowfall patterns and snow cover extent. Snowy Hydro will undertake further analysis using data provided by DECC and this information will be reported in future annual reports.
- Includes ongoing monitoring, analysis and reporting of snow density.
- Indicates that Snowy Hydro may report on beneficial impacts. The EMP states that Snowy Hydro supports research by DECC on threatened species through various initiatives outside the EMP and, where relevant to the cloud seeding trial, the outcomes of this research will appear in future annual reports.

The NRC is pleased to note that in revising the EMP, Snowy Hydro has responded to some of the recommendations we made in our last report, and to suggestions made by DECC.

4.2 Reporting on ecotoxicity

While we acknowledge that Snowy Hydro has improved its ecotoxicity survey design, we still have some remaining concerns about this matter. In our 2007 report, we noted that as it was currently designed, the ecotoxicity survey did not provide credible evidence to support

¹⁵ Snowy Hydro Limited (2009), *Snowy Precipitation Enhancement Research Project – Evaluation Plan*.

unqualified claims about the trial having no significant environmental impacts. To make such a claim, particularly in relation to ecotoxicity impacts, the ecotoxicity survey design would need to be amended to increase its statistical power and make it more representative of the intermediate, target and downwind areas.

Snowy Hydro increased the number of samples collected from designated sites following the 2006 and 2007 seasons, but it has not increased the number of sites sampled. Snowy Hydro also commissioned the Ecology Lab to determine the statistical power of the data to detect changes that may be environmentally significant. The Ecology Lab's analysis was confined to generator sites and concluded that "there was a strong likelihood that an increase [in silver or indium concentrations] would be detected statistically well before the GTV was reached" at these sites.

However, the NRC's concern regarding the statistical power of the ecotoxicity survey design relates principally to the target area, and not the generator sites that the Ecology Lab focused on. The expansion of the trial, especially the doubling of the target area, has increased this concern, as it may not be feasible for Snowy Hydro to sample sufficient sites in an area of more than 2,000 square km at sufficient intensity to reach a conclusion of 'no impact' of silver or indium contamination.

The NRC has previously noted that it is unlikely that the precipitation of silver will occur uniformly across the target area. Some sites are preferential areas of precipitation and potential accumulation. Unless Snowy Hydro can develop an alternative monitoring approach and demonstrate that its ecotoxicity monitoring activities are able to detect contamination downwind of generator sites, the conclusions it draws from the ecotoxicity survey of the intermediate, target and downwind areas should be heavily qualified.

4.3 Reporting on impacts on downwind precipitation and inflows to storages

As discussed above, Snowy Hydro will report on the trial's impacts on downwind precipitation and inflows to storages in 2010, after completion of the original trial period and again in 2015 (following conclusion of the trial period). The EMP indicates that the end-of-trial reporting will include assessments of changes in stream flow and the effects of cloud seeding on downwind precipitation. The methods for these analyses have been included in the Evaluation Plan¹⁶ for the original trial period, which forms part of the 2008 annual report.

The monitoring and reporting of these impacts is important. The impact of cloud seeding on downwind areas is uncertain. Rainfall patterns may be altered, which could lead to an increase or a reduction in downwind precipitation. If cloud seeding generates significant additional amounts of snowfall there should be increases in water flows in the Murray, Murrumbidgee and Snowy River catchments.

As previously recommended by the NRC, Snowy Hydro has adopted a 'before - after - control - impact' (BACI) approach in the Evaluation Plan to assess the impacts on stream flow and inflows to Snowy Mountains Scheme storages. However, Snowy Hydro should consider how

¹⁶ Two evaluation plans will be prepared for the trial, one for the original trial period and one for the extended trial. These plans will describe analysis that is required to be undertaken at the end of the trial, including methodologies for analysing the impact on downwind precipitation and inflows to storages.

extension of the trial will affect the feasibility of using this approach as extension of the target area will encroach into the proposed 'control' catchment.

Prior to the extension of the trial, a BACI design could be adopted using the Murrumbidgee River catchment storages as the 'control' area, and the Murray River and Snowy River catchment storages as the 'impact' area. Long running inflow data for those storages collected prior to 2004 would constitute the 'before' component, and inflow data collected after 2004 would be the 'after' component for the assessment.

However, with the extension of the trial, the Murrumbidgee River catchment now constitutes an 'impact' area, and so can no longer be used as a 'control' area. As there do not appear to be other areas that could be used as a 'control' area, it is not clear how a BACI assessment can be undertaken.

