

## **Research & Development—cloud seeding; climate change; and water resources**

### **Cloud seeding and climate modification**

#### **What is cloud seeding?**

- 7.1 Cloud seeding<sup>1</sup> is a procedure to attempt to artificially generate precipitation from clouds. It may attempt to produce rain or snow when none would fall naturally, or it may attempt to increase the amount of rain or snow which falls over a particular area.
- 7.2 Clouds are made up of millions of water droplets. When these tiny droplets join with particles (also called cloud nuclei) which are present in the atmosphere they become heavy enough to fall to the ground as raindrops, snowflakes or hailstones. These particles may be dust, salt from evaporated sea spray, sand or other material from forest fires, volcanic eruptions and pollution.

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1 This explanation of cloud seeding and the background to cloud seeding in Australia is largely taken from the CSIRO web site [http://www.dar.csiro.au/publications/holper\\_2001c.htm](http://www.dar.csiro.au/publications/holper_2001c.htm) accessed on 16 September 2003. The submissions from Hydro Tasmania (no. 40) and Snowy Hydro (no. 55) contain brief descriptions of cloud seeding and some history of cloud seeding in Australia. A detailed description of the Australian experience with cloud seeding is contained in “*Guidelines for the utilisation of cloud seeding as a tool for water management in Australia*” published by the Agriculture and Resource Management Council of Australia and New Zealand in May 1995.

- 7.3 Under cold conditions in clouds, droplets of water form ice crystals on the surfaces of the particles. Water vapour in the cloud then freezes directly onto the surface of these crystals, which become heavier and eventually fall.
- 7.4 Cloud seeding from a plane uses silver iodide burners, dry ice pellets or hygroscopic flares. Clouds can be seeded from the ground using silver iodide generators.

### History of cloud seeding in Australia

- 7.5 Americans made the discovery in 1946 that pellets of dry ice could induce precipitation from clouds. The following year cloud seeding experiments commenced in Australia with CSIRO scientists using aircraft to drop dry ice into the tops of cumulus clouds.
- 7.6 During the late 1950s and early 1960s, CSIRO performed large-area cloud seeding trials in the Snowy Mountains, on the York Peninsular in South Australia, in the New England district of New South Wales, and in the Warragamba catchment area west of Sydney.
- 7.7 Of these four experiments, only the one conducted in the Snowy Mountains produced statistically significant rainfall increases over the entire experiment.
- 7.8 Between 1965 and 1971, the State Governments of Victoria, New South Wales, Queensland, South Australia and Western Australia all undertook cloud seeding operations. However, in all cases where the analysis of the seeding operations was possible the results were inconclusive.
- 7.9 The CSIRO's trials in Tasmania in the 1960s were more successful, achieving significant rainfall increases. Since that time Hydro Tasmania has regularly undertaken seeding in mountainous parts of the State (see para 7.14 for more details on Tasmania).
- 7.10 In 1972-75 CSIRO conducted cloud seeding experiments in Emerald, Queensland, and in 1979-80 in Western Victoria. The Western Australian Government ran trials in 1980-82 to test the viability of seeding in the northern wheat belt.
- 7.11 None of these activities found that seeding would be an economical, reliable way of increasing rainfall. A major problem in marginal areas was that aircraft costs were rising much more quickly than wheat prices, which impacted on the cost/benefit ratio.

- 7.12 Between 1988 and 1992 CSIRO acted as scientific advisor to Melbourne Water in a cloud seeding assessment conducted over the Baw Baw plateau, a major water catchment area about 120 kms east of Melbourne. The results of analyses of the rain gauge network showed that any increase in rainfall was not statistically significant.<sup>2</sup> Other tests for the buffer area between the target and the control areas showed a statistically significant increase, although the reasons for this are not understood.<sup>3</sup>
- 7.13 In 1994, Hydro Tasmania was retained by the NSW Government to undertake a 12 week cloud seeding program in an area north of Tamworth NSW for drought relief. Although rainfall was consistently recorded throughout the program, this operation was not conducted as a formal scientific trial so there was no conclusive evidence of the actual increases in rainfall due to the cloud seeding.

#### Tasmania

- 7.14 Tasmania has had the most practical experience in Australia with cloud seeding. The submission from Hydro Tasmania provides the following outline of cloud seeding activities in Tasmania from 1964 to the present.<sup>4</sup>

##### **Stage 1 - 1964-1971**

This was an alternate year trial over Tasmania's Central Plateau providing randomisation on a seed / no-seed 1:1 ratio, using silver iodide. This trial was designed and assessed by CSIRO. From this trial it was concluded that there was strong statistical evidence that seeding increased rainfall by estimated values of 30% in Autumn and 12% in Winter. The experiment was concluded in 1971 when the reservoirs were full.

##### **Stage II - 1979 – 1983**

This experiment over the same catchment area used a ratio of suitable seeded / unseeded days at 2:1 to provide randomisation with clouds seeded every year. Silver iodide was used as the seeding agent and the work was done in conjunction with CSIRO. The results of this experiment showed increases in rainfall attributable to cloud seeding in the order of 37%.

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2 Agriculture and Resource Management Council of Australia and New Zealand “*Guidelines for the utilisation of cloud seeding as a tool for water management in Australia*”, May 1995, p. 7.

3 Agriculture and Resource Management Council of Australia and New Zealand “*Guidelines for the utilisation of cloud seeding as a tool for water management in Australia*”, May 1995, p. 10.

4 Submission no. 40, p. 6.

### **Drought Relief Operations - 1988-1991**

During this period all suitable cloud was seeded over Hydro Tasmania's catchments.

### **Stage III - 1992 –1994**

This trial was very similar to Stage II except that dry ice was used as the seeding agent. This experiment found statistically significant increases in rainfall due to seeding but the magnitude and temporal duration of this was less than Stage II.

### **Drought Relief – Spring 1994 and 1995**

Hydro Tasmania conducted drought relief operations over the agricultural areas of Tasmania's midlands and east coast.

### **Operational Seeding – 1998 to present**

Currently cloud seeding is being undertaken in operational mode. All suitable cloud over designated hydro catchments is seeded between April and November each year during both night and day. Silver iodide is used as the seeding agent.

- 7.15 The submission from Mr Ian Searle, who had many years practical experience in cloud seeding with Hydro Tasmania, gave an indication of the costs involved. Mr Searle noted that, as a guide, the Tasmanian cloud seeding operation comprising one aircraft and 3 full time staff operating over an area of 6,000 sq. kms, cost a little over \$1 million per annum.<sup>5</sup>

### **The current situation**

- 7.16 By 1995 the CSIRO appears to have reached the conclusion that, except in a few areas such as Tasmania and possibly the Snowy Mountains, Australia does not have weather conditions suitable for cost-effective cloud seeding.
- 7.17 The CSIRO decided that it would maintain a 'watching brief' on international developments in relation to cloud seeding, but that it would not be a priority area of research until more potential benefits were apparent. The CSIRO expressed its position in the Guidelines, as follows:

Given the current priorities for atmospheric research in CSIRO, the study of weather modification techniques must compete with funds for research into climate change, climate variability and air

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5 Submission no. 31, p. 16.

pollution studies. It is likely that any substantial research into this area in the future will be initiated by the Water Industry and will require substantial support from that body. However CSIRO will retain its expertise in the fundamental cloud physics necessary to evaluate any studies undertaken by the Water Industry.<sup>6</sup>

- 7.18 In May 1995 the Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ) published the “*Guidelines for the utilisation of cloud seeding as a tool for water management in Australia.*” The guidelines were drawn up by Dr B. Ryan, Principal Research Scientist, CSIRO Division of Atmospheric Research, and Dr B. Sadler, Executive Director Water Resources of the Water Authority of Western Australia. According to the publication:

“The guidelines ... have been developed to aid planning and decision-making for water managers in effective partnership with atmospheric scientists and commercial operators... recommend the disciplines to be followed in the planning and implementation of a cloud seeding experiment that seeks to maximise the opportunities for defining and achieving a successful outcome.<sup>7</sup>

- 7.19 These Guidelines are designed to ensure that at the conclusion of any cloud seeding operations there would be a clear understanding as to the results achieved in terms of increased precipitation. The Guidelines, as issued, are comprehensive and would normally involve a trial period of some years to gather conclusive evidence of increased precipitation.

- 7.20 Many of the submissions to the Inquiry which raised the issue of cloud seeding supported a greater effort by the Commonwealth in that regard. Typical was the comment made by Coleambally Irrigation Cooperative:

Whilst we have listened to both sides of the debate (on cloud seeding) with interest we are concerned that this science has not been given open consideration. I feel Australia would benefit from an open debate on this technology as a real response to drought and climate change.<sup>8</sup>

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6 Agriculture and Resource Management Council of Australia and New Zealand “*Guidelines for the utilisation of cloud seeding as a tool for water management in Australia*”, May 1995, p. 12.

7 Agriculture and Resource Management Council of Australia and New Zealand “*Guidelines for the utilisation of cloud seeding as a tool for water management in Australia*”, May 1995, p. 12.

8 Submission no. 29, p. 1.

7.21 Similarly, the submission from the Coordinating Committee of the Namoi Valley Water Users' Association Inc. called on governments to immediately implement cloud seeding trials.<sup>9</sup>

7.22 Mr Lawrence Arthur, Chairman of Irrigators Inc. told the Committee that about 40 cloud seeding operations in the USA are funded by private capital, (although he gave no indication that private companies were willing to fund such operations in Australia). He continued:

We are all aware that these sorts of groups look very hard at their budgets. So if there were not the benefits in cloud seeding, why would these private organisations want to be funding it?

7.23 On the other hand, a number of submissions advised caution, based Australia's poor experience with cloud seeding. The submission from the Queensland Government made the following comment on the prospects for cloud seeding in Australia:

The low frequency of appropriate meteorological conditions make the prospects for success very limited ... weather modification must compete for research funding with more pressing and perhaps more useful climate variability and climate change research.<sup>10</sup>

7.24 The submission of the Western Australian Government also expressed its reservation, as follows:

Western Australia does not believe the Commonwealth Government should be involved in climate modification programs such as cloud seeding as this approach is at best of marginal value and appears to be treating a symptom rather than addressing the challenge of adaptation and better planning under greater uncertainty.<sup>11</sup>

#### **CSIRO's position on cloud seeding**

7.25 The Committee sought to clarify the CSIRO's current thinking on research into cloud seeding at the public hearing on 25 June 2003. In response to a question, Dr. Brian Ryan, Leader, Earth Systems Modelling Program of the Division of Atmospheric Research commented:

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9 Submission no. 95, p. 1.

10 Submission no. 129, p. 23.

11 Submission no. 117, p. 5.

No, there has been no research effort in Australia ... within CSIRO the priorities have been in developing weather applications and climate in a particular area ... We have kept a watching brief on the state of weather modification. If we were to re-establish it in Australia, it would be a massive effort.<sup>12</sup>

- 7.26 The Committee sought further clarification from Dr Ryan as to what would be involved for the CSIRO to recommence research into cloud seeding. He responded:

If you are asking me to speak honestly in terms of what it would require, CSIRO itself would not actually have the capacity to undertake all the various areas concerned. For example, if you look at what is happening in places like the US, I am sure, if it starts up, there will be a whole lot of technologies—radar and those sorts of things—which currently we would certainly not have the ability to use. It would actually take a wide range of skills to be able to do it.<sup>13</sup>

- 7.27 Following a number of inconclusive trials (except Tasmania) over more than three decades, the CSIRO decided that other areas of research presented greater returns in cost/benefit to Australia.

- 7.28 The Committee received evidence suggesting that the CSIRO is against private investment in cloud seeding. For example, these comments by Mr Arthur of Irrigators Inc:

It is also worth commenting that there is a strong view in the community that the CSIRO see any private investment in cloud seeding to be in direct competition with their access to government funds. That is a commonly put view that I have heard in various groups trying to push the cause for cloud seeding. That does cause me some concern.<sup>14</sup>

- 7.29 The CSIRO advised the Committee that it was definitely not opposed to private cloud seeding initiatives. It explained that, while cloud seeding has not been a priority research area for the CSIRO in recent years, they are very willing to provide advice to any privately-funded cloud seeding operations so that the results of such operations can be scientifically verified.

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12 Transcript of evidence, p. 462.

13 Transcript of evidence, p. 463.

14 Transcript of evidence, p. 519.

## Review of cloud seeding by American National Academy of Sciences

- 7.30 At the public hearing on 25 June 2003, the CSIRO's Dr Ryan advised the Committee that the American National Academy of Sciences was undertaking a comprehensive review of cloud seeding, and that the results of that review would be available in a few months.
- 7.31 The committee established by the Academy to conduct the review published its report titled '*Critical Issues in Weather Modification Research*' in October 2003. The review committee concluded:
- The Committee concludes that there still is no convincing scientific proof of the efficacy of intentional weather modification efforts. In some instances there are strong indications of induced changes, but this evidence has not been subjected to tests of significance and reproducibility.<sup>15</sup>
- 7.32 Media reports noted the review's conclusion that there is no scientific evidence that cloud seeding works, in spite of the millions of dollars spent around the world on cloud seeding operations. The Canberra Times quoted the President of the National Centre for Atmospheric Research, Colorado, as saying "To some extent weather modification is an act of faith with people. In terms of precipitation on the ground, there's no compelling evidence."<sup>16</sup>
- 7.33 The American National Academy of Sciences review noted that funding for research into weather modification in the USA had fallen from US\$20 million per annum in the late 1970s to less than US\$0.5 million p.a. now.
- 7.34 The review called for a coordinated national research program to, once-and-for-all, determine if cloud seeding works. Such a program would "address the fundamental questions that will lead to credible scientific results ... in time, this research will place us in a position to determine whether, how, and to what extent weather and weather systems can be modified."<sup>17</sup>

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15 American National Academy of Sciences website accessed 15 October 2003  
[http://www.nap.edu/catalog/10829.html?onpi\\_topnews\\_101303](http://www.nap.edu/catalog/10829.html?onpi_topnews_101303)

16 The Canberra Times, 15 October 2003, '*Millions spent on rainmakers – no evidence that it works*', p. 15,

17 American National Academy of Sciences website accessed 15 October 2003  
[http://www.nap.edu/catalog/10829.html?onpi\\_topnews\\_101303](http://www.nap.edu/catalog/10829.html?onpi_topnews_101303)



## The Snowy Hydro program

- 7.35 The Snowy Mountains has been regarded as having relatively good potential for cloud seeding operations. In its submission, Snowy Hydro Limited set out the background to past cloud seeding attempts, and argued that a properly conducted cloud seeding trial should be attempted again.<sup>18</sup>
- 7.36 The CSIRO conducted experiments in the Snowy Mountains from 1955-59. Preliminary results looked promising, but later were regarded as inconclusive because of perceived shortcomings in the design of the experiment.
- 7.37 A study in 1986 and field investigations during the winters of 1988 and 1989 indicated positive prospects, and preliminary plans were made for a more detailed trial. However those plans were shelved due to concerns raised by three groups— by environmental groups concerned about possible impact on wilderness areas of the Kosciuszko National Park; by ski resort operators concerned that the increased precipitation could fall as rain rather than as snow; and by downwind farmers concerned that they could be deprived of rainfall.
- 7.38 Snowy Hydro has identified a long term downward trend in precipitation in the Snowy Mountains region. They believe that cloud seeding provides an economic and viable method to counter that trend. Their submission states:
- The estimated increase in runoff from a fully operational program is estimated to be well over 100 gigalitres per year based on a 6% increase. Some of this would flow directly into the River Murray as the snow melted, most would be regulated for release to the River Murray during drier months.<sup>19</sup>
- 7.39 Representatives of Snowy Hydro appeared before the Committee at a public hearing on 20 August 2003. Mr Terry Charlton, Snowy Hydro's Chief Executive Officer, told the Committee that he was confident that cloud seeding would produce positive results:
- We are looking at a six-year experiment. We do not use the word 'experiment' among ourselves because we know it is going to work. We are very confident of that. But the word 'experiment' is there because we do want to gather data. We do want access to the
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18 Submission no. 55, p. 3.

19 Submission no. 55, p. 4.

park in a way that we can validate the conclusions that we are drawing and the confidence that we have. Clearly the board, after a period of time, is going to want to know that the \$5 million or \$6 million a year has been reasonably well spent.<sup>20</sup>

7.40 In response to a question of whether the benefit of the proposed cloud seeding trial outweighs the cost, Mr Charlton said:

Yes, it does. That is why we are prepared to do it without asking for any assistance. The bottom line is that we are looking at a minimum of 12 events a year, up to 20. We are looking at an extra 15 centimetres in snow pack, an extra three to five days in fall—nothing more than that—which is well within natural variation. We are looking at 100 to 150 gigalitres extra water run-off eventually and available for turbinning. That means a revenue of somewhere around \$12 million for the \$5 million that we are prepared to put in.<sup>21</sup>

7.41 Snowy Hydro assured the Committee that the cloud seeding program it proposed addressed the three concerns expressed earlier—wilderness areas will be excluded from the program; cloud seeding will only take place when snow can be guaranteed; and studies have confirmed that cloud seeding has a negligible impact on normal precipitation downwind of seeded areas.

7.42 On 25 February 2004 the NSW Minister for Agriculture and Fisheries announced that the NSW Government had agreed to Snowy Hydro's cloud seeding plans. Legislation to enable the six-year trial to take place was introduced into NSW State Parliament, and approved on 7 April 2004. The Snowy Hydro cloud seeding program is scheduled to commence in the winter of 2004.

7.43 The Committee fully supports the cloud seeding trials by Snowy Hydro. This is potentially a very significant win/win situation—the proposed cloud seeding operations will not be an impost on the taxpayer, and the projected gain of more than 100 GL would be a very significant boost to the River Murray system.

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20 Transcript of evidence, p. 621.

21 Transcript of evidence, p. 621.

- 7.44 Snowy Hydro normally supplies about 550 GL annually to each of the Murray and Murrumbidgee Rivers, so the estimated increase through cloud seeding of 100 – 150 GL represents an overall increase of between 10 percent and 15 percent, which would be of great potential benefit both to environmental flows and to irrigators.<sup>22</sup>
- 7.45 The Committee understands that the CSIRO and the Bureau of Meteorology have both been involved in designing Snowy Hydro's cloud seeding program. These bodies should be closely involved throughout, to ensure that the trial is based on sound scientific principles so that, at the end of the period, the results in changed snowfall can be conclusively proven.

### Future developments

- 7.46 The last 15 years or so have seen significant technical advances in meteorology, in areas such as the use of computers, radar and satellites. The American Academy of Sciences review of cloud seeding described these developments, as follows:

Despite the lack of scientific proof, the Committee concludes that scientific understanding has progressed on many fronts since the last National Academies' report and that there have been many promising developments and advances. For instance, there have been substantial improvements in the ice-nucleating capabilities of new seeding materials.

Recent experiments using hygroscopic seeding particles in water and ice (mixed-phase) clouds have shown encouraging results, with precipitation increases attributed to increasing the lifetime of the rain-producing systems. There are strong suggestions of positive seeding effects in winter orographic glaciogenic systems (i.e., cloud systems occurring over mountainous terrain).

Satellite imagery has underlined the role of high concentrations of aerosols in influencing clouds, rain, and lightning, thus drawing the issues of intentional and inadvertent weather modification closer together.

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22 Transcript of evidence, p. 624.

This and other recent work has highlighted critical questions about the microphysical processes leading to precipitation, the transport and dispersion of seeding material in the cloud volume, the effects of seeding on the dynamical growth of clouds, and the logistics of translating storm-scale effects into an area-wide precipitation effect.<sup>23</sup>

- 7.47 Water is a vital resource in a dry continent such as Australia, and the Committee feels strongly that all aspects of water availability and use should be continuously explored.
- 7.48 The Committee believes that Australia needs to be at the forefront of researching and verifying the prospects for cloud seeding and that, given the willingness of Snowy Hydro to invest in cloud seeding in the Snowy Mountains region, this would be an opportune time for the Commonwealth Government to revisit this subject. The question is how to do so in the most efficient and effective way?
- 7.49 The submission from the Centre of Dynamical Meteorology and Oceanography (CDMO) of Monash University canvasses the possibility of creating a Cooperative Research Centre (CRC) to coordinate research into cloud seeding. The submission states:
- CRCs are designed to have a seven-year lifetime ... partnership between industry, universities and government laboratories allows for the research to respect both commercial interests and scientific integrity ... Such a proposal would also clearly fall under the government's research priority of sustainability.<sup>24</sup>
- 7.50 The CRC Programme was established in 1990 to improve the effectiveness of Australia's research and development effort. It links researchers with industry to focus R&D efforts on progress towards utilisation and commercialisation. The close interaction between researchers and the users of research is a key feature of the programme.<sup>25</sup>
- 7.51 Following completion of the 2002 selection round, there are 71 CRCs operating in 6 sectors: environment, agriculture, information and communications technology, mining, medical science, and technology and manufacturing.

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23 American Academy of Sciences report '*Critical Issues in Weather Modification Research*', October 2003.

24 Submission no. 123, p. 1.

25 CRC web site [www.crc.gov.au](http://www.crc.gov.au) accessed on 17 September 2003

- 7.52 Over the past 12 years, participants have committed more than \$7 billion (cash and in-kind) to CRCs. The major contributions have come from— Australian Government (\$1.8 billion), universities (\$1.8 billion), industry (\$1.3 billion), and almost \$1 billion by CSIRO.<sup>26</sup>
- 7.53 The CDMO submission suggests that a CRC into climate modification could investigate the following areas as part of its research program:
- the feasibility, viability and expense of cloud-seeding programs in the Snowy Mountains and other parts of Australia,
  - the hypothesis that regional pollution has already been affecting precipitation,
  - the potential downwind and secondary effects of cloud seeding,
  - hail suppression and other weather modification techniques,
  - implementation strategies to optimize the operation of the existing program at Hydro Tasmania.<sup>27</sup>
- 7.54 The CSIRO is positively disposed towards the CDMO's suggestion because it would test the real interest in cloud seeding in both the wider scientific community and in the commercial sector. In commenting on the CDMO proposal Dr Ryan said:
- I note that one of the submissions to your committee was from Monash University suggesting ... a CRC. I think the attraction of that would be that it actually would require hard business sense. To create a CRC, you actually are required to get partners...the CSIRO would be prepared to take part in discussions on such a thing.<sup>28</sup>
- 7.55 To obtain Commonwealth approval and funding, all CRCs must include private sector participation to ensure that their outcomes have a solid commercial focus. Snowy Hydro indicated its definite interest in such a proposal during the public hearing on 20 August 2003.<sup>29</sup> The Committee believes that Hydro Tasmania could also be interested in participating in such a CRC and possibly other rural and urban water authorities.

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26 CRC web site [www.crc.gov.au](http://www.crc.gov.au) accessed on 17 September 2003

27 Submission no. 123, p. 2.

28 Transcript of evidence, p. 463.

29 Transcript of evidence, p. 637.

- 7.56 Irrigator groups have expressed strong support for increased research and trials in cloud seeding, although they have stopped short of making firm financial commitments themselves. Mr Arthur, Chairman of Irrigators Inc, told the Committee:

It was brought up in our submission that Irrigators Inc. would strongly support further investigations on current technology into cloud seeding, particularly when we are looking at the poor yields from our alpine regions recently. We strongly support Snowy Hydro's position to investigate some commercial cloud seeding trials.<sup>30</sup>

- 7.57 So there is a reasonable prospect that appropriate private sector interest could be generated to make a CRC into climate modification a viable proposition.
- 7.58 The CRC program comes under the Minister for Education, Science and Training. Applications for new CRC proposals are called every two years, with the next expected in 2004. The Committee urges all interested stakeholders to join together to put forward a case for a new CRC into climate modification to be considered in this next round of applications.
- 7.59 The Committee's strong view is that Australia needs a well coordinated national research effort on climate issues. Climate is of such fundamental importance across the nation that a separate, specialist CRC focussed on climate issues, and with substantial industry funding, is definitely warranted and should be seen as a national priority.

## **The effect of pollution on precipitation**

- 7.60 In the context of cloud seeding as a possible generator of additional precipitation, the Committee received a submission from Australian Management Consolidated Pty Ltd (AMC) which claimed to have scientific evidence that pollution in the air is the cause of reduced rainfall in certain parts of Australia. Mr Aron Gingis, Managing Director of AMC, also gave evidence at a public hearing in June 2003.

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30 Transcript of evidence, p. 518.

- 7.61 AMC's claims are based on methodology developed by Professor D Rosenfeld of the Hebrew University in Israel. Prof. Rosenfeld uses cloud and atmosphere data transmitted by satellites of the joint USA/Japan Tropical Rainfall Measuring Mission.
- 7.62 Prof Rosenfeld's research has found that rain-forming processes in maritime convective clouds and continental convective clouds are sensitive to air pollution, such as urban and industrial pollution, dust, and smoke from fires.<sup>31</sup> AMC believes that pollution reduces precipitation in the Victorian Alps and the Snowy Mountains by 'at least 5,000 GL'.<sup>32</sup>
- 7.63 The AMC submission claims that cloud seeding trials in Israel employing a spray system of concentrated brine have achieved good results, and that similar results could be achieved in Australia. Mr Gingis told the Committee:
- In the Hebrew University they have developed a special model, a cloud physics model ... We can measure the cloud system when it comes along many hours before it hits the catchment ... We can also simulate what cloud seeding material we can apply to these clouds in order to make them of maximum efficiency. We calculate plus or minus 10 per cent how much rainfall they will produce and how much rainfall they will not produce if we do not seed them.<sup>33</sup>
- 7.64 AMC's submission describes the company's approaches since 1999 to the CSIRO, the Bureau of Meteorology, and to various State Governments. None of these agencies have been willing to enter a commercial arrangement with AMC.
- 7.65 Mr Gingis advised the Committee that his company requires a budget allocation to undertake proper research. He mentioned that he had unsuccessfully sought \$400,000 from the Minister for the Environment and Heritage 'to run a specific study over the Snowy Mountains to determine many things, including how much rainfall they are losing'.<sup>34</sup>

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31 Submission no. 113, p. 3.

32 Submission no. 113, p. 10.

33 Transcript of evidence, p. 440.

34 Transcript of evidence, p. 440.

- 7.66 The Committee asked Mr Charlton, Chief Executive Officer of Snowy Hydro, if he would include research into pollution effects in his proposed cloud seeding trial. He replied that such research was outside Snowy Hydro's primary interest. He said:

I do not know that it is our brief to do that. If somebody wants to assist with some data gathering, that is fine, but I am not sure that we are persuaded by those arguments ... What are we going to do about it? We cannot shut down Port Pirie and other places.<sup>35</sup>

- 7.67 In reply to a question whether Snowy Hydro would be prepared to accommodate other groups wishing to use the proposed cloud seeding trials to research the impact of pollution, Mr Charlton said:

The data gathering is satellite based anyway. There is no difficulty in having that running in parallel with something we do. There is no problem there. As I said, we talk to Aron regularly. There is no difficulty there.<sup>36</sup>

- 7.68 The Committee asked the representatives of the Western Australian Department of Environment whether they were aware of the research into the impact of airborne pollution on clouds. Mr Ed Hauck, Manager of Hydrology and Water Resources in the Department of Environment, told the Committee that he was aware of the research taking place, but felt that it was still largely at a theoretical level. He said:

I am aware of Danny Rosenfeld's work and other meteorologists that are respected throughout the world. Basically, cloud physics and the explanations about the influence of pollution can be appreciated, but the context of some of the science to the local impact is where there has not been a lot of work to date. Most of the work is at a theoretical level. There have been some studies, but in terms of WA, we have not had or participated in any work that is looking directly at aerosol impacts to our rate of run-off.<sup>37</sup>

- 7.69 The Committee then asked if the Government of Western Australia sees research into the impact of pollution on their rainfall patterns as a priority. In reply Mr Fred Tromp, a Director of the Department of Environment, questioned the applicability of Prof. Rosenfeld's initial research findings to the situation in Western Australia. He indicated that all of the south-

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35 Transcript of evidence, p. 636.

36 Transcript of evidence, p. 636.

37 Transcript of evidence, p. 653.



western part of Western Australia had suffered from reduced precipitation since the mid-1970s, not just the Perth region which experienced much higher levels of pollution.

- 7.70 Furthermore, Mr Tromp indicated that the WA Water Corporation did not believe that investing in cloud seeding was worthwhile. He told the Committee:

Our initial response would be probably not. I will give one or two reasons for that. One is that the reduction in the rainfall pattern that we see superficially, at least in any case in south-western Australia, does not seem to be associated with, for example, a plume of pollution from our industrial or urban areas. If we look at some of our rainfall records in the more southern parts of our State, which are not impacted at all by pollution sources in Perth, we see similar reductions in rainfall. So it is not a matter of the areas which are, if you might say, in a cloud shadow from Perth where the prevailing weather systems which drop rain on to this part of the state occurs. It is actually right across the southern half of the state. So there does not seem to be an immediate link there.

Secondly, the organisation which would probably benefit most from research into that area ... would be our Water Corporation, because they have a direct financial interest in increasing water gathering ... They do not seem to see the financial rationale in quite the same way as the Snowy Hydro people seem to think that there is a commercial gain to be made there, and they are prepared to put that \$5 million into it.<sup>38</sup>

- 7.71 It is apparent that the CSIRO, the Bureau of Meteorology and various State Governments are not convinced that Prof. Rosenfeld's research warrants financial support from Australian government sources at this stage of its development.
- 7.72 While the Committee was not able to come to a firm conclusion as to the relevance of Prof. Rosenfeld's research to Australia, any high-quality research to do with the possibility of increasing precipitation should be taken seriously. In that sense the Committee urges scientific agencies to monitor future developments in Prof. Rosenfeld's research, and to keep an open mind as to its relevance to circumstances in Australia.

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38 Transcript of evidence, p. 653.

## Climate change and future water availability

- 7.73 In recent years there has been much debate over climate change, and its possible impact on future water supplies.
- 7.74 The impacts of greenhouse gases on global warming and climate change have been subjects of major international attention over the last two decades. The scientific research in this area is coordinated by the Intergovernmental Panel on Climate Change (IPCC)—the recognised international scientific authority on this subject.
- 7.75 The IPCC has concluded that the balance of evidence suggests that human induced effects are contributing to changes in global climate.<sup>39</sup>
- 7.76 The submission from the Department of Agriculture, Fisheries and Forestry summed up global warming as follows:

An international scientific consensus has emerged that our world is getting warmer. Abundant data demonstrate that global climate has warmed during the past 150 years. The increase in temperature was not constant, but rather consisted of warming and cooling cycles at intervals of several decades. Nonetheless, the long term trend is one of net global warming.<sup>40</sup>

- 7.77 Mr Campbell of Land & Water Australia told the Committee that he believed that Australia's experience with climate variability would enable us to adjust more easily to climate change. He said:

... the tools that we are developing to manage climate variability will stand us in very good stead in handling climate change, because the annual variation of our climate is much greater than the projected long-term trends in background change. So other countries are going to have to get used to the degree of climate variability that Australia has been coming to grips with for as long as we have been here.<sup>41</sup>

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39 Transcript of evidence, p. 269.

40 Submission no. 160, Attachment A, p. 4.

41 Transcript of evidence, p. 21.

## Climate change predictions for Australia

- 7.78 In Australia, the CSIRO's Division of Atmospheric Research (CAR) is the leading agency undertaking research into climate change. The section on climate change in the submission from the Department of Environment and Heritage<sup>42</sup> is based largely on a report titled '*Climate change – projections for Australia*' published by CAR in 2001. The following are the key points of that report.<sup>43</sup>
- 7.79 Australian average surface temperature increased by 0.76° C between 1910 and 2000, with average minimas up by 0.96° C and average maximas up by 0.56° C. Most of this increase has occurred since 1950.<sup>44</sup>
- 7.80 Australia's rainfall is highly variable and although there have been regional trends little significant change in the continental-average was observed in the period 1910 – 2000.
- 7.81 Using climate model simulations, CSIRO has estimated future changes in Australian temperature, rainfall and evaporation. The estimates take into account uncertainties associated with the range of future global warming and the range of regional climate model responses. The CSIRO future estimates are:

### *Temperature*

- By 2030, temperatures are estimated to increase 0.4° to 2°C over most of Australia relative to 1990, with slightly less warming in some coastal areas and Tasmania, and slightly more warming in the northwest.
- By 2070, annual average temperatures increase by 1° to 6°C over most of Australia with spatial variations similar to those for 2030. Greatest warming occurs in spring and least in winter. In the north-west, most warming occurs in summer.

### *Rainfall*

- Changes in annual average rainfall tend to decrease in the south-west of Australia (–20% to +5% by 2030 and –60% to +10% by 2070), and in parts of the south-east of Australia and Queensland (–10% to +5% by 2030 and –35% to +10% by 2070). Most other areas show negligible changes.

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42 Submission no. 150, p. 6 - 7.

43 [www.dar.csiro.au/publications/projections2001](http://www.dar.csiro.au/publications/projections2001). Web site accessed 12 September 2003.

44 'State of the Environment 2001' report, p. 25.

### *Evaporation and moisture balance*

- Higher temperatures are likely to increase evaporation. Annually averaged increases in evaporation are estimated to range from 0 to 8% per degree of global warming over most of Australia, and up to 12% over the eastern highlands and Tasmania. The increases tend to be larger where there is a corresponding decrease in rainfall.
- Net atmospheric moisture balance is the difference between potential evaporation and rainfall. The overall pattern shows decreases in moisture balance on a national basis. Average decreases in annual water balance range from about 40 to 120 mm per degree of global warming. This represents decreases of 15 to 160 mm by 2030 and 40 to 500 mm by 2070.

### *El Niño and La Niña*

- El Niño and La Niña events have a strong influence on climate variability in many parts of Australia, and this will continue. Climate models do not give a consistent indication of future changes, but the drying associated with El Niños may be enhanced by global warming.

7.82 The CSIRO's submission made the following observation on the accuracy of climate change predictions:

Climate change projections (or 'scenarios') are not forecasts. Rather, they constitute a set of plausible futures. The levels of confidence that can be ascribed to these scenarios vary from place to place, and with the size of the region(s) of interest. They also vary with time as new knowledge and greenhouse gas emission projections become available, and the performances of global and regional climate models improve... Uncertainties about future human behaviour and thus greenhouse-gas emissions, and shortcomings in climate modelling are included in the ranges quoted in the CSIRO climate projections on water resources.<sup>45</sup>

7.83 According to the submission from the Department of the Environment and Heritage (DEH), Australia is already experiencing climate change as shown by decreased rainfall in the southwest and southeast regions of the continent in recent decades.<sup>46</sup>

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45 Supplementary submission no. 164, p. 7.

46 Submission no. 150, p. 2.

- 7.84 Stream flow in southern Australia will probably decrease because of reductions in rainfall and increased evaporation due to higher temperatures. The IPCC Third Assessment Report (2001) estimated that changes in stream flow in the east-central Murray-Darling Basin will range from 0 to -20% in 2030 and +5 to -45% in 2070.<sup>47</sup>
- 7.85 Dam storages are also likely to be reduced due to climate change. Modelling of the Macquarie River catchment in the Murray-Darling Basin indicates decreases in stream flow into the Burrendong Dam, the main storage in the catchment. The estimated simulated decreases in storage in Burrendong Dam range from about 0 to -15% in 2030 and 0 to -35% in 2070.<sup>48</sup>
- 7.86 The DEH submission argues that future water assessment and management should allow for the likely effects of climate change. It states:

The trends within climate change are irreversible, and this will induce increasing pressure on Australia's water resources ... Climate change, and the increase in climate variability that accompanies climate change, must be taken into account in the development of policies, especially where these policies may relate to the competing demands for the allocation of water between agricultural, environmental, and urban uses.<sup>49</sup>

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47 Submission no. 150, p. 7 quoting IPCC *Climate Change 2001: Third Assessment Report*, and CSIRO Supplementary Submission no. 164, p. 7.

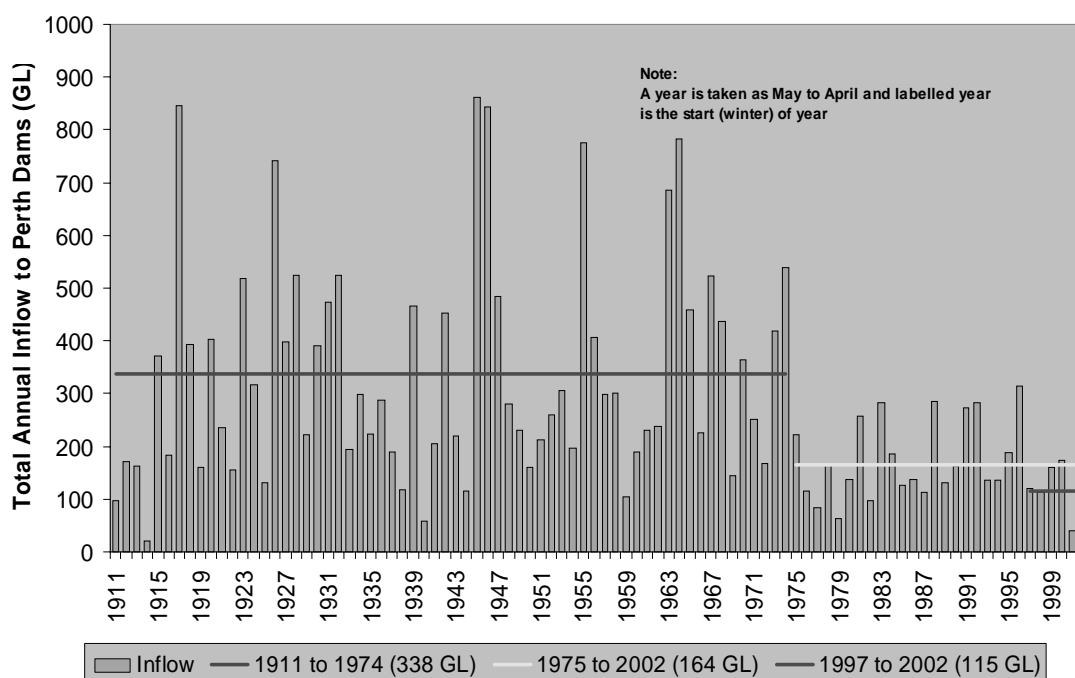
48 Submission no. 150, p. 7 quoting from a report commissioned in 1998 by the Australian Greenhouse Office: *Climate change scenarios and managing the scarce water resources of the Macquarie River*.

49 Submission no. 150, p. 7.

## Recent changes in Western Australia

7.87 The Committee received evidence that Perth's dams have experienced a significant decrease in in-flow since the mid-1970's. The following figure shows the change:

Figure 7.1 Inflow into Perth dams, 1911 – 2002.



Source Provided by the Western Australian Department of Environment, November 2003.

7.88 The figure shows that the average annual inflows for the sixty years before 1975 was 338 GL per annum, which dropped to an average of 164 GL p.a. for the period 1975 to 2001. A third period of low in-flows may have started in 1997, with in-flows since then averaging 115 GL p.a. (1997 – 120.8 GL; 1998 – 112 GL; 1999 – 160.5 GL; 2000 – 174.5 GL; 2001 – 40 GL; 2002 – 88 GL). Notably, no inflows since 1975 have reached even the average of the previous sixty years.

7.89 Ninety five percent of Perth's surface water storage capacity is located within 80 kilometres of the city.

7.90 The Committee asked the representatives of the Western Australian Department of Environment, Mr Tromp and Mr Hauck, what had caused this very significant change since the mid-1970s.

7.91 Mr Tromp said that the definitive cause of the sharp decrease in in-flows since 1975 was still being debated. He said that a new research program, the Indian Ocean Climate Initiative, is investigating the reasons for the change. He also informed the Committee that the trend of decreasing in-flows was continuing. He said:

The figure that I guess concerns us even more is that for the period of 1997 to the year 2002, that average yield figure had in fact dropped to 115 gicalitres, so we are still seeing a declining trend there. We do not see anything kicking up yet to give us an indication that we may be at the end of that cycle.<sup>50</sup>

7.92 Mr Hauck described the changed weather patterns in the following terms:

The change that was observed in the mid-1970s was very much across the globe in terms of observed changes in sea level pressures. The causal factors behind that are still very much debated in the world meteorological community, but various factors have been studied. In the Western Australian context, it can be best thought of in terms of synoptic patterns. The highs from the west tend to stick in the Bight for longer and persist longer throughout the season. So there is a tendency for warmer and drier air to flow across the continent. What we are seeing is a delay or a diminishing of early winter rainfalls, which results in an extension of the dry summer period, versus the previous situation where cold frontal systems were much more prominent.<sup>51</sup>

7.93 Mr Hauck pointed out that dam in-flow is the result not only of rainfall, but also of catchment management practices such as vegetation and mining. The Committee agrees with this observation. It is likely that re-forestation in Perth's catchment area, together with reduced precipitation, have been the major contributors to the reduction in dam in-flow. The figures reported above in paragraph 7.88 seem not to take this into account. The change in inflow must be seen in the context of the re-vegetation of the catchments.

7.94 The Committee is very concerned at the dramatic fall in Perth's dam in-flow since the mid-1970s, and urges that every effort be made to determine the causes for this change.

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50 Transcript of evidence, p. 652.

51 Transcript of evidence, p. 652.

## Research into climate and climate change

- 7.95 Climate research in Australia is undertaken primarily by the Bureau of Meteorology; the CSIRO; some Cooperative Research Centres; the Bureau of Resource Sciences; and the Queensland Centre for Climate Applications. Selected universities, other government agencies, and the private sector also undertake some research.
- 7.96 In the past there was little communication between climatologists, meteorologists and oceanographers. For example, the oceanographers first identified water temperature changes in the Pacific Ocean early in the twentieth century, but it was only in the 1980s that the connection with climate was made, and the El Nino-Southern Oscillation became an important component of climate prediction modelling.
- 7.97 In recent years the Bureau and the CSIRO have made an effort to better coordinate their plans for atmospheric and related research, and to identify joint research activities and areas of collaboration at the project level.
- 7.98 This collaboration occurs within the framework of a formally agreed division of responsibility. The Bureau has primary responsibility for research in support of its own operations and services, and for liaison with the World Meteorological Organization (WMO) in relation to relevant research in Australia. The CSIRO's research focuses on the atmospheric and ocean environments, and on the multidisciplinary interfaces, which link climate variability and change to specific sector and industry-related impacts and responses.<sup>52</sup>
- 7.99 A supplementary submission from the CSIRO explained that their new 'Climate Initiative' integrates climate research across thirteen Divisions. Furthermore, the impact of climate on Australian water resources is a central theme in the Healthy Country Flagship, which has as its overarching objective a 10 fold increase in social, economic and environmental benefits from water use by 2025.<sup>53</sup>

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52 Bureau of Meteorology 2001-02 Annual Report, p. 58.

53 Supplementary submission no. 164, p. 6.



7.100 Regarding the funds involved, the CSIRO submission indicated that:

The current CSIRO investment in climate research ... is estimated to be about \$40 million, while the initial CSIRO investment in the Healthy Country Flagship is of the order of \$16 million in the current financial year.<sup>54</sup>

7.101 Examples of the different types of research undertaken are:

- Pure research: Based on the advances in understanding of the El Niño - Southern Oscillation phenomena over the last two decades, research is being carried out on the development of techniques to predict climate variations on seasonal and longer time scales. To date there is not yet a clear indication of the intrinsic predictability of climate; i.e. the extent to which climate can be predicted at these time scales.
- Strategic research: the development of numerical models and associated software that use the joint Bureau-CSIRO supercomputer to simulate and predict the state of the atmosphere and ocean.
- Applied research: the Australian Air Quality Forecasting System (AAQFS), a collaborative project between the BMRC, CSIRO and the Environment Protection Authorities (EPAs) of Victoria and New South Wales provides detailed forecasts of air quality for the Melbourne and Sydney metropolitan regions.<sup>55</sup>

## Land and Water Australia

7.102 One of the key programs funded by Land and Water Australia (LWA)<sup>56</sup> was the Climate Variability in Agriculture Program (CVAP) which concluded in 2002. The Rainman and Rainman-streamflow software programs were major outcomes of funding provided under the CVAP.

7.103 The submission from the Department of Agriculture, Fisheries and Forestry provides the following background in respect to CVAP:

The major vehicle for collaborative climate research for land management between the Commonwealth and external agencies for the last 10 years has been the Climate Variability in Agriculture Program (CVAP). For much of its history, CVAP has concentrated on developing and communicating better seasonal forecasts and

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54 Supplementary submission no. 164, p. 6.

55 Bureau of Meteorology 2001-02 Annual Report, p. 61 - 63.

56 More background on Land and Water Australia is provided in paras 7.122 – 7.125.

has been instrumental in changing the ‘mental map’ of climate for many Australians. More recently, it has broadened its focus into managing stream flow variability.<sup>57</sup>

- 7.104 LWA’s Board has decided to establish a new climate research program called Managing Climate Variability Program (MCVP). Negotiations with potential partners are taking place, with the expectation that MCVP will be launched in mid-2004.
- 7.105 One of the likely areas of operation of MCVP is to improve the accuracy of seasonal forecasts, which would be of great benefit to farmers.
- 7.106 At this stage the MCVP’s prospective partners have agreed to contribute a total of \$4.5 million over four years. Prospective partners include LWA, the Department of Agriculture, Fisheries and Forestry, the Grains, Sugar, and Dairy Research and Development Corporations, and possibly the Wool and Livestock marketing bodies.
- 7.107 The Committee is concerned at the limited funding which LWA has available under MCVP for applied research into climate issues. These are major areas of interest, which impact on a large portion of the Australian economy. The benefits from solutions are potentially enormous and these matters deserve to be treated seriously. The Committee believes that LWA should be provided with significantly increased funding to devote to applied climate research.

### Scientific gaps

- 7.108 During 2002 the Australian Greenhouse Office commissioned a review of the current research program into climate change. The review identified several gaps—including the science to underpin understanding of climate change impacts, and the detection and attribution of climate change. It also noted that funding for the program, in real terms, had declined significantly over the past decade.<sup>58</sup>
- 7.109 Mr Rod Lehmann, President of the Australian Water Association, made the following observation to the Committee on the paucity of research into climate change in Australia:

Chris Davis and I went to the World Water Forum in Kyoto earlier this year and it was apparent that quite a lot of work has been done internationally on climate change. We have not seen much

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57 Submission no. 160, p. 9.

58 Submission no. 150, p.8.

happening in Australia in that regard ... We think that will particularly affect certain rural areas ... I think the planning has not been done to look at how we are going to manage climate change and I think we should be investing substantial funds to get on top of this problem.<sup>59</sup>

- 7.110 The submission from the Department of Environment and Heritage also advocates increased research into climate change. It made the following comment on this subject:

Current climate change models provide a reasonable understanding of the directions of climate change and, in broad terms, some understanding of the possible impacts of climate change on Australia's water resources. Additional precision in climate models at regional levels across Australia, however, would greatly strengthen our capacity to develop the required policies for the supply and management of water resources for Australia's rural industries and communities.<sup>60</sup>

- 7.111 The Irrigation Association of Australia (IAA), being concerned about future water availability, presented a strong argument that research into climate change should be a priority. It said:

The IAA believes greater investment in R&D on climatic forecasting is required. Funding and coordination of the best information available on climate change projections and the likely impacts of changed rainfall patterns and catchment yields is required urgently.

The potential effects of climate change have the ability to overwhelm all other reforms and initiatives aimed at improving water resource management in Australia. Reductions in allocations for irrigation, or indeed any other use, due to increased environmental flows and increased domestic use have the potential to be insignificant compared to reductions in available water due to climate change.

Similarly, even a 20% reduction in water used for irrigation through achievable improvements in efficiency of irrigation systems and management could be more than offset by reduced or unreliable precipitation due to climate change.<sup>61</sup>

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59 Transcript of evidence, p. 542.

60 Submission no. 150, p. 8.

61 Submission no. 28, p. 8.

7.112 The submission from Hydro Tasmania also supported research into climate change. It noted:

The ability to predict climate change effects will be extremely useful, even if the predictive tools could only provide order of magnitude changes then this would be beneficial. There is a need to undertake more analysis of the climate change effect on all regions in Australia ... a stronger Commonwealth Government initiative is imperative to ensure more knowledge is available on climate change in Australia.<sup>62</sup>

7.113 The submission from the Queensland Farmers' Federation advocated a national 'planning for climate change initiative', of which research would be an integral part.<sup>63</sup>

7.114 The Committee believes that climate change, with its potential to severely impact on the future availability of water, should be a priority area for national research. Better understanding by water managers of the impact of climate change on future water supplies will greatly assist policy making. There is still much to be learnt in this field and increased research funding should be provided so that modelling techniques can continue to be developed.

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## **Recommendation 29**

**7.115 The Committee recommends that the Commonwealth Government:**

- **recognises research into climate issues, including climate change and its potential impact on future water supplies, as a national research priority; and**
- **encourages relevant research, academic and private sector bodies to develop an application to form a Cooperative Research Centre on Climate, with a key focus on climate modification.**

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62 Submission no. 40, p. 14.

63 Submission no. 116, p. 19.

- 7.116 Whilst the Committee supports increased research into climate issues, it notes that the result of such research is likely to have limited impact on greenhouse-induced climate change unless there are also substantial initiatives to enhance the role and contribution of renewable energy sources.

## Research into water resource management

- 7.117 While most of the evidence received by the Committee on future research requirements related to research into climate issues—as specified in the terms of reference—the Committee also received evidence on Australia’s overall research effort into water resource management.

- 7.118 In December 2002 the Prime Minister announced four national research priorities. Water is described as a critical resource under the first priority ‘*An environmentally sustainable Australia*’. The goal set for water research reads:

Ways of using less water in agriculture and other industries, providing increased protection of rivers and groundwater and the re-use of urban and industrial waste waters.<sup>64</sup>

- 7.119 All the evidence received by the Committee supported the Commonwealth’s role as the key funder and provider of research in Australia. Submissions and evidence taken in public hearings all encouraged the Commonwealth to continue to take responsibility for research into all facets of natural resource management, including climate issues.

- 7.120 The submission from the Department of Agriculture, Fisheries and Forestry noted the Commonwealth’s significant contribution to research into water issues. The submission said:

The Commonwealth makes substantial investments in improving the science that supports the management of our water resources. This investment is made directly through the:

- Commonwealth Bureau of Meteorology;
- CSIRO Division of Atmospheric Research;

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64 Department of Education, Science and Training website accessed on September 2003 [http://www.dest.gov.au/priorities/environmentally\\_sustainable.htm#1](http://www.dest.gov.au/priorities/environmentally_sustainable.htm#1)

- Australian Research Council through the Cooperative Research Centres, including the recently announced CRC for Irrigation Futures;
- Natural Heritage Trust;
- Agriculture Forestry and Fisheries – Australia through the Bureau of Rural Science and the Research and Development Corporations; and
- Land and Water Australia.<sup>65</sup>

7.121 Dr Blackmore of the MDBC told the Committee that in the past Australia's research effort has been focussed on commodity research, at the expense of other areas such as river ecology. He said:

This nation has a very thin knowledge base of ecology. We have invested most of our money in commodity research, because that is what was driving us economically, and we still do that. It dominates grains, meat and so on ... the Commonwealth, for example, has 13 R&D corporations. Twelve of them are commodity focused and one of them is on landscapes—Land and Water Australia—the only one that invests solely in how landscapes behave and the ecology you are after. So we are starting a long way back in having universities and institutions with people who think this way and try to understand it.<sup>66</sup>

7.122 Land and Water Australia (LWA, formerly known as the Land and Water Resources Research & Development Corporation), was established in July 1991 as one of 13 rural research and development corporations under the Primary Industries and Energy Research and Development Act 1989.

7.123 LWA relies on budget appropriations for its funding. Its funding has increased only marginally since its establishment—from \$11.1 million in 1991-02 to \$11.9 million in 2002-03. It is the only R&D Corporation which does not receive supplementary funding through industry levies.

7.124 LWA funds research on issues related to land, water and vegetation. For management purposes, its programs are divided into five broad research areas—sustainable primary industries; river landscapes; vegetation; future landscapes; and activities which cut across two or more of the other four areas. The Climate Variability in Agriculture Program was administered under the 'sustainable primary industries' program area.

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65 Submission no. 160, p. 9.

66 Transcript of evidence, p. 409.

7.125 LWA identifies potential research programs, and then approaches other agencies to become partners in the program, either by providing additional funding or contributions ‘in kind’. A key objective for LWA is that the research undertaken is of an applied nature, and that findings are implemented. Mr Campbell of LWA advised the Committee:

I should make clear to the committee that Land and Water Australia does not actually do any research ... We are an R&D corporation that invests in, manages and coordinates research, but we buy it from CSIRO and universities—wherever we find the best science ... We like to work as much as possible in partnership with industry in delivering those programs because we believe that, for research to be any good, it has to be adopted, and that requires good linkages with the end users of the R&D.<sup>67</sup>

7.126 There are six water-related Cooperative Research Centres (CRCs) which deal with complementary aspects of the water cycle. They are:

- CRC for Catchment Hydrology deals with runoff from land to rivers and streams,
- CRC for Freshwater Ecology focuses on the ecological environment of rivers and lakes,
- CRC for Drinking Water Quality looks at water treatment and related public health aspects,
- CRC for Waste Management and Pollution Control considers the return of wastewater to the environment,
- CRC for Coastal Zone, Estuarine and Waterway Management specialises in the effective management and ecological health of coastal areas.
- CRC for Irrigation Futures, whose goals are to double the profitability and halve the water use of Australian irrigation, while defining sustainable irrigation areas and practices.

7.127 Furthermore, water issues are of interest to a large number of the rural-industry focussed CRCs such as the CRCs for Cotton; Sheep Industry; Cattle and Beef Quality; Innovative Dairy Products; Sustainable Production Forestry; Sustainable Rice Production; Sustainable Sugar Production; and Viticulture.

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<sup>67</sup> Transcript of evidence, p. 21.

- 7.128 The Committee received little evidence to show that these various CRCs are coordinating their research in any strategic sense to meet national objectives. There is a danger that the research effort is being fragmented with the creation of so many entities. The Committee believes that it is vital that Australia achieves maximum outcomes from this research activity and urges that formal structures to enhance cooperation and communication be put in place.

## **A national research strategy**

- 7.129 The Committee believes that the many and varied research suggestions put forward in submissions and during public hearings provide a very good starting point for consideration of a well-coordinated and strategic national research effort into water issues. Suggestions included—desalination; impact of irrigation on water quality; the inter-connectivity of surface water and groundwater; total water cycle; and research into new products and possible overseas and domestic markets.
- 7.130 Based on the water surveys the Australian Bureau of Statistics (ABS) has commenced, by 2006-07 Australian water managers and policy makers will have access to much better data on water use in Australia. However, much more needs to be done to gather better information on water availability and water quality. There is no doubt that the National Land and Water Resources Audit completed in 2000-01 was a very good first step. However, the Audit identified many remaining data gaps and the filling of those gaps must be at the very top of the priorities of the National Water Initiative.
- 7.131 The ABS compiles the extensive *Water Account for Australia* report every 4 years<sup>68</sup>. It will also undertake a *Water Survey – Agriculture* report every 2 years (commencing with 2002-03). To complete the water picture, the ABS is intending to compile *Water Surveys* covering urban/industrial (20 percent of total water use<sup>69</sup>) and ‘other rural’ (5 percent of total water use) in 2005.

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68 The first ‘*Water Account for Australia*’ covered the years 1993-94 to 1996-97 and was released in May 2000. The second in the series, covering the years 1997-98 to 2000-01, was released on 19 May 2004.

69 Estimate from the National Land and Water Resources Audit ‘*Australian Water Resources Assessment 2000*’.



- 7.132 If water is to be treated as a key national priority, then much better data must also be made available on water availability and water quality.
- 7.133 Decision makers at all levels need access to the best possible information and the Committee sees this as a necessary and essential step in achieving the nation's future water management goals. The Committee found serious deficiencies in relation to the data underpinning the Living Murray Initiative, which prompted the release of the Committee's interim report in April 2004. This is a fundamental issue, which must be addressed before significant decisions can be made on future allocation of scarce water resources.
- 7.134 The 2002-03 Annual Report of Land and Water Australia noted that over 50 organisations are involved in research into natural resource management (NRM) in Australia. The report said:
- Including cooperative research centres, rural R & D corporations, CSIRO and other Australian Government agencies, more than 50 other organisations at the Australian Government level contribute to national investment (including state, territory and industry funding) in natural resource management research of more than \$300 million annually.<sup>70</sup>
- 7.135 The Committee is concerned at the estimate that there are over 50 different organisations involved in funding or undertaking NRM research. It is most unlikely that this is an efficient or effective structure.
- 7.136 The Committee believes that there should be better coordination of the research effort to ensure that maximum return is obtained. There should be clear national priorities for NRM, and the research effort should be focussed on enabling those objectives to be achieved.
- 7.137 The whole question of how research priorities should be set, funded and coordinated should be reviewed in the context of the new National Water Initiative. The Committee strongly recommends that research be seen as an integral part of the National Water Initiative, and that the opportunity is taken to formulate a well-funded and comprehensive National Research Strategy on Water.

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70 Land and Water Australia, 2002-03 Annual Report, p. 21.

**Recommendation 30**

- 7.138 **The Committee recommends that the Commonwealth Government works through the Council of Australian Governments to develop a national research strategy that prioritises and coordinates all research activities on water, as an integral part of the National Water Initiative.**

Kay Elson MP

Committee Chair

2 June 2004