

Other optional water sources

Key findings

- 8.1** Given the current climate change predictions and that over 80 per cent of Melbourne's water supply is rainfall dependent, the Committee believes that there is an urgent need to diversify the city's water supply rather than invest in the construction of new dams. On this basis alone the Committee does not support the option of supplementing Melbourne's water supply with new dams.
- 8.2** Intense bushfires are the most significant threat to the quality and quantity of Victoria's water supplies. The most recent fires significantly damaged the upper reaches of the Maroondah, Upper Yarra and O'Shannassy catchments.
- 8.3** There remains a considerable level of debate regarding the impact of timber harvesting activities on water yields within Melbourne's water catchments.

Introduction

This chapter discusses issues relating to the sixth term of reference which requires the Committee to examine the merits of supplementing Melbourne's water supply with any other optional water source. The Committee was advised of a number of optional water sources, including the construction of additional dams, timber harvesting in water catchments, the installation of a water supply pipe from Tasmania to Melbourne¹; increased black water recycling² and cloud seeding.³ The first two options are examined in this chapter. Insufficient evidence was received on the other alternatives to warrant further discussion.

Dams

The 2004 *Securing Our Water Future Together* white paper notes that the traditional approach to managing Melbourne's water supply has been to utilise "...rivers and aquifers, create dams to supply towns, industry and irrigation, and then dispose of the wastewater back into rivers or the ocean."⁴ A number

¹ G. Harrison, *Submission*, no. 8, 29 July 2008, p. 4; G. Croker, *Submission*, no. 53, 29 August 2008, p. 1; W. Raper, *Submission*, no. 10, 5 August 2008, p. 1; J. and E. Cribbes, *Submission*, no. 70, 29 August 2008, p. 6.

² CSIRO, *Submission*, no. 34, 29 August 2008, p. 15.

³ The Waters Family, *Submission*, no. 55, 29 August 2008, p. 2.

⁴ Department of Sustainability and Environment, *Securing Our Water Future Together*, Victorian Government, Melbourne, 2004, p. 11.

of stakeholders suggested that the construction of one or more major new dams – or an increase in the capacity of existing dams – could address Melbourne's future water supply needs.

Melbourne's piped water supply commenced operation in 1857, with the completion of Yan Yean Reservoir, adjacent to the Plenty River, with a capacity of 30 gegalitres.⁵ Over the years, the traditional approach to managing drought has been to build new reservoirs to meet increasing demand for water, spurred by population growth, dry spells and occasional drought.⁶

The late 1920s and early 1930s saw the completion of the Maroondah (1927), O'Shannassy (1928) and Silvan (1932) Reservoirs. Upon completion of the Upper Yarra Reservoir in 1957, Melbourne's water storage capacity tripled to nearly 300 gegalitres. Severe drought and the introduction of water restrictions in the late 1960s, spurred another round of dam building with the construction of the Cardinia and Greenvale reservoirs in the late 1960s-early 1970s.⁷ Stage 6 water restrictions were introduced in Melbourne during the 1982-83 drought.⁸ The last and largest of Melbourne's water storages, the Thomson Reservoir, was completed in 1983.⁹ The Thomson Reservoir was expected by government to drought-proof the city.¹⁰

Today, the Victorian Government and Melbourne Water believe the ongoing reliance on reservoirs is no longer sustainable. *Securing Our Water Future Together* notes the government's policy of no new dams for Melbourne in the next 50 years. The white paper states that:

If a new dam were built for Melbourne, it would need to be filled with water that is currently used by rural and regional communities and the environment: a new dam for Melbourne would take water from Gippsland or Goulburn Valley farmers who depend upon irrigation for their livelihoods; it would also take water from our rivers that are already stressed. This would not only harm the habitat of our native plants, fish and animals, but also threaten our waterways, tourism and recreation industry. Taking more water for Melbourne from Gippsland is also likely to harm the Gippsland Lakes, which are vital for Gippsland's economy; a new dam for Melbourne would be expensive, costing Victorians up to one billion dollars. These costs are not justified when there are great opportunities to use the water already available to Melbourne more wisely. The cost of saving water through sensible water conservation is far less than the cost of building a new dam; and there is existing water supply infrastructure that can be used to harness increased supplies for Melbourne.¹¹

The *Central Region Sustainable Water Strategy (CRSWS)*, 2006 notes that:

⁵ Melbourne Water, 'History of Melbourne's Water Supply', viewed 15 May 2009, <<http://www.melbournewater.com.au>>.

⁶ Melbourne Water, 'A Dry History', viewed 15 May 2009, <<http://drought.melbournewater.com>>.

⁷ Melbourne Water, 'History of Melbourne's Water Supply', viewed 15 May 2009, <<http://www.melbournewater.com.au>>.

⁸ Water restriction stages in the early 1980s are not comparable to those applied today.

⁹ Melbourne Water, 'History of Melbourne's Water Supply', viewed 15 May 2009, <<http://www.melbournewater.com.au>>.

¹⁰ P. Ker, 'Dam water levels dwindling to historic low', *The Age*, 15 April 2009.

¹¹ Department of Sustainability and Environment, *Securing Our Water Future Together*, Victorian Government, Melbourne, 2004, p. 95.

New dams do not create new water. They take water from rivers and downstream irrigators. They would also seriously impact on the health of rivers, to which the community wants more water returned to protect their sustainability.¹²

The CRSWS also notes that during the past ten years of drought, the levels of Melbourne's reservoirs have fallen revealing that there is a significant risk in relying almost solely on water supplied from rivers and reservoirs. It is also expected that climate change will significantly reduce the volume of runoff available to store in reservoirs.¹³ New dams are not part of the strategy.¹⁴

In response to declining storage levels, a number of stakeholders who provided evidence to the inquiry have argued that the government should revisit its policy on "no new dams".¹⁵ The submissions called for the construction of new dams to the east of Melbourne, notably a dam on the Mitchell River or a diversion weir on the Aberfeldy River.

In 2005, Sinclair Knight Merz (SKM) undertook a study for the Department of Sustainability and Environment into the financial, social and environmental impacts of new dams to augment Melbourne's water supply. The yields and costs associated with each option and the potential environmental and social impacts are illustrated in Figures 8.1, 8.2 and 8.3. The diversion of the Aberfeldy River was not included in SKM's analysis.

The Mitchell River is often identified as the river most suitable for damming to supplement Melbourne's water needs. The proposed dam, according to the SKM report, would involve the construction of an 80 metre high dam wall with a 500 gigalitre storage capacity. The estimated annual yield would be 86 gigalitres. The dam would flood approximately 30 kilometres of river and over 2,700 hectares of private land.¹⁶ While the Mitchell River proposal provides the greatest estimated yield of all the dam options considered (86 gigalitres), the analysis of the environmental impacts of this option were nearly all rated moderate to severe by SKM.¹⁷

The SKM report found that:

- The biggest question mark over the dam is the impact on the Gippsland Lakes, a Ramsar Wetland site. The Mitchell River is the highest freshwater flow contributor to the Gippsland Lakes. They already suffer water quality problems and a further reduction of freshwater inflow to the Gippsland Lakes would only aggravate these water quality

¹² Department of Sustainability and Environment, *Sustainable Water Strategy Central Region: Action to 2055*, Victorian Government, Melbourne, 2006, p. 65.

¹³ *Ibid*, p. 65.

¹⁴ Melbourne Water, 'A Dry History', viewed 15 May 2009, <<http://drought.melbournewater.com.au>>.

¹⁵ The Victorian Government, *Securing our Water Future Together* states no new dams for Melbourne in the next 50 years.

¹⁶ Sinclair Knight Merz in association with Parsons Brinkerhoff, *Eastern Water Recycling Proposal: Alternative Options to Meet Long Term Demands - Dams*, Sinclair Knight Merz, Melbourne, 2005, p. v.

¹⁷ *Ibid*, pp. 131-132.

problems – this has the potential to affect the environment as well as recreation and commercial use of the lake;

- The Mitchell River is Victoria's last largely untouched major river and has Heritage River status. Areas of inundation would include part of the northern extent of the Mitchell River National Park; and
- A new dam would flood productive farmland and displace people living in the valley including the townships of Dargo and Tabberabbera.¹⁸

The only other option considered in the report which is capable of providing a similar level of water yield to the Mitchell River proposal, is the Hume Corridor Scheme – 80 gigalitres.¹⁹ The Hume Corridor Scheme involves the diversion of water from the Goulburn River near Seymour, downstream from Lake Eildon, and then treating and pumping the water to the Greenvale Reservoir.²⁰ The principle social impact of the scheme is the purchase of water rights. Water for the scheme would need to be purchased from current water users in compliance with the Murray Darling Basin Cap on water extraction.²¹ This would reduce the availability of water for agricultural production and would be politically and socially sensitive to divert water north of the divide to Melbourne.²² The report stated that:

Although minor economic impacts are predicted on a regional scale, there may be particular localities within these regions that are affected more severely than others. Where this occurs, the reduction in agricultural output may result in localised reduction in expenditure, leading to localised loss in employment, and other flow-on economic and social effects. Localised rural communities already considered under pressure may be more susceptible to such impacts.²³

It is anticipated that the scheme would have two primary environmental impacts, construction impacts resulting from the construction of the pipeline and pump and the alteration of river flow. However, of all the options considered, the Hume Corridor Scheme had the lowest overall environmental impact as it did not involve the construction of a new dam or diversion of water from a pristine waterway.²⁴

The SKM report concluded that, based on the cost and considerations of environmental and social impacts, the Hume Corridor Scheme was the preferred option.²⁵ This scheme would have social consequences associated with the diversion of water resources from regional Victoria to Melbourne, and

¹⁸ Ibid, p. v.

¹⁹ Ibid, p. 74.

²⁰ Ibid, p. vii.

²¹ Ibid, pp. 82-84.

²² Ibid, p. 84.

²³ Ibid, p. 83.

²⁴ Ibid, p. 133.

²⁵ Ibid, p. 133.

the likely reduction of agricultural production in the Goulburn River valley and associated economic activity.²⁶

Figure 8.1: Costs and yields for dam options

Scheme	Yield (GL/Year)	Capex excluding contingency (\$M)	Recurrent cost (\$M/Year)	\$/ML/Year with contingency allowance*	\$/ML/Year without contingency allowance
Mitchell River Dam ²⁷	86	773	36.9	1,040	1,490
Mt Useful Dam ²⁸	29	398	20.5	1,640	2,330
Big River Diversion ²⁹	31	324	1.7	770	1,070
Black River Diversion ³⁰	43	419	2.1	710	1,010
Hume Corridor ³¹	80	430	26.6	700	820
Hall Ridge Dam (Aire River) ³²	26	333	10.6	1,280	1,730
Upper Gellibrand Dam ³³	7	211	3.5	2,550	3,700

Source: Sinclair Knight Merz in association with Parsons Brinkerhoff, *Eastern Water Recycling Proposal: Alternative Options to Meet Long Term Demands - Dams*, Sinclair Knight Merz, Melbourne, 2005, pp. 131.

²⁶ Ibid, pp. 133-134.

* The contingency level refers to the confidence level based on the cost estimates. For example, a contingency of 20 per cent refers to a project with a high level of design already undertaken while a contingency level of 80 per cent refers to a project with no design completed.

²⁷ North west of Bairnsdale

²⁸ Near Licola

²⁹ South of Jamieson

³⁰ South of Jamieson

³¹ South of Seymour

³² West of Apollo Bay

³³ West of Lorne

Figure 8.2: Environmental impacts of dam options

Environmental impact	Mitchell River	Mt. Useful	Big River	Black River	Hume Corridor	Hall Ridge	Upper Gellibrand
Loss of native vegetation in the impound area	Severe	Moderate to severe	Severe	Moderate	Moderate	Severe	Severe
Loss of threatened species	Severe	Moderate	Moderate to severe	Moderate	Moderate	Severe	Severe
Alteration to flow	Moderate to severe	Moderate to severe	Severe	Severe	Moderate	Severe	Moderate to severe
Loss of river connectivity	Severe	Severe	Moderate	Moderate	Moderate	Severe	Severe
Geomorphological change	Unknown	Unknown	Unknown	Unknown	Low	Unknown	Unknown
Water quality impact	Severe	Moderate to severe	Moderate	Moderate	Low	Severe	Severe
River connectivity	Severe	Moderate to severe	Moderate to severe	Moderate to severe	Low (depending on size of works)	Severe	Severe
Loss of aquatic species through change in flow regime	Moderate	Moderate	Moderate	Moderate	Low	Moderate	Moderate
Loss of riparian and floodplain vegetation through decreased flooding	Moderate to severe	Severe	Moderate	Moderate	Low	Severe	Severe
Relevant legislation and policies	Severe	Severe	Severe	Moderate	Moderate	Severe	Severe

Source: Sinclair Knight Merz in association with Parsons Brinkerhoff, *Eastern Water Recycling Proposal: Alternative Options to Meet Long Term Demands - Dams*, Sinclair Knight Merz, Melbourne, 2005, pp. 131-132.

Figure 8.3: Social impacts of dam options

Social impact	Mitchell River	Mt. Useful	Big River	Black River	Hume Corridor	Hall Ridge	Upper Gellibrand
Town relocation or increased risk of flooding	Yes	Yes	No	No	No	No	No
Potential threat to current tourism activities	Yes	Yes	Yes	Yes	No	Yes	Yes
Potential threat to commercial fisheries	Yes	Yes	No	No	No	No	No
Potential threat to logging industries	No	No	Yes	Yes	No	Yes	Yes
Potential threat to current renewable energy production	No	No	Yes	Yes	No	No	No
Potential threat to downstream agriculture	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: Sinclair Knight Merz in association with Parsons Brinkerhoff, *Eastern Water Recycling Proposal: Alternative Options to Meet Long Term Demands - Dams*, Sinclair Knight Merz, Melbourne, 2005, p. 133.

Benefits and impacts of new dams

Proponents of the construction of new dams highlighted the potential benefits including:

- the potential to augment Melbourne's water supply by capturing water from rivers;
- the potential to source water at a price cheaper than alternative water sources; and
- the potential to provide a level of flood mitigation.³⁴

Evidence supporting the construction of new dams also noted a number of site specific benefits such as improved reliability of water for irrigators and minimal water treatment requirements.³⁵

The construction and operation of new dams is also likely to have a range of potential direct and indirect environmental and social impacts. These include:

- loss of productive land;
- negative impacts on downstream water quality;
- loss of aquatic species;

³⁴ Victorian Farmers Federation, *Submission*, no. 9, 1 August 2008, p. 8; Institute of Public Affairs, *Submission*, no. 98, 6 October 2008, p. 12.

³⁵ Plug the Pipe, *Submission*, no. 84, 29 August 2008. Attachment 1 pp. 1-3

- loss of habitat;
- downstream transportation of construction sedimentation and pollution;
- loss of trigger flows and changes in water temperature may impact upon flora and fauna;
- threat to tourism and amenity values; and
- threat to downstream agriculture and commercial fisheries.³⁶

Stakeholder evidence

The Victorian Government submission to the inquiry stated that:

Building a new dam does not create new water, it just takes water from existing users, including downstream irrigators and the environment. Dams are a significant investment and the most cost effective and reliable storages have already been built. New dams also involve flooding valuable farmland and forests. Flooded forests are themselves a major source of greenhouse gases as the vegetation breaks down.³⁷

For example, Mr Peter Harris, Secretary of the Department of Sustainability and Environment also noted that the certainty and reliability of water produced by a desalination plant is greater than that of dams, stating that:

By comparison with the Mitchell River, a significant heritage river, we will have environmental impacts and therefore we will have significant mitigators required to meet those environmental impacts, plus the amount of water that is available. In the end, desalination by comparison with a river-based solution, the river-based solution relies upon it raining and raining reliably, and our problem is we are here now because it has not been raining reliably; therefore a dam is inherently a more risky solution. As I said, it has more environmental impacts by comparison with a desalination plant in terms of the local environment and the pipeline effect from the Mitchell River. The pipeline would have had to have been longer.³⁸

Ms Kelly O'Shanassy informed the Committee that Environment Victoria does not support dams highlighting that water flowing down rivers provides an important ecosystem function:

We do not believe that all that water going to the sea is a waste or is wastewater. I think a lot of scientists and scientific evidence back that up. Even if you did not want to believe the scientists, you could just look at the Coorong or the Gippsland Lakes and see that water flowing out into estuarine ecosystems is an incredibly important component of the health of

³⁶ Department of Sustainability and Environment, 'Environmental Impacts of Dams, Weirs and Pumping', viewed 15 May 2009, <<http://www.ourwater.vic.gov.au>>; Sinclair Knight Merz in association with Parsons Brinkerhoff, *Eastern Water Recycling Proposal: Alternative Options to Meet Long Term Demands - Dams*, Sinclair Knight Merz, Melbourne, 2005, pp. iii-xii.

³⁷ Victorian Government, *Submission*, no. 54, 29 August 2008, p. 25.

³⁸ P. Harris, Secretary, Department of Sustainability and Environment, *Transcript of evidence*, Melbourne, 8 September 2008, p. 8.

those systems. We have very few rivers in Victoria that have not been dammed or affected in any way; there is only a very small number, and some of them are in Gippsland. There are one or two in northern Victoria, and those rivers are really important, particularly in the north, because they provide most of the environmental flows that go into the Murray at the moment because they are unregulated. So if you regulate those, you have real problems in the Murray River as well.³⁹

The National Council of Women's submission to the inquiry highlighted the cost and environmental disruption of new dams noting that while dams may have a place in flood mitigation management, they are generally not appropriate for south east Victoria.⁴⁰

Professor John Langford, Director of Uniwater, noted that if a dam was to be considered, the only viable option would be to dam the Mitchell. Professor Langford stated:

It does have a significant amount of water in it. Pre the step-down in rainfall it was about 750 000 megalitres a year, so now probably 500 000. But if you were going to get any of that, you would need a very substantial dam. It is one of the few free-flowing rivers in Victoria, and it flows into the Gippsland Lakes, so the environmental consequences of doing anything to that — and in our current circumstance, building a dam takes a while, a long pipeline, it is energy intensive to get it here, plus we have got to wait till the dam fills.

So it really is not an alternative to the desalination plant, because if we are trying to fill a dam in a dry sequence, it is not going to work. So it is definitely not an alternative to the desalination plant, and personally I do not think it is worth considering.⁴¹

Dr Ian McPhail, Commissioner for Environmental Sustainability also informed the Committee of his lack of support for new dams noting that: the best sites for dams are already used; that dams do not create new water; and that the increasing interconnection of supplies is beginning to reduce the need for new dams.⁴² Dr McPhail also informed the Committee that:

The argument against the Mitchell is fairly straightforward. It will have a direct effect upon the Gippsland Lakes and would, I think, create a series of reactive situations that would be just as complex as what might have been solved by damming it.⁴³

In contrast to the views highlighted above, several stakeholders expressed strong support for the investigation into, or construction of, new dams or diversion weirs.⁴⁴ The Institute of Public Affairs' (IPA) submission to the inquiry

³⁹ K. O'Shanassy, Chief Executive Officer, Environment Victoria, *Transcript of evidence*, Melbourne, 8 September 2008, p. 34.

⁴⁰ National Council of Women Victoria, *Submission*, no. 73, 29 August 2008, p. 6.

⁴¹ J. Langford, Director, Uniwater, Department of Civil and Environmental Engineering, The University of Melbourne, *Transcript of evidence*, Melbourne, 27 October 2008, p. 7.

⁴² I. McPhail, Commissioner for Environmental Sustainability, *Transcript of evidence*, Melbourne, p. 3.

⁴³ I. McPhail, Commissioner for Environmental Sustainability, *Transcript of evidence*, Melbourne, p. 3.

⁴⁴ B. McGuire and F. Headlam, *Submission*, no. 24, 22 August 2008, p. 7; L. Harrington, *Submission*, no. 5, 21 July 2008, p. 1; Boroondara Residents' Action Group, *Submission*, no. 33, 25 August 2008, p. 2; P. Gaynor, Victorian Water Forum, *Transcript of evidence*, Melbourne 10 November 2008.; Institute of Public Affairs, *Submission*, no. 98, 6 October 2008, pp. 1-21; Victorian Farmers Federation, *Submission*, no. 9, 1

analysed a variety of water supply options for Melbourne. In particular, the submission outlined the options of damming the Thomson/Macalister, Latrobe or Mitchell Rivers and highlighted the costs associated with each option. The submission concluded that the construction of a new dam to collect water from these rivers would likely be the most cost effective approach (compared to other alternatives such as desalination, recycling, rainwater harvesting and stormwater) and would act as a flood mitigation measure and provide improved water security for Gippsland farmers.⁴⁵

The Victorian Farmers Federation (VFF) expressed their support for a policy review regarding the construction of new dams noting that climate change is predicted to deliver more extreme weather events such as floods, and that a new dam has the potential to mitigate the impact of floods such as those experienced in Gippsland in 2007.⁴⁶ The VFF went on to state that:

The VFF requests that the Government takes all the necessary steps to investigate the options for extending existing dams including the Big Buffalo dam and William Hovel dam, as well as building new dams including a dam on Mitchell River and capturing more of the rain that falls over the Otway Ranges. These options should be seriously considered on their relative merit of supplementing additional water.⁴⁷

A number of stakeholders informed the Committee that the construction of a diversion weir on the Aberfeldy River (east of the Thomson Dam) should be considered as an option to supplement Melbourne's water supplies.⁴⁸ It was argued that the construction of 30-40 metre high diversion weir on the Aberfeldy River accompanied by a diversion tunnel to the Thomson Dam would provide 25 gigalitres of water annually for Melbourne.⁴⁹ Stakeholders noted that this option would provide low cost water (\$0.37 per kilolitre⁵⁰), and reduce the amount of flooding and nutrient loss (which occurred during the Gippsland floods in 2007).⁵¹

Plug the Pipe's submission notes that any diversion placed on the Aberfeldy River may impact on flows available to the Maffra/Macalister Irrigation District.⁵² The submission suggested that instead, a diversion of the Big or Black Rivers should be considered. Plug the Pipe argued that water sourced from these rivers would require minimal treatment and have minimal environmental

August 2008, p. 8; Plug the Pipe, *Submission*, no. 84, 29 August 2008. Attachment 1 p. 1-3; Citizens for Sustainable Water, *Submission*, no. 65, 29 August 2008, p. 35; R. Barraclough, *Submission*, no. 88, 8 September 2008, p. 4; G. Crapper, *Submission*, no. 62, 29 August 2008, pp. 1-23.

⁴⁵ Institute of Public Affairs, *Submission*, no. 98, 6 October 2008, p. 16.

⁴⁶ Victorian Farmers Federation, *Submission*, no. 9, 1 August 2008, p. 8.

⁴⁷ *Ibid*, p. 8.

⁴⁸ G. Crapper, *Submission*, no. 62, 29 August 2008, pp. 1-23; Citizens for Sustainable Water, *Submission*, no. 65, 29 August 2008, pp. 32-35; P. Gaynor, Victorian Water Forum, *Transcript of evidence*, Melbourne 10 November 2008, p. 3; R. Barraclough, *Submission*, no. 88, 8 September 2008, p. 4.

⁴⁹ G. Crapper, *Submission*, no. 62, 29 August 2008, p. 3; Citizens for Sustainable Water, *Submission*, no. 65, 29 August 2008, p. 33.

⁵⁰ Citizens for Sustainable Water, *Submission*, no. 65, 29 August 2008, p. 34.

⁵¹ G. Crapper, *Submission*, no. 62, 29 August 2008, pp. 1-23.

⁵² Plug the Pipe, *Submission*, no. 84, 29 August 2008. Attachment 1. p.1

impact.⁵³ The submission reported the volume of water available from these two schemes to be between 80-100 gigalitres annually.⁵⁴ The Sinclair Knight Merz report noted that the Big River and Black River diversion schemes could provide between 31 and 43 gigalitres per year respectively, but that both schemes would pose a significant barrier to fish passage, sediment transport and reduce the availability of water for agricultural production.⁵⁵

Plug the Pipe's submission also suggested that the construction of a storage reservoir on the Macalister River upstream of the Glenmaggie Reservoir should be considered. Plug the Pipe believe that the reservoir would provide irrigators with an increased security of supply, and reduce the volume of water released from Thomson Dam for irrigation purposes making it available for metropolitan use.⁵⁶

Dams in other jurisdictions

Advice provided to the Committee whilst overseas indicated that some jurisdictions are not constructing new dams due to their environmental impacts. The Committee notes that the future role of dams in providing urban water supplies is not a management issue unique to Victoria.

The United States of America

As part of its investigations the Committee was briefed by representatives of the Bureau of Reclamation, United States Department of the Interior, on the role of dams in the United States of America. Mr Michael Hood, Senior International Affairs Specialist informed the Committee that, beginning in the early 1900s, the Bureau had been responsible for the construction of most of the major water infrastructure in the United States, including the Hoover and Grand Coulee dams, and is now responsible for the operation of more than 350 dams.⁵⁷ However Mr Hood also noted, that the Bureau had not constructed a new dam since the 1970s and that it was now considered unlikely that another major dam would be built in the United States due to the environmental impacts and costs associated with dam construction combined with a lack of political will.⁵⁸ Mr Hood informed the Committee that some dams in the USA, which were built in the 1930s and 1940s, are now being demolished in an attempt to address the environmental and other impacts caused by their construction.⁵⁹

The Committee was also advised that the viability of some dams in the USA is subject to a number of additional recent pressures. Perhaps most notable among these is a predicted decline in future storage levels for some major

⁵³ Ibid. p.2

⁵⁴ Ibid. p.2

⁵⁵ Sinclair Knight Merz in association with Parsons Brinkerhoff, *Eastern Water Recycling Proposal: Alternative Options to Meet Long Term Demands - Dams*, Sinclair Knight Merz, Melbourne, 2005, pp. vi-vii.

⁵⁶ Plug the Pipe, *Submission*, no. 84, 29 August 2008. Attachment 1. p. 3.

⁵⁷ M. Hood, Senior International Affairs Specialist Bureau of Reclamation, United States Department of the Interior, Meeting in Washington, 20 November 2008

⁵⁸ Ibid

⁵⁹ Ibid

dams. This point was reinforced by Mr Michael Hood who referred to work by the National Sciences Academy of the United States which suggests that the last half of the 20th century may have been a relatively wet period in historical terms for the Colorado River.⁶⁰ Mr Hood went on to note that the combined effects of drought, climate change, population growth and increased security challenges, posed serious water policy challenges for the future.⁶¹

The effect of these pressures is illustrated at Lake Mead, on the Colorado River behind the Hoover dam, where the storage level has been falling since October 1998. Lake Mead is one of the most important water resources in the western United States and is one of the world's largest water reservoirs which, since the 1930s, has supplied water to farms, homes and businesses in Arizona, Nevada, California, and northern Mexico.⁶² As at 25 October 2007, the level of the lake had fallen to 46 per cent capacity.⁶³ While the level of Lake Mead has fallen to similar or lower levels on occasions during preceding decades,⁶⁴ a 2008 report on the status of Lake Mead by scientists at the Scripps Institution of Oceanography has predicted that there is now a 50 per cent probability of the lake becoming completely dry by 2021, due to climate change and overuse of water from the Colorado River.⁶⁵

Singapore

The Committee inspected a new reservoir which has been constructed in the centre of Singapore city – the Marina Barrage. The Marina Barrage extends 350 metres across the mouth of the Marina Channel and is now the largest of Singapore's 15 reservoirs with a catchment area of around 10,000 hectares – approximately one-sixth of the country's total landmass. Located in the centre of the city, construction of the Marina Barrage began in early 2005 and the Barrage was officially opened on 31 October 2008.⁶⁶

The Marina Barrage incorporates a system of nine hydraulically operated steel gates, spaced along the length of the dam wall, which, combined with natural flushing and tides, will create a freshwater reservoir over a period of one to two

⁶⁰ M. Hood, Senior International Affairs Specialist Bureau of Reclamation, United States Department of the Interior, Meeting in Washington, 20 November 2008. See also: The National Academies, 'Colorado River Basin Water Management: Evaluating and Adjusting to Hydroclimatic Variability', viewed 15 May 2009, <http://dels.nas.edu/dels/rpt_briefs/colorado_river_management_final.pdf>.

⁶¹ M. Hood, Senior International Affairs Specialist Bureau of Reclamation, United States Department of the Interior, Meeting in Washington, 20 November 2008.

⁶² See: NASA, 'Drought Lowers Lake Mead', viewed 15 May 2009, <<http://earthobservatory.nasa.gov/Features/LakeMead/>>; U.S Department of the Interior, 'Lake Mead - Low Water', viewed 15 May 2009, <<http://www.nps.gov/lame/naturescience/lowwater.htm>>.

⁶³ University of Nebraska-Lincoln, 'Lake Mead Elevation at Hoover Dam Continues to Fall', viewed 15 May 2009, <<http://www.hprcc.unl.edu/nebraska/Lake-Mead-2007.html>>.

⁶⁴ For a graph showing the October elevations of Lake Mead from 1938 to 2007 see: Dr. Ken Dewey, University of Nebraska-Lincoln, 'Lake Mead Elevation at Hoover Dam Continues to Fall', viewed 15 May 2009, <<http://www.hprcc.unl.edu/nebraska/Lake-Mead-2007.html>>.

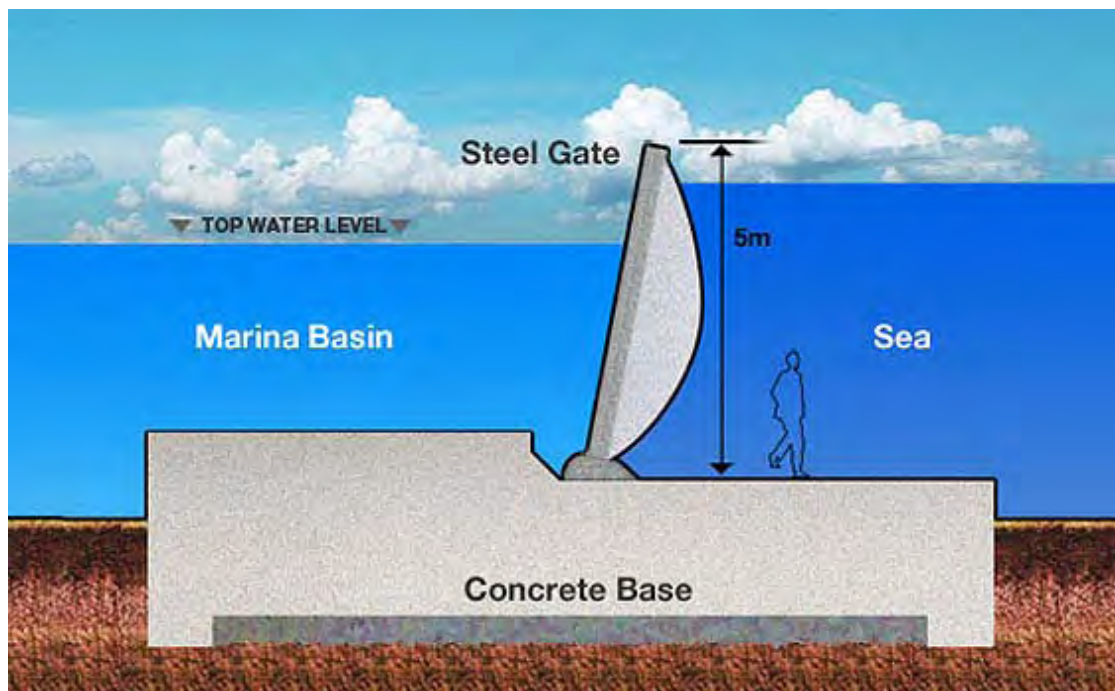
⁶⁵ Arachnoid, 'Lake Mead Water Levels — Historical and Current', viewed 15 May 2009, <<http://www.arachnoid.com/NaturalResources>>

⁶⁶ Singapore Public Utilities Board, 'Marina Barrage', viewed 25 February 2009, <<http://www.pub.gov.sg/marina/Pages/default.aspx>>; V. Chew, 'Marina Barrage', viewed 25 February 2009, <http://infopedia.nl.sg/articles/SIP_1387_2008-12-24.html>.

years.⁶⁷ The freshwater will then be treated using reverse osmosis membrane technology prior to consumption. When operational, the Marina Reservoir will meet more than 10 per cent of Singapore's current water demand.⁶⁸

The Marina Barrage will also form part of a flood control system for the city's low-lying areas, including Chinatown, Boat Quay, Jalan Besar and Geylang. During periods of heavy rain, the dam's series of nine crest gates will be opened to release excess stormwater into the sea at low tide. During high tides, excess stormwater will be expelled into the sea by large pumps which have the capacity of pumping an Olympic-sized swimming pool each minute.⁶⁹ Figures 8.4 provides a cross-section of one of the dam's steel gates.

Figure 8.4: Cross-section of Marina Barrage gate



Source: Singapore Public Utilities Board, 'Marine Barrage: Scheduled Operation of Gates and Pumps', viewed <<http://www.pub.gov.sg/marina/operation/Pages/default.aspx>>.

Discussion

The Committee was particularly interested in the advice it received from US water experts on the trend away from building dams in the US on the basis of environmental effects and costs, and the move towards decommissioning old dams for various reasons. The Committee also acknowledges the compelling evidence it received from experts such as Professor Tony Wong from Monash University who cautioned that under a worst-case scenario in terms of peak

⁶⁷ Singapore Public Utilities Board, 'Marine Barrage: Scheduled Operation of Gates and Pumps', viewed 15 May 2009, <<http://www.pub.gov.sg/marina/operation/Pages/default.aspx>>.

⁶⁸ Singapore Public Utilities Board, 'Marine Barrage', viewed 25 February 2009, <<http://www.pub.gov.sg/marina/Pages/default.aspx>>.

⁶⁹ Ibid.

flow into our current dams, Melbourne's dams will never fill again.⁷⁰ Furthermore the Committee understands that Melbourne may experience a second significant drop in the level of its inflows to water storages, as has been the case in Perth. In Perth, as a consequence of a climatic shift, planners are examining water supply scenarios where they do not source water from dams.⁷¹

Given the current climate change predictions and that over 80 per cent of Melbourne's water supply is rainfall dependent, the Committee believes that there is an urgent need to diversify the city's water supply rather than invest in the construction of new dams. On this basis alone the Committee does not support the option of supplementing Melbourne's water supply with new dams.

Furthermore the Committee understands from the SKM report that there are environmental impacts of constructing a dam that cannot be managed, including connectivity, sediment transport, nutrient/carbon transport, scouring downstream of the dam, loss of productive land and loss of habitat (including native vegetation and threatened species habitat).⁷² The two likeliest options, by volume - Mitchell River and Hume Corridor – have significant drawbacks. As noted above the environmental impacts of the Mitchell River option were nearly all rated moderate to severe. The Hume Corridor option has social consequences and would impact on agricultural production.

Accordingly the Committee recommends that:

Recommendation 8.1

No additional dams be constructed to supplement Melbourne's water supply.

Timber harvesting and catchment management

The ENRC's Inquiry into the *Impact of Public Land Management Practices on Bushfires in Victoria*, 2008 identified that the threat of bushfires in the water supply catchments poses "a clear risk to the quantity and quality of Victoria's water supplies".⁷³ This threat was realised during the Victorian bushfires of February 2009 when parts of the upper reaches of the Maroondah, Upper Yarra and O'Shannassy catchments were damaged.⁷⁴ As a precaution, water was transferred to other reservoirs in an effort to protect water quality.⁷⁵

⁷⁰ T. Wong, Chief Executive Officer, Facility for Advancing Water Biofiltration, Honorary Professorial Fellow, School of Geography and Environmental Science, Faculty of Arts, Monash University, *Transcript of evidence*, Melbourne, 27 October 2008, p. 5.

⁷¹ J. Langford, Director, Uniwater, Department of Civil and Environmental Engineering, The University of Melbourne, *Transcript of evidence*, Melbourne, 27 October 2008, p. 2.

⁷² Sinclair Knight Merz in association with Parsons Brinkerhoff, *Eastern Water Recycling Proposal: Alternative Options to Meet Long Term Demands - Dams*, Sinclair Knight Merz, Melbourne, 2005, p. ii.

⁷³ Environment and Natural Resources Committee, *Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria*, Melbourne, 2008, p. 89.

⁷⁴ Melbourne Water, *Update on Bushfires in Catchments*, Media Release, 10 February 2009.

⁷⁵ ABC News, 'Fire-affected catchments emptied to save water supply', viewed 16 February 2009, <<http://www.abc.net.au/news/stories/2009/02/16/2492035.htm>>.

Some submissions to the bushfire inquiry advocated particular forms of timber harvesting – thinning for example – as a means of regulating fuel loads in Victoria’s forests and thereby preventing bushfires of the scale and intensity experienced in recent years.⁷⁶ The Committee found that there is a need for an increase in the extent and frequency of prescribed burning in water catchment areas to mitigate the risks associated with future bushfires.⁷⁷

The Committee received conflicting evidence in relation to timber harvesting within Melbourne’s water catchments. Advocates for timber harvesting argued that the active management of forests can substantially increase water yields in the catchments of dams. In contrast, a number of stakeholders argued that timber harvesting within catchments should be banned as the new tree growth after harvesting uses more water than old tree growth.

Submissions received by the Committee referred to both logging and thinning. The Committee assumes that those submissions advocating for the cessation of logging refer to any form of timber harvesting.

Melbourne’s water catchments are granted a higher level of protection from timber harvesting than State forests due to concerns about the possible impact of harvesting on water quality and yields. The Australian Conservation Foundation informed the Committee that Yarra River tributaries which include the Cement, Armstrong, Starvation and McMahon’s creeks, are open to logging despite a 1999 pre-election commitment to exclude logging from Melbourne’s closed water catchments.⁷⁸ The Victorian Association of Forest Industries’ (VAFI) submission noted that approximately 265 hectares (0.17 per cent) of Melbourne’s water catchment has been harvested each year over the past two decades.⁷⁹

In 2004 as part of *Securing Our Water Future Together* (Action 2.21) the Victorian Government commenced the Harvesting in Water Catchments study. The project, more commonly referred to as the “Wood and Water Project”, aims to:

- undertake hydrological studies on the impact of logging on water yield of catchments in State forests supplying water to Melbourne;
- develop options aimed at improving the water yield, including potential changes to management practices and phasing out logging in these areas;
- assess the feasibility of establishing plantations outside State forests to offset any reductions in timber availability. This will be informed by the results of modelling and mapping work on high, medium and low hydrologic impact zones for plantations; and

⁷⁶ Environment and Natural Resources Committee, *Inquiry into the Impact of Public Land Management Practices on Bushfires in Victoria*, 2008, p. 169.

⁷⁷ Ibid p. 90.

⁷⁸ Australian Conservation Foundation, *Submission*, no. 90, 11 September 2008, p. 4.

⁷⁹ Victorian Association of Forest Industries, *Submission*, no. 92, 18 September 2008, p. 2.

- investigate the economic, social and environmental benefits and costs of these options.⁸⁰

On completion of these studies, “the Government will report on the findings of these studies and begin consultation with the timber industry, the community, and other stakeholders to develop a long term plan that will aim to improve water yield outcomes for Melbourne’s catchments, while continuing to meet timber supply commitments”.⁸¹

Technical studies for the project were completed in October 2008.⁸² Project research that has been released estimates that the cessation of timber harvesting in the Thomson, Tarago, Bunyip and Yarra Tributaries catchments would yield 5.1 per cent per annum (15 gigalitres) more water in 2050 compared to the current yield which allows for the harvesting of a maximum of 340 hectares per annum within the catchments.⁸³

Stakeholder evidence

The Committee received a number of submissions advising that if logging ceased, water yield would increase. The volumes of savings varied between submissions.⁸⁴

Dr Ian McPhail, Commissioner for Environmental Sustainability expressed support for the banning of logging in catchments noting that in addition to regrowth reducing water yield, the logging process also creates silt runoff. Dr McPhail informed the Committee that:

I believe there should not be logging in the water catchments for Melbourne. I am not saying there should not be old-growth forestry, but I am saying not in the water catchments. The reason was fairly straightforward for me. I went to visit the Thomson catchment at one stage, up through some of that magnificent country from Gippsland, and I thought, as a New Zealander of a long time ago, that they were in fact snigging out the valuable logs — in other words, they were pulling them out overhead as they do in other countries. But they were not; they are clear-fell. As far as I am concerned I would like to put to the vote, if you like, those who would support the mosaic logging of the Yarra catchment, which was closed in the 19th century. If the answer was yes to that, I would be interested in the discussion on the Thomson. But the reality is we need to maintain the highest quality water that we can. There was somebody speaking earlier who was right: re-growth does actually increase water

⁸⁰ Department of Sustainability and Environment, *Securing Our Water Future Together*, Victorian Government, Melbourne, 2004, p. 36.

⁸¹ Ibid

⁸² Department of Sustainability and Environment, 'Harvesting in Catchments', viewed 15 May 2009, <<http://www.ourwater.vic.gov.au/environment/harvesting-in-catchments>>.

⁸³ Department of Sustainability and Environment, *Research Results for 'Wood and Water Project': using the latest science to develop a future management plan for State forests supplying water to Melbourne*, Victorian Government, Melbourne, 2004, pp. 1-4.

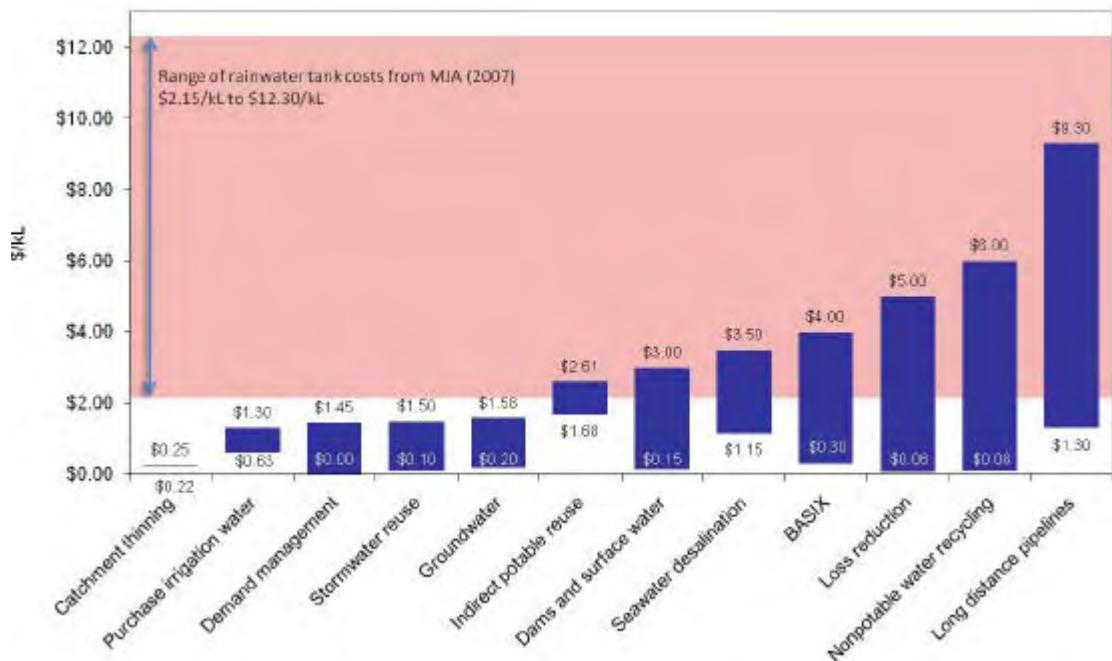
⁸⁴ Department of Sustainability and Environment, 'Harvesting in Catchments', viewed 15 May 2009, <<http://www.ourwater.vic.gov.au/environment/harvesting-in-catchments>>; Citizens for Sustainable Water, *Submission*, no. 65, 29 August 2008, p. 9; Protectors of Public Lands Victoria Inc., *Submission*, no. 96, 19 September 2008, p. 2; Australian Conservation Foundation, *Submission*, no. 90, 11 September 2008, p. 4.; Environment Victoria, *Submission*, no. 58, 29 August 2008, p. 12.

absorption by the new plant. But it is more than that; it is just the fact that the clear-felling allows surface runoff, silt runoff, the whole works, which then adds to the cost of water treatment as it comes into the system.⁸⁵

The Yarra Riverkeepers also informed the Committee that logging reduces runoff into reservoirs and catchments, negatively impacting upon rivers and water supply. The Yarra Riverkeepers recommend that logging “must be stopped as a matter of urgency”.⁸⁶

Both the Environment Victoria and Institute for Public Affairs submissions⁸⁷ noted work undertaken by Marsden Jacob Associates which illustrated that catchment thinning is one of the cheapest water augmentation options - between \$0.22 and \$0.25.⁸⁸ The work compared the direct costs of a range of water supply options based on water supply plans for Sydney, Perth, Adelaide, Newcastle and NSW Treasury cost estimates (see Figure 8.5).

Figure 8.5: Direct costs of water supply/demand options for Sydney, Adelaide, Perth and Newcastle



Source: Marsden Jacob Associates, *The Economics of Rainwater Tanks and Alternative Water Supply Options: A Report Prepared for Australian Conservation Foundation, Nature Conservation Council (NSW) and Environment Victoria 2007*, p. 13.

⁸⁵ I. McPhail, Commissioner for Environmental Sustainability, *Transcript of evidence*, Melbourne, pp. 5-6.

⁸⁶ Yarra Riverkeepers, *Submission*, no. 56, 29 August 2008, p. 4.

⁸⁷ Environment Victoria, *Submission*, no. 58, 29 August 2008, p. 10.; Institute of Public Affairs, *Submission*, no. 98, 6 October 2008, p. 8.

⁸⁸ Marsden Jacob Associates, *The Economics of Rainwater Tanks and Alternative Water Supply Options: A Report Prepared for Australian Conservation Foundation, Nature Conservation Council (NSW) and Environment Victoria 2007*, p. 13.

In contrast, to the anti-timber harvesting evidence the Victorian Association of Forest Industries (VAFI) argued that:

VAFI believe that a program of thinning of regrowth forest could be undertaken to maximise water yield. This approach has been tested in research trials in Victoria and Western Australia and is being considered under action 2.21 [of Our Water Our Future: Securing Our Water Future Together] as an element of potential forest management regimes.⁸⁹

The potential increase in water yield reported by VAFI is supported by catchment thinning work being undertaken in the Wungong catchment in Western Australia.⁹⁰ The Wungong catchment covers an area of approximately 13,000 hectares which is predominantly State Forest.⁹¹ The catchment is a mosaic of differing tree types and age profiles, and contains no old growth forest.⁹² The preferred primary thinning option involves treating the tree with herbicide which leaves the tree standing. In contrast to felling the tree this approach is far cheaper and makes it easier to carry out a burn after the thinning as there is less accumulated ground fuel.⁹³ Thinning will be conducted in approximately 62 per cent of the catchment area with a focus on non-commercial thinning.⁹⁴

The Wungong Catchment Environment and Water Management Project is expected to restore four to six gigalitres of runoff water to the Wungong Dam per year through the thinning of selected trees.⁹⁵ Preliminary research indicates that the equivalent to one gigalitre of additional water was generated for each 1,000 hectares thinned.⁹⁶

The Project Implementation Plan for the thinning trial noted the benefits of the scheme to include:

- an increased average runoff of 20-25 per cent compared to runoff without treatment over the 12 year trial;
- possible increase in aquatic diversity;
- reduced CO₂ emissions by reducing reliance on pumping for a new water supply source; and

⁸⁹ Victorian Association of Forest Industries, *Submission*, no. 92, 18 September 2008, p. 2.

⁹⁰ The DSE define thinning as the harvesting of a selection of some of the trees in a forest stand in order to increase the growth rate, health or wood quality of the remaining trees and in some water catchments is used as a means of increasing water yields from forests.

⁹¹ Water Corporation, *Wungong Catchment Environment and Water Management Project*, Western Australia Water Corporation, Perth, 2005 p. 6.

⁹² *Ibid* p. 3.

⁹³ *Ibid*. p. 5.

⁹⁴ *Ibid*.

⁹⁵ *Ibid*.

⁹⁶ *Ibid*, p. 6.

- deferral of new water supply developments.⁹⁷

Recent research and monitoring of the project released in 2008 states that:

Streamflow quantity and quality monitoring of the first treated area (TA1) has shown no adverse impact on water quality. Also there is no apparent increase in runoff, which is not unexpected as it could require a further one or two winters before any additional water released into the soil and groundwater is observed in streamflow.⁹⁸

It is anticipated that the project will run for 12 years and will cost about \$20 million, which is a unit cost of approximately \$0.25 per thousand litres.⁹⁹ The Committee notes that this unit cost is within the range of the Marsden Jacob data.

In addition to an increase in water yields, VAFI note that active forest management, such as thinning of the water supply catchments, also creates economic, social and environmental benefits. For example, the presence of skilled personnel and forestry access tracks are an important part of a risk minimisation approach to fire management.¹⁰⁰ Similarly, VicForests' submission to the inquiry recognises the economic benefits of timber production within Melbourne's water catchments noting its contribution to Victoria's regional economy, particularly in the Yarra Valley, West and Central Gippsland and Central Highlands.¹⁰¹

Discussion

The Committee understands that a considerable level of debate remains regarding the impact of timber harvesting activities on water yields within Melbourne's water catchments. It is generally accepted that following a disturbance such as thinning, catchment water yields will typically experience a significant increase. For example, a 2001 paper by Patrick Lane and Stephen Mackay which examined a thinning project in NSW noted an increase in streamflow after thinning, with water yields increasing by 31 per cent in the first four years before returning to pre-treatment levels.¹⁰² The Committee note however that there is a lack of continuous long term monitoring of the impact of thinning on water yields, with the Committee advised that monitoring of Melbourne's catchment yields tapered off during the late 1980s and early 1990s.¹⁰³ The Committee were advised that the University of Melbourne is in the process of reviewing some of these projects.

⁹⁷ Water Corporation, *Wungong Catchment Trial: Project Implementation Management Plan*, Western Australia Water Corporation, Perth 2008, p. 5.

⁹⁸ *Ibid*, p. 3.

⁹⁹ Water Corporation, *Wungong Catchment Environment and Water Management Project*, Western Australia Water Corporation, Perth, 2005 p. 6.

¹⁰⁰ Victorian Association of Forest Industries, *Submission*, no. 92, 18 September 2008, p. 2.

¹⁰¹ VicForests, *Submission*, no. 27, 22 August 2008, p. 1.

¹⁰² P. Lane and S. Mackay, *Streamflow response of mixed-species eucalypt forests to patch cutting and thinning treatments*, *Forest and Ecology Management* 143, 2001, pp131-142

¹⁰³ L. Bren, Associate Professor, University of Melbourne, *personal communication*, 19 May 2009.

The Committee also notes that intense bushfires are the most significant risk to Melbourne's water supply catchments. Accordingly, the Committee recommends that:

Recommendation 8.2

In order to quantify the effects of thinning and prescribed burning (in appropriate areas) in Melbourne's water catchments, the Victorian Government initiate a detailed investigation and trial.

**Adopted by the Environment and Natural Resources Committee
25 May 2009**