REVIEW OF WATER RESTRICTIONS

Volume 1 – Review and Analysis

Final Report

For National Water Commission

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Currency of this report

The research presented in this report was completed during December 2006 to August 2007. The research, including perspectives and evidence collected from personal communications, is current only for that period.

Since August 2007, there have been changes to drought situations, restrictions policies, and urban water systems and planning.

Changes which have occurred since August 2007, including further evidence or studies into the costs and benefits of restrictions, are not reflected in this report.

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We would also like to thank our many colleagues for their input, advice, ideas and support throughout this study.
Executive Summary

This project is designed to enhance governments’, stakeholders’ and the National Water Commission’s understanding of the nature and effectiveness of water restriction policies across Australia. The project aims to assist NWI Parties meet their commitment under paragraph 91 (iii) of the National Water Initiative, where States and Territories agreed to:

_Review the effectiveness of temporary water restrictions and associated public education strategies and assess the scope for extending low level restrictions as standard practice._

Temporary restrictions and permanent water conservation measures (permanent restrictions) have very different potential roles in urban water management and planning. Although in some locations restrictions have been in place continuously for several years, these restrictions are categorised as temporary restrictions, as they have been implemented as a drought response. Nevertheless, there may be some perceptions within the community that temporary restrictions may not be lifted.

Temporary restrictions can delay the time to which available water (eg. in storages) decreases to the point where other options are required. Therefore, in terms of long-term planning, the suite of water options required to ensure an adequate water supply depends on the water savings that can be expected from the temporary restrictions implemented during droughts. These savings are a function of the acceptable frequency, duration and severity of restrictions (“levels of service”). In contrast, permanent restrictions act to permanently reduce water demand over time.

There are a wide variety of perspectives on the appropriateness of restrictions as a water management option. Some commentators and decision-makers oppose restrictions because, by definition, they impose on water users’ flexibility to choose how and when water is used. Others favour restrictions as a drought response measure, because of community support and the perceived equity of restrictions compared to other potential options such as pricing. Many agencies and organisations involved in planning for water supply systems (including at least some regulators) view restrictions as a cost-effective way to avoid the need to “gold-plate” supply infrastructure systems.

The overall assessment framework used in this review was to examine the cost-effectiveness of restrictions, in terms of meeting the underlying objective of ensuring adequate water availability at least cost (including environmental, social and economic costs and benefits). Costs and benefits include those which arise due to the imposition of restrictions’ rules on water users, and the resultant impacts on suppliers of water use technologies or products (eg. manufacturers and distributors of irrigation equipment). Because restrictions, if included in the portfolio of options, may mean that the water supply adequacy objective can be met without needing to implement other supply, demand management and/or incentive options (which have costs and benefits), the impacts of restrictions also include the avoided portfolio costs and benefits. These necessarily vary with location, and therefore a case study approach has been taken to assess the cost-effectiveness of restrictions.
A lack of comprehensive data and monitoring has posed a number of limitations on this review, in particular the quantitative assessment of the water savings due to specific restrictions rules (eg. sprinkler ban versus lawn-watering ban?), as well as monetary assessment of the costs of restrictions on households, the community and businesses. In particular, there is a lack of comprehensive information available about the effectiveness or costs of more recent severe restrictions (eg. involving bans on sprinkler use or all outdoor water use). This review has therefore used a number of quantitative and qualitative information sources including weather-corrected demand models, historical water consumption data, interviews with urban water utilities, industry representatives (including from swimming pool, car wash, irrigation equipment, turf producers and nursery and garden industries), community representatives (including public advocacy organisations and social services councils and providers), any available studies attempting to measure the impacts of restrictions in dollar terms, and community attitudes surveys. Full public consultation was however beyond the scope of the Terms of Reference.

**Permanent restrictions: description, effectiveness, costs and benefits**

As at August 2007, permanent water conservation measures (permanent restrictions rules) had been established for metropolitan locations in Victoria, South Australia and the ACT (although these are over-ridden by temporary restrictions rules). Most of the permanent rules reflect basic water-efficient practices such as restricting daytime use of sprinklers. Utilities have estimated savings due to permanent restrictions in the range of 4% to 9%, however these estimates are based on bulk supply figures – because the purpose of these estimates has generally been to adjust long-term projections of demand rather than to evaluate cost-effectiveness, the accuracy of these figures is not high.

The industry and community representatives contacted for this review did not raise concerns about the specific permanent restrictions rules currently in place – greater concern, if expressed, was raised for temporary restrictions rules which are currently far more severe in nature. Nevertheless, concern was raised by industry representatives about whether adequate information or analysis was used to underpin the design of restrictions rules. Specific concern was raised that permanent restrictions were not designed to reflect the most cost-effective approach to long-term demand management, but were simply “low levels of temporary restrictions made permanent”. Industry representatives suggested that far greater opportunities exist to design and implement permanent restrictions in a way which better complements and integrates with other programmes that encourage water-use efficient practices and technologies and the use of non-potable water sources.

**Temporary restrictions: description, effectiveness, costs and benefits**

Across Australian locations, restrictions regimes (sets of rules, stages, triggers and levels of service) vary considerably. Consistency of rules applying at a specified stage or level does not apply Australia-wide, although consistent definitions apply within Victoria and within Western Australia.
Temporary restrictions rules generally target residential and non-residential water uses (although some overlaps apply):

- Residential water use restrictions include a combination of rules on types, timing and technologies (methods) of water use. The main types of water uses that are restricted include gardens and lawns, swimming pools and spas, and the washing of vehicles and other hard surfaces. In most locations, residential restrictions apply to water sourced from mains or town water. Savings appear to be achieved through a mixture of promoting water-use efficiency (eg. trigger hoses, restricting timing of water use), making water use less water-efficient and more time- or energy-intensive for water users (eg. banning sprinklers but allowing buckets), and outright bans on specific water uses (eg. lawns, pools).

- A range of approaches are taken to restricting non-residential water uses, including rules on specific uses, specific exemptions, the requirement of water efficient management plans.

Across Australia, utilities and government agencies responsible for implementing restrictions have emphasised that education, awareness-raising and promotion are central to achieving water savings through restrictions. To date, legal provisions for enforcing restrictions through the court system have not been implemented. The extent to which water businesses issue on-the-spot fines (about $100 to $500) varies, but fines are usually only issued after second or third offences. Community groups contacted for this review did not express particular concerns about the enforcement of restrictions.

Ideally, measuring water savings due to restrictions would be estimated by collecting information and data about the extent to which specific water restrictions rules affect residential and non-residential water use behaviour. However, to date the comprehensive data required does not exist. This could at least in part reflect that in many locations, the most recent restrictions are of a type and severity that had not been previously implemented. The opportunity for gathering end-use data on the impacts of restrictions has only emerged as the restrictions in place continued over a period of time.

Nevertheless, given the absence of end-use data available at the time of the report, estimating savings was limited to using available data on total consumption – that is, metered total consumption observed during restrictions less total consumption estimated to have occurred in the absence of restrictions. Depending on location and stage of restrictions, and using a range of methods to correct for the impacts of weather, savings of between 8% and 33% have been estimated. Due to aggregation, estimates for most locations include savings due to any other demand management programmes. However, due to the limited contribution of savings from demand management in most locations, at the time of this analysis, this effect is not considered significant relative to the savings due to restrictions.

The impacts, and hence acceptability, of a restrictions regime also depend on various factors including:
• The severity of restrictions (eg. Sprinklers allowed twice a week versus total outdoor water ban);

• The duration of restrictions (eg. Two months versus four years);

• Time of year imposed (eg. Winter versus summer);

• The recurrence interval (eg. One summer in ten versus four summers in a row)

The extent to which information was available about the impact of restrictions overall, or individual restrictions rules, varied across different locations. In this study, a range of views and evidence was sought to identify and (where possible) measure the costs and benefits of temporary restrictions:

• Only one publicly available survey existed that attempted to determine the community’s willingness to pay to avoid restrictions, in dollar terms. This survey of Canberra residents was conducted prior to experience with current levels of restrictions and posed only a limited set of restrictions scenarios – particularly comparing “continuous” to “never”. Studies which have used these figures to extrapolate costs to other frequencies, severities and durations are unlikely to be accurate.

• A review of community attitudes surveys found significant support for low-level restrictions (however these surveys were all conducted prior to experience with severe restrictions such as outdoor water bans).

• The greatest impacts on recreational areas, due to the nature of rules, have most likely been in the ACT and Victoria. A number of potential impacts of reduced recreational areas have been identified by the Municipal Association of Victoria Sports Surfaces Taskforce, including loss of participation in source and associated impact on community health, community pride and spirit; rise in antisocial behaviour, and a loss of employment – with particular impacts in rural and regional areas.

• Industry representatives contacted for this review reported that impacts from restrictions arose due to affected sales, and that these costs were particularly great where restrictions applied to specific water uses (eg. lawn watering, affecting turf producers) or technologies (eg. sprinkler and dripper bans). Concern was raised that restrictions limit, rather than encourage, water-use efficient practices and technologies.

**Case studies: restrictions in the portfolio of options**

The case studies of Perth, ACT and Sydney presented in this report demonstrate a repeatable approach for assessing both the costs and benefits of restrictions against a suite of other options – including supply augmentation and demand management. This approach, in which the least-cost combination of options is selected to meet supply security objectives, enables the potential role of restrictions as a targeted drought response option with short lead times to be evaluated with respect to its
costs (to the community as a whole) and benefits (in terms of avoided costs of alternatives).

Due to differences in public availability of information and data for each case study location, the scope and approach taken also differed between case studies. In general terms, the broad approach taken in each case study included:

- Estimating or using estimates of water savings from restrictions (using climate-corrected demand models)

- Looking back over the current or most recent drought, the duration of which varies between locations:
  - Evaluating the additional investment which would have been required prior to the introduction of restrictions, to save or supply the equivalent amount of water saved by restrictions, that is, the avoided cost of investment, calculated over the most recent drought period
  - Examining available quantitative and qualitative evidence on the cost of restrictions to households, industry, local government and utilities over this past drought period.

- Looking forward, over timeframes consistent with each location’s long-term water supply-demand management planning:
  - Estimating the cost of portfolio options required under different ‘restrictions scenarios’, ie. Different levels, durations or frequencies of restrictions
  - Estimating the cost of these restrictions scenarios over this period.

- Identifying any lessons for planning and designing restrictions in the future.

The case studies revealed that restrictions have been effective in reducing water demand. This refers to the effectiveness of an overall set of restrictions, as data was not available to evaluate the effectiveness of specific rules.

By reducing the pressure on rain-fed supplies during drought, a key benefit is that restrictions overall have helped to decrease the probability that costly decisions about alternative sources of supply are needed.

This report also details feedback from industries that restrictions on specific technologies impose high costs on specific industries. However, as there is great uncertainty about cost estimates, it is not possible to rely on monetary measurements of costs to determine whether the costs of restrictions (to mid-2006 for Sydney and Canberra, and until end-2006 for Perth) outweigh the benefits. There is, however non-monetary evidence (from surveys) indicating that the community accepts and recognises the water management value of low levels of restrictions.

Looking forward to incorporate more recent information into future planning, several lessons can be drawn from the case studies:
Perth

- To date, the negative impacts of restrictions on households and industries have not been substantial. This is most likely because, through a process of consultation with industries and the community, the WA Water Corporation has limited the nature and extent of outdoor water restrictions.

- The WA Water Corporation’s planned investigation of community values regarding a sprinkler ban, if conducted in a consultative way that informs the community about the trade-offs involved, is likely to enable planners to set criteria for the expected frequency of a sprinkler ban in a way that matches society’s values.

Sydney

- In Sydney, restrictions have deferred the need for potentially costly investment in supply infrastructure by allowing the supply-demand balance to be met during droughts. This value of restrictions is particularly evident in Sydney, because of its very large existing storage capacity and because long-term climate change predictions for the area indicate that severe droughts are not necessarily part of a continuing downward trend in water supply availability.

- Nevertheless, there is a need an opportunity for reviewing and optimising the current restrictions regime, ahead of any future droughts. In consideration of existing household support for restrictions but mixed responses from industry, forward planning for restrictions should review the reliability criteria, trigger points, and restriction rules and levels.

Canberra

- The various restriction stages applied in Canberra from December 2002 to the time of this study have been effective in reducing demand. Alternatively, if all other emergency supply options (which have since been implemented) had been “brought forward” and implemented before 2001, these would have prevented the need for temporary restrictions since 2002. However, there is no conclusive evidence to suggest that these measures would have necessarily been less costly than restrictions – for example, the capital cost alone of the Cotter to Googong Bulk Transfer option would have been $25 million.

- ACTEW’s stated intention to undertake further WTP studies to gauge community attitudes towards restrictions is an important component of incorporating society’s values and attitudes – including those towards restrictions – into water supply planning.

- Carefully-designed and applied WTP surveys are one possible mechanism to determine community preferences regarding the trade-offs between restrictions and other possible options for ensuring system security, and to provide feedback to decision-makers on these tradeoffs. WTP results, like all
metrics, must be used with transparency and accountability. The tendency for “black-boxing” and scaling up WTP cost figures by arbitrary selection of assumptions must be avoided for this approach to accurately reflect community values.

Practical conclusions and recommendations

This study found that, as a way to reinforce other approaches to promoting water efficiency, permanent water conservation measures (eg. daytime water bans) receive strong support from industry – on the proviso that they are constructed with a focus on water efficiency rather than water use volume. In many locations they form part of a broader educational approach to promoting water conservation and water use efficiency, and could act to reduce long-term demand.

However, if temporary measures were to be made permanent, it would mean that they are no longer available as a tool for managing the supply-demand balance in future droughts. Furthermore, as temporary and permanent restrictions have different roles in terms of urban water management and planning, permanent water conservation measures should be designed specifically to capture long-term demand savings – for example, through integration with other demand management and water efficiency programmes. Further analysis of potential savings and ‘demand hardening’ is warranted.

In terms of temporary restrictions, filling information gaps about cost-effectiveness will enable planners to better assess what restrictions regime (in terms of rules, stages, triggers and levels of service) is most appropriate for location-specific conditions. At the time of this study, the data upon which utilities based their decisions regarding restrictions did not generally reflect detailed analysis of end-uses, or of the costs of restrictions. Opportunities exist for more detailed evaluation.

Effectiveness of restrictions, including specific restrictions rules

More detailed evaluation of the effectiveness of restrictions is important in terms of designing rules, stages, triggers and reliability criterion in a way which captures the potential of restrictions to slow down the rate of decline of storage levels during drought. Understanding how restrictions affect end uses will also help planners predict and manage the rate of bounce-back of demand once restrictions are lifted.

Importantly, evaluating the effectiveness of specific restrictions rules is essential to comprehensively evaluating the cost-effectiveness of these rules, including assessment and transparent communication of distributional effects. In many locations, restrictions are broadly based on a “hierarchy of uses”. Some utilities, acknowledging that it is value-based, also report that this is a transparent way to communicate the rationale behind restrictions rules. However, suppliers of restricted products and technologies will necessarily have a different perspective than water users. Evaluating the actual savings from specific water restrictions rules will be important to transparently weighing up the savings, distribution of impacts, and alternative options.
Current top-down analysis of aggregate water use is not sufficiently precise to enable fine-turning of restrictions rules nor to accurately predict demand hardening. To enable greater insight into the savings achieved by restrictions, and to enable more cost-effective urban water planning in general, this report recommends:

- Considering the use of more detailed demand forecasting models – for example, end-use or sector-based forecasts, rather than just historical forecasts
- Obtain information for end-use modelling – collecting data including time diaries, household interviews and questionnaires, water meters attached to specific end uses, and smart metering.

**Extend understanding of the costs, impacts and acceptability of restrictions**

The nature of the impacts of restrictions poses a number of challenges when attempting to quantify costs in monetary terms. Willingness to pay studies, if designed well and supported by other qualitative research activities, have the potential to better inform decision-makers about the magnitude of costs associated with restrictions. However, as there are many dimensions to restrictions – including frequency, duration, specific rules, exemptions, history of recent restrictions, approach to communication – these surveys invariably only capture responses to stylised restrictions sets, from which conclusions cannot meaningfully be extrapolated, inferred or transferred to different restrictions frequencies, durations or severities.

Further location-specific analysis of costs is required. However, due to the uncertainties associated with estimated dollar costs, these monetised values should be considered in conjunction with other relevant information such as attitude and preference surveys.

**Community and industry engagement in decision-making**

Several processes in the design and implementation of restrictions should reflect community values, including to:

- Determine reliability criteria
- Assess the costs of restrictions
- Assess the impacts of developing supply infrastructure.
- Assess attitudes towards uncertainty such as the risks posed by climate change on water supply security.

A number of techniques such as surveys and interviews can help elicit information about community values. However, there is also emerging evidence that key decisions about resource allocation best reflect society’s values when the community themselves are involved in the decision-making processes – such as through deliberative processes. Following the recent, extensive restrictions, there will be a timely opportunity to ensure that there is adequate community engagement in
relation to restrictions and also more generally regarding decisions between different drought response and system security options.

**Design considerations**

This review has identified a number of considerations for the design of future restrictions, including:

- Incorporating flexibility, as a way to reduce the impacts on households and the industries which support specific uses, for example through incentives and offsets (or going beyond restrictions – see below).

- Promoting water-efficiency in garden watering – buckets and cans do not have the same potential for water-efficiency as at least some types and uses of sprinklers and drippers.

- Review the reliability criterion – selecting reliability criterion has implications for supply system costs as well as the costs of any potential restrictions on the community. Consider the following issues – changes in systems characteristics; possible for reliability criteria reflecting different severities and durations; community engagement; and incorporating restrictions frequency as a stochastic variable in supply planning.

- Weigh up the potential benefits of consistency with location-specific conditions – Consistency of triggers would not allow planners sufficient flexibility to design the restrictions regime to reflect the water availability and scarcity situation in each location and point in time. As noted above, consistency of rules and stages has the advantages of clarity for water uses industries operating across locations. However, the effectiveness of these rules and stages depends on many location-specific factors, including availability and sources of water; system characteristics and types of options available; and weather and climate.

**Expand the possibilities of drought response options**

In improving the understanding of the costs, benefits and effectiveness of temporary restrictions, an opportunity also exists to assess these restrictions within a broadened scope of possible drought response options beyond temporary restrictions and pre-emptive construction of supply infrastructure. These options could include demand management and water efficiency programmes; designing options for readiness during drought, and incentive mechanisms such as rationing, pricing or urban trading. All options should be assess with full consideration of costs, benefits, sustainability and distributional impacts.
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<th>Description</th>
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<tbody>
<tr>
<td>ACT</td>
<td>Australian Capital Territory</td>
</tr>
<tr>
<td>ACTCOSS</td>
<td>ACT Council of Social Service</td>
</tr>
<tr>
<td>CUAC</td>
<td>Consumer Utilities Advocacy Centre</td>
</tr>
<tr>
<td>DM</td>
<td>Demand management</td>
</tr>
<tr>
<td>DSE</td>
<td>Department of Sustainability and the Environment (VIC)</td>
</tr>
<tr>
<td>GBP</td>
<td>Great Britain Pounds</td>
</tr>
<tr>
<td>GL</td>
<td>Gigalitres (1,000,000,000 litres)</td>
</tr>
<tr>
<td>IAA</td>
<td>Irrigation Association of Australia</td>
</tr>
<tr>
<td>IPART</td>
<td>Independent Pricing and Regulatory Tribunal (NSW)</td>
</tr>
<tr>
<td>IRP</td>
<td>Integrated Resource Planning</td>
</tr>
<tr>
<td>ISF</td>
<td>Institute for Sustainable Futures</td>
</tr>
<tr>
<td>IWSS</td>
<td>Integrated Water Supply Scheme (WA)</td>
</tr>
<tr>
<td>kL</td>
<td>Kilolitres (1,000 litres)</td>
</tr>
<tr>
<td>km</td>
<td>Kilometres</td>
</tr>
<tr>
<td>L/p/day</td>
<td>Litres per person per day</td>
</tr>
<tr>
<td>L/hh/day</td>
<td>Litres per household per day</td>
</tr>
<tr>
<td>LCP</td>
<td>Least Cost Planning</td>
</tr>
<tr>
<td>MAV</td>
<td>Municipal Association of Victoria</td>
</tr>
<tr>
<td>ML</td>
<td>Meegalitres (1,000,000 litres)</td>
</tr>
<tr>
<td>MWEPS</td>
<td>Minimum Water Efficiency Performance Standards</td>
</tr>
<tr>
<td>NGIA</td>
<td>Nursery &amp; Garden Industry Australia</td>
</tr>
<tr>
<td>NSW</td>
<td>New South Wales</td>
</tr>
<tr>
<td>NWI</td>
<td>National Water Initiative</td>
</tr>
<tr>
<td>PIAC</td>
<td>Public Interest Advocacy Centre</td>
</tr>
<tr>
<td>PV</td>
<td>Present value</td>
</tr>
<tr>
<td>PWCM</td>
<td>Permanent Water Conservation Measures</td>
</tr>
<tr>
<td>QWC</td>
<td>Queensland Water Commission</td>
</tr>
<tr>
<td>SA</td>
<td>South Australia</td>
</tr>
<tr>
<td>SEQ</td>
<td>South-East Queensland</td>
</tr>
<tr>
<td>SPASA</td>
<td>Swimming Pool &amp; Spa Association</td>
</tr>
<tr>
<td>TAMS</td>
<td>Territory and Municipal Services (ACT)</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>VIC</td>
<td>Victoria</td>
</tr>
<tr>
<td>WA</td>
<td>Western Australia</td>
</tr>
<tr>
<td>WACOSS</td>
<td>WA Council of Social Service</td>
</tr>
<tr>
<td>WEMP</td>
<td>Water Efficiency Management Plan</td>
</tr>
<tr>
<td>WTA</td>
<td>Willingness to accept</td>
</tr>
<tr>
<td>WTP</td>
<td>Willingness to pay</td>
</tr>
</tbody>
</table>
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>avoided portfolio costs and benefits of restrictions</strong></td>
<td>Those costs and benefits (of a portfolio option) that are avoided if restrictions, if included as a possible option, result in the water supply adequacy objective being met without needing to implement some other portfolio options.</td>
</tr>
<tr>
<td><strong>bounce back</strong></td>
<td>The extent and rate of increase of water use after restrictions have been lifted.</td>
</tr>
<tr>
<td><strong>demand hardening</strong></td>
<td>The reduced effectiveness of restrictions (in terms of achieving water savings) in subsequent applications.</td>
</tr>
<tr>
<td><strong>direct costs and benefits of restrictions</strong></td>
<td>Arise due to the imposition of restrictions rules on types, timing and technologies (methods) of water uses. These costs and benefits include those affecting water users, as well as suppliers of products or technologies associated with restricted water uses.</td>
</tr>
<tr>
<td><strong>discretionary uses</strong></td>
<td>Those types of water use for which customers would be less willing to pay to obtain the water, hence implying a lower value.</td>
</tr>
<tr>
<td><strong>end-use modelling</strong></td>
<td>The use of data (eg. from smart meters or surveys) on volumes and patterns of water use by specific end uses (eg. toilets, taps, pools) to estimate demand, and changes in demand due to various programmes or policies.</td>
</tr>
<tr>
<td><strong>level of service</strong></td>
<td>The desired maximum frequency, severity and duration of restrictions (Erlanger and Neal 2005). Because LOS objectives are used to communicate potential restrictions regimes to the community, they should be framed in a way which is easily understood, and in ways that matter to customers – for example, expressing frequency, severity and duration of water restrictions in terms of maximum average period of recurrence; or maximum duration that can be expected.</td>
</tr>
<tr>
<td><strong>permanent restrictions</strong></td>
<td>Restrictions on timing, types, technologies or methods of water use, that in place at all times, regardless of drought or water availability situation.</td>
</tr>
<tr>
<td><strong>readiness option</strong></td>
<td>Rainfall-independent supply infrastructure which is not yet required in terms of long-term average conditions, but might need to be brought forward in the case of an extreme drought (eg. desalination plants). These have been described as readiness options because they are planned and designed in a way where construction or implementation could proceed with relatively short lead-times if needed, or may be deferred (for example, if the drought breaks).</td>
</tr>
<tr>
<td><strong>reliability (system reliability)</strong></td>
<td>The proportion of time that a supply system is able to meet demand without temporary restrictions in place. Reliability is often expressed as the probability that restrictions will not be imposed in a given year or month.</td>
</tr>
<tr>
<td><strong>restrictions regime</strong></td>
<td>The schedule or framework of restrictions, comprising rules at different levels or stages, possible triggers for the introduction of different stages (for example, linked to dam levels), and any levels of service or reliability criterion.</td>
</tr>
</tbody>
</table>
| **stochastic data run** | A simulated data series which has the same statistical
characteristics as the historical series of data on which it was based (for example, 100 “runs” of 50 years of rainfall and runoff data which are not the actual historical values but have similar characteristics).

<table>
<thead>
<tr>
<th>temporary restrictions</th>
<th>Restrictions on timing, types, technologies or methods of water use, that have been implemented as a drought response measure, and with the intention of removing them when the drought breaks.</th>
</tr>
</thead>
<tbody>
<tr>
<td>yield</td>
<td>The yield of a supply system is the maximum volume, on average, that can be supplied by the system. The yield of a system is a function of system characteristics and operating rules, but also of rainfall and runoff.</td>
</tr>
</tbody>
</table>
PART I – BACKGROUND
1 Introduction

Water restrictions have been widespread across Australia, in many locations for longer periods or at greater severity than previously experienced. In line with the severity and duration of recent and current droughts, restrictions have been implemented with the aim of reducing consumption to assist maintaining adequate water supplies. In many locations, restrictions have prevented or deferred the need for expenditure on supply infrastructure. However, restrictions are not costless and have affected the community in various ways.

Parties to the National Water Initiative (NWI) and the broad community have raised concerns about restrictions, including:

- The extent to which restrictions are cost-effective in securing water supplies during drought, compared to other adaptive or longer-term measures, and how best to design restrictions rules and triggers.
- The extent to which the rules and triggers of restrictions, as well as other related water supply and demand management portfolio options, are designed to transparently reflect community values and consider the positive and negative impacts.
- The distribution of the costs of restrictions to certain industries and sections of the community.

By addressing these and other issues, this project is designed to enhance governments’, stakeholders’ and the National Water Commission’s understanding of the nature and effectiveness of water restriction policies across Australia. The project aims to assist NWI Parties meet their commitment under paragraph 91 (iii) of the National Water Initiative, where States and Territories agreed to:

Review the effectiveness of temporary water restrictions and associated public education strategies and assess the scope for extending low level restrictions as standard practice.

Although in some locations restrictions have been in place continuously for several years, these restrictions are categorised as temporary restrictions – that is, they are defined as those restrictions that have been implemented as a drought response measure, and with the intention of removing them when the drought breaks. In contrast, permanent restrictions, widely known as permanent water conservation measures (PWCM) or permanent water savings rules (PWSR), refer to those restrictions that are in place at all times – regardless of water supply availability. These PWCM, as currently applied, are generally much less severe than the temporary restrictions in place across Australia. In this report, ‘restrictions’ refer to temporary, drought-response restrictions and ‘PWCM’ or ‘PWSM’ refer to permanent restrictions.
1.1 Scope of metropolitan water areas

Although restrictions have been in place in many metropolitan and non-metropolitan areas across Australia, this study has focussed on reviewing and analysing restrictions in place in the metropolitan water areas specified in the terms of reference (see Table 1). The extent of data, evidence and information available to conduct this review varied significantly between different locations.

Table 1 Metropolitan water areas specified in Terms of Reference

<table>
<thead>
<tr>
<th>State or Territory</th>
<th>Metropolitan water area</th>
<th>Water businesses and other agencies responsible for planning or implementing restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>Canberra</td>
<td>ACTEW Corporation</td>
</tr>
<tr>
<td>NSW</td>
<td>Sydney</td>
<td>Metropolitan Water Directorate (previously NSW Cabinet office, now Department of Water and Energy)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sydney Water Corporation</td>
</tr>
<tr>
<td></td>
<td>Hunter</td>
<td>Hunter Water Corporation</td>
</tr>
<tr>
<td></td>
<td>Gosford/Wyong</td>
<td>Gosford/Wyong Council’s Water Authority</td>
</tr>
<tr>
<td>QLD</td>
<td>South-East Queensland/Brisbane</td>
<td>Queensland Water Commission</td>
</tr>
<tr>
<td>SA</td>
<td>Adelaide</td>
<td>SA Water Corporation</td>
</tr>
<tr>
<td>VIC</td>
<td>Ballarat</td>
<td>Department of Sustainability and Environment</td>
</tr>
<tr>
<td></td>
<td>Bendigo</td>
<td>Central Highlands Water</td>
</tr>
<tr>
<td></td>
<td>Geelong</td>
<td>Coliban Water</td>
</tr>
<tr>
<td></td>
<td>Melbourne</td>
<td>Barwon Water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yarra Valley Water, South East Water, City West Water, Melbourne Water (bulk supplier)</td>
</tr>
<tr>
<td>WA</td>
<td>Perth</td>
<td>Water Corporation of WA</td>
</tr>
<tr>
<td>NT</td>
<td>Darwin</td>
<td>Metropolitan water areas suggested in terms of reference but not included in review or not included to same level of detail, due to limited or no history of recent restrictions and/or limited available information:</td>
</tr>
<tr>
<td>TAS</td>
<td>Hobart and Launceston</td>
<td></td>
</tr>
<tr>
<td>SA</td>
<td>Eyre Peninsula</td>
<td></td>
</tr>
</tbody>
</table>

1.2 Summary of study limitations

This study has been guided by the terms of reference provided by the National Water Commission. Particular emphasis has been placed on the three main elements of the terms of reference:

3.1 Review and analysis of water restrictions policies across Australia
3.2 Analysis of the costs and benefits of water restrictions
3.3 Conclusions

Data and information availability has limited the extent to which this study has addressed individual components within these three areas. The limitations apply to data and information about:

- The effectiveness of restrictions in reducing consumption – particularly any information about specific restrictions rules or types.
The costs of restrictions on various community and industry sectors – particularly information from the most recent and severe restrictions stages. There are also limitations to the extent to which various types of costs can be measured in a meaningful way using dollar values.

The benefits of restrictions in terms of avoided economic, environmental and social costs of other water management options.

Information has not been available to the same level of detail across all Australian locations. As expected, less information is available relating to the recent and more severe restrictions, than earlier restrictions periods.

Because of the lack of available data on the monetary costs and impacts of restrictions on various sectors of the community, this review has included interviews with a number of stakeholder representatives to identify and synthesise the perspectives and information. The study was not intended to provide a comprehensive stakeholder consultation process regarding impacts and costs of restrictions. These interview results have been used to inform the study and to complement the other data gathering and analysis methods.

Further explanation of these limitations is presented throughout the report.

1.3 Timing of study and report

This study was undertaken from December 2006 to April 2007. The material presented in this report was current during this period only. Changes that have occurred since April 2007, including to restrictions policies and rules, and information about savings and costs, are not documented in this report.

1.4 Organisation of report

This report summarises the analysis undertaken by the Institute for Sustainable Futures and ACIL Tasman. The report is organised as follows.

<table>
<thead>
<tr>
<th>PART I</th>
<th>BACKGROUND</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chapter 2 outlines some of the perspectives underpinning the policy debate on restrictions.</td>
</tr>
<tr>
<td></td>
<td>Chapter 3 describes the potential role of permanent and temporary restrictions in urban water planning and management.</td>
</tr>
<tr>
<td></td>
<td>Chapter 4 outlines the overall approach followed in this review to assessing the effectiveness, costs and benefits of restrictions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART II</th>
<th>PERMANENT WATER RESTRICTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chapters 5 reviews permanent water restrictions, when they were introduced, rules, and available evidence on effectiveness (savings due</td>
</tr>
</tbody>
</table>
to permanent restrictions).

Chapter 6 reviews perspectives on the benefits and costs of permanent water restrictions (data required for monetary quantification not available).

**PART III**  
**REVIEW AND ANALYSIS OF TEMPORARY WATER RESTRICTIONS**

Chapter 7 reviews temporary restrictions rules, stages and triggers.

Chapter 8 reviews education, promotion and enforcement strategies.

Chapter 9 outlines methods to estimate savings due to temporary water restrictions, and uses available data and evidence to report on effectiveness.

**PART IV**  
**DIRECT COSTS AND BENEFITS OF TEMPORARY WATER RESTRICTIONS**

Chapter 10 outlines approaches to identifying and measuring the costs and benefits associated with temporary water restrictions, including both monetary and non-monetary techniques.

Chapters 11 to 14 analyse various sources of information on the impacts and costs of water restrictions to households and the broader community, industries, local governments and utilities.

**PART IV**  
**CASE STUDIES: ANALYSIS OF THE BENEFITS AND COSTS OF WATER RESTRICTIONS IN THE PORTFOLIO OF OPTIONS**

Chapter 15 outlines a framework for assessing the cost-effectiveness of restrictions within the portfolio of options, including reviewing potential avoided portfolio costs and benefits.

Chapters 16-19 present case studies of Perth, the Australian Capital Territory (ACT) and Sydney.

**PART VI**  
**PRACTICAL CONCLUSIONS**

Chapter 20 presents practical conclusions and recommendations. It provides guidance to planners on reviewing, designing and implementing restrictions.
2 Perspectives on restrictions from the policy debate

Various perspectives have emerged from the policy debate about the appropriateness of restrictions in managing water demand during drought. The views of some elected representative are presented in box 1.

**Perspective: Oppose restrictions because they are not economically efficient**

The reasoning associated with this type of opposition to water restrictions is that they require planners to make assessments on behalf of all individuals about which water uses are discretionary (e.g. outdoors) and which water uses are essential (e.g. indoors). Proponents of this view argue that because water restrictions do not allow flexibility for individuals to choose how they use water to maximise marginal values, they cannot result in ‘economically efficient’ outcomes (see, for example, Edwards 2006).

This perspective is reflected in analyses of supply and demand options in which the stated goal is to reduce the frequency of water restrictions – irrespective of whether restrictions afford any net benefits (in terms of avoided costs of alternatives). For example, in a discussion paper prepared for the Department of Prime Minister and Cabinet reviewing “opportunities and impediments” to secure Australia’s water supply, it was suggested that:

> Water planners have two fundamental options available to ease water restrictions – to encourage water conservation or to increase water supply. (Marsden Jacob Associates 2006).

Some, but not all, proponents of this view also tend to confuse the definitions of “permanent” and “temporary” restrictions. As detailed in chapter 3, temporary restrictions are those which apply only during water shortages, whereas permanent restrictions apply at all times. The presence of temporary restrictions for a long duration of time does not necessarily mean that a decision has been made to make them permanent. However, some commentators cite evidence of the impacts of temporary restrictions to argue against permanent restrictions per se (see, for example, Allen Consulting Group 2007), without necessarily clarifying that existing PWCM are generally far less severe in their requirements than current temporary restrictions.

**Perspective: Assess restrictions compared to other options to manage supply–demand balance during drought**

In contrast, a view exists – particularly amongst those involved in planning for water supply systems – that restrictions per se should not be omitted when considering options for ensuring adequate supply availability during drought. Proponents of this view refer to analysis indicating that, even with long-term climate change aside, inter- and intra-year climate variability would require over-investment in supply systems to reduce the probability of restrictions to near zero. They note that the costs of expenditure on water supply systems are ultimately borne by the community. For
example, Michael Keating, chair of the Independent Pricing and Regulatory Tribunal of New South Wales (IPART), noted:

I think it is understandable that water planners did not foresee what has been described as the ‘worst drought on record’. Even more important, there is a high cost to drought proofing a city so that drought never has an impact... Instead, the question that must be answered in these cases is whether the cost consequences of a drought, multiplied by the probability of it occurring, are greater than the cost of building and reserving additional water supply systems to cater for that drought. (Keating 2006).

Proponents of this view could be interpreted as challenging the assertion that removing temporary restrictions from the suite of available measures to address water shortage would in practice result in the best society-wide outcomes.

Perspective: Support some types of restrictions because of community support and a sense of shared responsibility

Community surveys, forums and interviews indicate support for at least low-levels of restrictions, at least in part because of a sense of ‘community pride and participation’ and perceived equity across all users.

This project

This project does not adopt the perspective that all restrictions on water use are (by definition) unacceptable as a principle. With this as a starting point, there would be no need to examine the costs or the benefits associated with restrictions. The study recommends, however, that because restrictions limit flexibility, other options (such as price and volume-based quantity controls) should be further analysed (although this is beyond the scope of this review).

This project also makes a careful distinction between temporary restrictions (referred to in this report as ‘restrictions’) and permanent restrictions (referred to in this report as ‘PWCM’ – permanent water conservation measures). Whilst in some locations temporary restrictions are severe in their rules and impacts, currently existing PWCM are far less severe. Whether these temporary rules, imposed in response to drought, would be appropriate for extension into non-drought periods, is a different question to assessing the appropriateness of currently existing PWCM.

This project acknowledges that because restrictions involve planners making decisions on behalf of individuals’ values, welfare losses are more likely if water restrictions – including specific rules – are imposed without effective consideration of community values.

Nevertheless, in practice, determining “acceptable” restrictions frequencies (whether near zero or otherwise) also involves planners making decisions on behalf of individuals – in terms of the community’s attitudes towards risk; how the community values the impacts of restrictions; and how the community values the
avoided economic, social and environmental impacts of alternative options to secure supply.

It is likely that better community-wide outcomes would be achieved if decisions about both the rules and the frequency/duration of restrictions are guided and informed by community values.

**Box 1 Perspectives – Examples of some elected representatives’ views on restrictions**

<table>
<thead>
<tr>
<th>Restrictions are often described by elected representatives as “draconian” impositions on individual freedoms:</th>
</tr>
</thead>
<tbody>
<tr>
<td>“The simple fact is that there is little or no reason why our large cities should be gripped permanently by water crises… Having a city on permanent water restrictions makes about as much sense as having a city on permanent power restrictions.” (The Hon. John Howard, Prime Minister, 17 July 2006, cited in Marsden Jacob Associates 2006).</td>
</tr>
<tr>
<td>“I think Melbournians have had a great amount of goodwill in saving water but I think, with the Government threatening to introduce some very draconian measures that the Government’s at risk of eroding community goodwill.” (The Hon. Louise Asher MLA, Victorian Shadow Minister for Water, 7:30 Report 29 December 2006 – ABC (2006a)).</td>
</tr>
<tr>
<td>“…I do object to the state government owners of these water companies managing them for cash, restraining demand through restrictions, so that expensive investment in new water supplies can be postponed.” (The Hon Malcolm Turnbull MP, Parliamentary Secretary to the Prime Minister, address to National Press Club in Adelaide, 22 November 2006 – Turnbull (2006)).</td>
</tr>
<tr>
<td>“The community is accepting the position at the moment; they are doing the right thing… I don’t think we need to send [sic] an air of panic… we can secure Sydney’s water supply without going to draconian water restrictions.” (The Hon David Campbell MP, NSW Minister for Water Utilities, <em>Sydney Morning Herald</em> 3 January 2007 – Frew (2007)).</td>
</tr>
</tbody>
</table>
3 The role of permanent and temporary restrictions in urban water planning and management

The underlying goal of urban water planning is to ensure a secure water supply, in terms of adequacy of water supply quantity and quality, in a way which minimises the overall cost to society, taking into account equity and sustainability objectives.

Because of the variability of rainfall across Australian locations, temporary restrictions have historically been implemented to prevent the need for expenditure on supply infrastructure to create generous supply “buffers” which might only be required once every 20 years (Erlanger and Neal 2005). Permanent water restrictions, more recently introduced, can also have the potential to contribute to water supply security, but with a different role than temporary restrictions.

Restrictions, however, are not the only option available to ensure water security. In both long-term and drought-response planning, restrictions should be compared against a full list of other available options – including supply augmentation, large-scale reuse, source substitution, demand management and other incentive mechanisms.

3.1 Background: supply-demand balance in urban water planning

A key element of planning urban water resources is determining the supply-demand balance into the future, in order to evaluate when various water management options (supply, reuse or demand management) will be needed, and also the amount of water needed to be saved or supplied by these options. The supply-demand balance comprises two components, demand projections and the “yield” of the system.

The yield of a supply system is the maximum volume, on average, that can be supplied by the system. The yield of a system is a function of system characteristics and operating rules, but also of rainfall and runoff. Yield can be estimated by:

- Examining historical rainfall and runoff data, or
- Using this historical time-series data (for example, 50 years of rainfall and runoff data) to generate multiple stochastic data runs which have the same statistical characteristics as the historical record for the data in question (for example, 100 “runs” of 50 years of rainfall and runoff data which are not the actual historical values but have similar characteristics).

The estimated yield of a given system (with given operating rules) is generally constant. However, if climate change is predicted to occur over time, yield may be projected to decrease over time. In many locations around Australia, urban water planners have recently assumed that, due to climate change, long-term historical records of rainfall and runoff are no longer an accurate representation of future
rainfall and runoff, and have accordingly explored the implications of revising downwards expected yields, by varying degrees.

The estimated yield of a given system is also dependent on the acceptable frequency, duration and severity (thus savings) of temporary restrictions in place. The role of temporary restrictions in urban water planning and management is described in section 3.2.

In many locations, the demand projections will be driven by population growth. Permanent restrictions, in a similar way to demand management programmes, can lower demand over time. This role of permanent restrictions is described in section 3.3.

3.2 Temporary water restrictions, reliability and levels of service

The role of temporary restrictions is essentially a targeted drought response option, which acts to reduce demand for water as storage levels decrease. Temporary restrictions therefore have implications for planning long-term water security options, as well as drought response options. A restrictions regime is used to refer to the schedule or framework of restrictions, comprising rules at different levels or stages, possible triggers for the introduction of different stages (for example, linked to dam levels), and any levels of service or reliability criterion (these concepts are explained below).

3.2.1 Temporary restrictions and long-term planning

In terms of long-term planning, if restrictions can be relied on to reduce demand during a drought, then on average a given system is less likely to run out of water – that is, be unable to meet demand. In this way, the estimated yield of a system depends on what frequency, duration and severity of restrictions is deemed acceptable.

The most commonly used measure of “acceptable” restrictions is what is often referred to as the system reliability, which is the proportion of time that a supply system is able to meet demand without temporary restrictions in place. Reliability is often expressed as the probability that restrictions will not be imposed in a given year or month.

The criteria of reliability, as defined above, is a useful way for urban water planners to determine the yield of the system (and hence, when compared to demand projections, plan for the implementation of options to ensure water security). The level of reliability should be reviewed periodically in the light of information on the costs of the restrictions and the trends in the severity and likelihood of restrictions of various levels being triggered.

However, targeting reliability as a single number could limit planners’ scope for more cost-effective system management. In terms of the impacts of restrictions, reliability is a blunt indicator of the extent to which community and industry will be
affected. The impacts, and hence acceptability, of a restrictions regime also depend on various factors including:

- How severe the restrictions rules are (e.g. sprinklers allowed twice a week versus total outdoor water ban);
- What the duration of restrictions are (e.g. two months versus four years);
- Time of year imposed (e.g. winter versus summer);
- What the recurrence interval is (e.g. one summer in ten versus four summers in a row).

There are also substantial variations in the distribution of impacts, depending on restrictions rules (see part IV).

In recognition of some of these factors (although not explicitly the distribution of impacts), the Water Services Association of Australia (WSAA) sets out an approach for urban water planning which involves defining long-term level of service (LOS) objectives in terms of the desired maximum frequency, severity and duration of restrictions (Erlanger and Neal 2005). Because LOS objectives are used to communicate potential restrictions regimes to the community, they should be framed in a way which is easily understood, and in ways that matter to customers – for example, expressing frequency, severity and duration of water restrictions in terms of:

- Maximum average period of recurrence, for a certain severity (such as stage 2 restrictions once in 10 years);
- Maximum duration that can be expected (e.g. restrictions for not longer than 12 months’ duration).

Across metropolitan water areas, LOS objectives are set in various ways, to various degrees of sophistication (see Table 2). Guidance on engaging with the community and industry, so that their values and preferences are included in the setting of LOS, is discussed in chapter 20.

3.2.2 Temporary restrictions and drought response planning

The long-term planning approach outlined above takes into account variability by using multiple stochastically generated sequences of rainfall/runoff data. Each of these sequences will contain droughts of varying frequency, duration and severity.

Nevertheless, it is still possible that droughts of greater severity and frequency than expected may occur (these may or may not be due to long-term climate change trends). Therefore in addition to long-term planning, in most locations drought response planning is also undertaken, to plan actions in the case of severe and protracted drought with the aim of not running short of water.
Table 2 Levels of service in different locations

<table>
<thead>
<tr>
<th>State or Territory</th>
<th>Metropolitan water area</th>
<th>Level of service objectives and definitions</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>Canberra</td>
<td>LOS approach not applied</td>
<td></td>
</tr>
<tr>
<td>NSW</td>
<td>Sydney</td>
<td>- Restrictions due to drought will not need to be applied more than 3% of the time. This expressed by SCA as “97% reliability”.&lt;br&gt;- Restrictions occur no more often than once every 10 years. This is expressed as “90% robustness”.</td>
<td>Sydney Catchment Authority (2007). Review of Sydney’s Water Supply System Yield.</td>
</tr>
<tr>
<td></td>
<td>Hunter</td>
<td>- “Security of supply criteria” defined as restrictions imposed no more than once in 10 years and 5% of the time, on average</td>
<td>Hunter Water (2006). Integrated Water Resource Plan.</td>
</tr>
<tr>
<td>QLD South-East Queensland/Brisbane</td>
<td>- Annual probability of Level 2 restrictions is less than 2% (1 year in 50 on average);&lt;br&gt;- Mean duration of restrictions is 12 months; and&lt;br&gt;- Level 2 restrictions to achieve a demand reduction of 15% and apply for no more than 3% of time.</td>
<td>DNRW (2006) Water for South East Queensland – A Long-Term Solution.</td>
<td></td>
</tr>
<tr>
<td>Geelong</td>
<td>- 95% is the “system reliability”, the proportion of time at which the yield of the system will meet unrestricted demand.</td>
<td>Water Supply-Demand Strategy for Melbourne 2006-2055.</td>
<td></td>
</tr>
<tr>
<td>Melbourne</td>
<td>- 95% reliability of supply (which means water restrictions would be expected no more than 5% of the time)&lt;br&gt;- Restrictions for no longer than 12 months.</td>
<td>WA Water Corporation (2005). Integrated Water Supply Scheme Source Development Plan 2005-2050.</td>
<td></td>
</tr>
<tr>
<td>WA Perth</td>
<td>- 3% probability of needing a total sprinkler ban (or 1 in 30 years).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Temporary restrictions are a key component of drought response planning. Unlike many supply infrastructure options which are rainfall-dependent and have long lead-times (such as surface water storages), restrictions can immediately relieve pressure on declining storage levels during drought. However, there may be other drought-response options, including:

- Transfers from other systems which are connected both physically (eg. through rivers or water distribution infrastructure) as well as institutionally (eg. through markets).
- Changes to operating variables of existing system, such as increases in pumping rates or decreases in environmental flows.
• Accelerating demand management programmes, such as minimum performance standards on appliances, and improving the water efficiency of equipment and processes in businesses.

• Rainfall-independent supply infrastructure which may not yet be required in terms of long-term average conditions, but might need to be brought forward in the case of an extreme drought (e.g. desalination plants). These have been described as readiness options because they are planned and designed in a way where construction or implementation could proceed with relatively short lead-times if needed, or where some or all of the investment may be deferred (for example, if the drought breaks).

Temporary restrictions, as a drought response option, can delay the time to which available water supplied (e.g. in storages) decreases to the point where other options are required. For example, temporary restrictions could delay the time to which transfers or increased pumping are required. By delaying the time to low storage levels (during which period, the drought might end), temporary restrictions can also reduce the probability that drought readiness infrastructure planned, would actually need to proceed to construction.

3.3 Permanent water restrictions, demand for water and the probability of temporary restrictions

Permanent water restrictions have recently been introduced in several metropolitan water areas. As discussed in chapter 5, to date most of the current permanent water conservation measures reflect basic water-efficient practices (such as not watering during the daytime).

Regardless of the nature of the rules, permanently restricting certain types, timing or technologies of water use has a different role to play in ensuring a secure water supply than temporary restrictions. Permanent restrictions are not themselves drought response measures (as they are in place all the time, and are in fact generally superseded by the severity of temporary restrictions during drought). However, permanent restrictions effectively reduce demand for water over time. Therefore:

• By reducing underlying demand, having permanent restrictions in place reduces the probability that temporary restrictions will be triggered as a drought progresses; and

• Depending on the specific rules, permanent restrictions may be a cost-effective option for supporting long-term water security objectives.
4 Approach to assessing the effectiveness, costs and benefits of restrictions

The overall framework used in this review is to examine the cost-effectiveness of restrictions, in terms of meeting the underlying objective of ensuring adequate water availability at least cost. Another key assessment criteria, in addition to cost-effectiveness, is the distribution of costs and benefits.

The cost-effectiveness of restrictions, both temporary and permanent, should be assessed in the context of other options available to contribute to adequate water availability – including supply augmentation, demand management and water-efficiency measures, and incentive mechanisms. As there are many interactions between restrictions and these options, particularly in terms of effectiveness, the cost-effectiveness of restrictions should be assessed in terms of how restrictions change the overall cost-effectiveness of the portfolio of options. The role of restrictions will therefore be different in different locations (see chapter 20 for discussion of designing restrictions and consistency).

The costs and benefits of restrictions can be viewed as arising in two ways:

- The **direct costs and benefits of restrictions**, which arise due to the imposition of restrictions rules on types, timing and technologies (methods) of water use. These costs and benefits include those affecting water users, as well as suppliers of products or technologies associated with restricted water uses.

- The **avoided portfolio costs and benefits of restrictions**, which arise because restrictions, if included in the portfolio of options, may mean that the water supply adequacy objective can be met without needing to implement some other options (which have costs and benefits).

Therefore, the cost-effectiveness of restrictions is best gauged by comparing:

- The most cost-effective portfolio of options to meet the water adequacy objective, if restrictions are included as a possible option; to

- The most cost-effective portfolio of options to meet the water adequacy objective, if restrictions are not included as a possible option.

There are many ways in which the restrictions regime (rules, stages, triggers and levels of service) can be designed, which will also affect the cost-effectiveness. For example, how does a ban on a technology (eg. sprinkler ban) compare to restricting types of water use (eg. lawn watering), in terms of costs on the community and businesses, and water saved? However, lack of data has prevented comprehensive assessment of the effectiveness of costs of different restrictions rules at this detailed level:

- The methods (and limitations) for measuring the savings from temporary restrictions are discussed in chapter 9. There was limited data available to assess
savings from particular types of restrictions rules. The factors influencing effectiveness of restrictions are also discussed in chapter 9.

- The methods (and limitations) for measuring the direct costs and benefits of restrictions are discussed in more detail in chapter 10. There are several limitations to the extent to which the costs of restrictions can be meaningfully measured in monetary terms. Consequently, this review included interviews with a number of key stakeholder representatives. However, comprehensive stakeholder consultation was not intended to be part of this study and was not conducted.

Despite these measurement limitations the broad portfolio cost-effectiveness approach has been used to structure the analysis (see Figure 1).

**Figure 1 Map of report chapters and cost-effectiveness assessment**

![Diagram](image-url)
PART II – PERMANENT WATER RESTRICTIONS
5 Review of permanent restrictions

5.1 Introduction of permanent restrictions

In metropolitan locations in Victoria, South Australia and the ACT, there are permanent restrictions rules that apply at all times, independent of the drought situation. As discussed in chapter 3, permanent restrictions effectively act as demand management measures – lowering demand on a permanent basis.

These permanent restrictions are referred to as “permanent water savings rules” (PWSR) in Victoria and “permanent water conservation measures” (PWCM) in South Australia and the ACT. Permanent restrictions do not currently apply in the other metropolitan locations covered in this review – Sydney, Hunter, Gosford/Wyong, Hobart, Launceston, Darwin or south-east Queensland. Although there is no formal system of permanent restrictions on various water uses in Perth, a daytime outdoor sprinkler ban was introduced in 1994.

Permanent restrictions have been introduced at various times, in many locations after there had been a period of drought and temporary water restrictions. For example:

- In the ACT, following a period of almost three years of temporary restrictions (ranging from stage 1 to stage 3), rainfall in the months prior to November 2005 eased pressures on water supplies and in November 2005 stage 2 restrictions were lifted and stage 1 restrictions, previously part of the “temporary” schedule, were re-introduced, made permanent, and called permanent water conservation measures. A new temporary restrictions schedule was introduced, in which rules under the previous stages 2 to 5 were renamed stages 1 to 4 respectively.

- In Geelong, PWSRs were introduced in January 2003. In Melbourne, PWSRs were introduced on 1 March 2005 following the lifting of stage 2 temporary restrictions. PWSR were introduced in the Ballarat region in January 2006 by Central Highlands Water.

- In Adelaide, PWCMs were introduced on 26 October 2003, when stage 2 temporary restrictions (which had been in place for four months) were lifted.

- In Sydney discussion has commenced about the transition to permanent water conservation measures.

5.2 Permanent restrictions rules

Most of the PWCMs/PWSRs currently implemented reflect basic water-efficient water use practices such as restricting daytime use of sprinklers, thus avoiding losses due to evaporation.
Table 3 Examples of permanent restrictions rules currently in place

<table>
<thead>
<tr>
<th>State</th>
<th>Location</th>
<th>Permanent water saving rules / Permanent water conservation measures</th>
</tr>
</thead>
</table>
| ACT   | ACT      | • Watering of gardens, lawns and plants must not cause pooling or runoff.  
        |          | • Hand-held hoses fitted with trigger nozzles, buckets or watering cans may be used at any time.  
        |          | • From 1 September to 31 May, sprinklers and other irrigation systems only allowed 6pm-9am.  
        |          | • Windows and gutters may be cleaned any time. Buckets or high-pressure low-volume cleaners can be used anytime to clean paved surfaces and buildings. Otherwise, no use of water to clean paved areas and buildings except for health, safety or emergency.  
        |          | • If not washed at a commercial car wash, vehicles may only be washed using bucket, watering can, high-pressure low-volume cleaner, or hand-held hose fitted with trigger nozzle.  
        |          | • Water can only be used for dust or other pollutant suppression purposes by means of a hose fitted with a flow cut-off device or a vehicle fitted with sprinklers. |
| SA    | Adelaide | • Sprinklers only allowed 5pm-10am  
        |          | • Buckets, can, hoses and dripper systems allowed any time.  
        |          | • No hosing of paved areas, except for health, safety or emergency.  
        |          | • Cleaning of motor vehicles and boats only from buckets, watering cans, high-pressure low volume devices, hoses with trigger nozzles, or commercial car washes.  
        |          | • Construction industry hoses require trigger nozzles. |
| VIC   | Melbourne | • Manual watering systems only allowed 8pm–10am.  
        |        | • Automatic watering systems only allowed 10pm–10am.  
        | Geelon | • Hoses must be fitted with a trigger nozzle  
        | Ballarat | • Only fountains that recirculate water can be operated.  
        | Bendigo | • No hosing of paved areas, except for health, safety or emergency.  
        |          | • Approval required to fill a new pool of capacity greater than 200L |
| WA    | Perth    | • Daytime sprinkler ban. |

Note that this list is not comprehensive.

5.3 Effectiveness of permanent restrictions

Savings due to permanent restrictions have been estimated by water utilities by examining changes in observed water use. These estimates are not based on measuring or monitoring end uses. The purpose of these estimates has generally been to adjust long-term projections of demand (for long-term water supply system planning) rather than to evaluate the cost-effectiveness of permanent restrictions as a demand management tool:

- In the ACT, projections of total required bulk supply were reduced by 8% following observed savings due to PWCM introduced in November 2005 (ACTEW pers. comm. January 2007).
- In Melbourne, PWSRs are assumed to result in a 9% reduction in outdoor water use, which is equivalent to 2.3% of bulk supply (WaterSmart 2006).
- In Geelong, PWSRs are assumed to result in a 4% reduction in bulk demand (Barwon Water pers. comm. March 2007).
6 Perspectives on benefits and costs of permanent restrictions

Generally, utilities supplying outdoor water use products (eg. nursery and irrigation products) interviewed for this study view permanent restrictions as an effective approach to encouraging consumers to invest in water-efficient technologies.

The industry and community representatives contacted for this review did not raise concerns about the specific permanent restriction rules currently in place. As none of these rules ban specific technologies or types of water use, they are likely to have far fewer and less severe negative impacts on water users and suppliers of irrigation technologies than some temporary water restrictions.

For example, one industry organisation (pers. comm. August 2007) suggested that, unlike temporary restrictions (which can create an uncertain planning environment for outdoor water users and affected businesses), permanent measures enable consumers to improve, manage and invest in their water-using assets with certainty. They also suggested that PWSRs, in contrast to temporary restrictions, allow industry to develop systems and garden types suited to low water availability.

However, although another industry organisation (pers. comm. August 2007) did not specifically oppose, and indeed supported, many of the permanent restrictions rules currently in place, concern was raised about the processes and information or analysis used to underpin the design of these permanent rules. This organisation expressed concern that, at least in some locations, permanent water conservation measures were not designed to reflect the most cost-effective approach to long-term demand management but were, for example, simply “low levels of temporary restrictions made permanent”. They suggested that far greater opportunity exists to design, promote and implement PWCMs in a way to complement and integrate with other programmes that encourage water-use efficiency and the innovation of water-efficient technologies, and diversity of non-potable water sources. They also suggested that both permanent and temporary restrictions should be assessed against a wider scope of potential drought management options, including incentive mechanisms such as pricing and water trading. These other options are outlined in chapter 20.
PART III – REVIEW AND ANALYSIS OF TEMPORARY WATER RESTRICTIONS
7 Temporary restrictions rules, stages and triggers

Outdoor water use restrictions are currently in place in 12 of the 15 metropolitan water areas included in the terms of reference for this review – including all capital cities except Darwin and Hobart. Many other cities and towns across Australia (such as Goulburn, Toowoomba and Townsville) have recently experienced restrictions.

The restrictions landscape across Australia is characterised by extreme diversity between locations. Widespread differences exist in restrictions rules on residential and non-residential users, the pace at which restrictions levels have been increased and approaches to designing, implementing and promoting compliance. No consistency applies in rules across “level” or “stage” numbers across Australia. Therefore, comparisons between states of the severity of restrictions based solely on level are not likely to be meaningful. However, consistent state-wide restrictions stage definitions apply within Victoria and within Western Australia.

Many locations introduce restrictions stages according to pre-specified “triggers” that are based on storage levels. However, during the current drought, in many locations the actual introduction of restrictions stages has varied, in terms of timing or rules, from pre-specified schedules of triggers and stages.

The information in this chapter is current as of 1 March 2007 and was obtained from personal communications with water utilities, and various websites listed in Volume 2 – Appendices. Detailed descriptions of restrictions rules for each location are documented in the Appendices.

A range of State acts and regulations underpin the design and implementation of water restrictions in metropolitan areas across Australia. The regulations generally grant power and responsibility to water businesses to design, implement and enforce temporary restrictions. These acts and regulations are listed in the Appendices.

7.1 Types of temporary restrictions rules

7.1.1 Restrictions on residential water use

Residential water use restrictions include a combination of rules on types, timing and technologies (methods) of water use. The key types of residential water uses that face restrictions are gardens and lawns, swimming pools and spas, and the washing of vehicles and other hard surfaces. The types of water uses targeted by restrictions are almost exclusively outdoor water uses, although some indoor water uses are covered in offsets programmes. As discussed below, many (but not all) restrictions on the timing and technologies of water use are not designed to save water through improving water-use efficiency, but rather through making it more time- or energy-intensive to use water (eg. banning sprinklers) or banning certain types of water use altogether.

In most locations, residential restrictions refer to water sourced from mains or town water and do not apply to water sourced from private bores, rainwater collected
from roofs, indoor re-use or other sources. However, in some locations, restrictions apply to non-mains water – for example, in the Gosford/Wyong area, stage 4 restrictions apply to mains water use and stage 2a restrictions apply to rainwater use.

In many locations restrictions exist on fountains and ponds (e.g. requiring recycling of water) and on cleaning hard surfaces and buildings (e.g. restricting water use to bucketing or if by other means, only for safety and emergency purposes). Restrictions on these uses are detailed in Volume 2 – Appendices. Concern appears to be more widespread about restrictions on the three types of water uses examined in further detail in this section.

Restrictions on residential garden and lawn watering

As illustrated in Figure 2, in different locations (all under level/stage 3 or 4), different time restrictions are placed on different garden and lawn watering technologies (methods). A common requirement, however, is that trigger nozzles be placed on hoses. In several locations, exemptions are available in order to establish new gardens and/or lawns.

At the time of this study, total outdoor water bans were in place in Gosford/Wyong and Geelong, Bendigo and Ballarat. These locations have had restrictions progressively increasing to a total water ban on outdoor water use.

At the time of this study, in Brisbane, all sprinkler use (including drippers) and hosing was banned. It appears that the approach to achieving consumption savings places bans on watering technologies that are more time-efficient (e.g. sprinklers) and places fewer time restrictions on technologies that are less time-efficient (e.g. buckets and cans) – in effect, to focus on raising the user-cost of applying water.

In contrast, in Melbourne and Sydney, a distinction is made between dripper watering systems and other sprinkler watering systems. In these locations, dripper systems are allowed 2 days/week. A general exemption applies in Canberra that allows dripper systems 3 days/week. In Adelaide and Perth, there are no outright bans on any specific garden watering technologies, although in Adelaide sprinklers are restricted to only 1 day/week.

In Melbourne and Canberra, at the time of this study, lawn watering is banned, although garden watering is allowed (but restricted).
Some restrictions on the *timing* of water use (e.g., banning daytime watering) are consistent with water-use efficient practices. Limiting watering to certain days of the week is also intended to discourage over-watering. Nevertheless, in general restrictions on timing of water use (particularly at higher stages or levels) are a blunt instrument to encourage efficient water use.

Many of the restrictions on *technologies* (method) are not designed to save water through improving water efficiency. For example, requiring trigger nozzles on hoses is a way to improve water-use efficiency in a way that the same service can be delivered from less volume of water. However, in comparison banning sprinklers and drippers is a blunt instrument to achieve water savings – although some users may use irrigation technology inefficiently, sprinkler and dripper systems have far greater water-use efficiency potential than applying water through buckets or cans (Industry organisation, pers. comm. August 2007).
Restrictions on residential pools and spas

Restrictions on private pools and spas vary in their severity in different locations. Filling of new pools has been banned in Melbourne, Ballarat, Bendigo, Geelong and Gosford/Wyong. A permit or exemption is required for filling of all new pools in Canberra and all new pools greater than 10 000L in Sydney. To fill a new pool in Adelaide, a permit is required and a pool cover is required. There are no restrictions on the filling of new pools in Perth and Brisbane/South–East Queensland (SEQ).

In Victoria, a water conservation plan (incorporating offsets from reduced water use elsewhere inside or outside) is required to fill existing pools greater than 2 000 L. In the ACT, existing pools with a pool cover may be topped up by attended hose (those without a cover, by bucket). There are limited or no restrictions on topping up existing pools in Sydney, Adelaide, Brisbane/SEQ and Perth.

Restrictions on residential vehicle washing

In stage 4 restrictions in Ballarat, Bendigo and Geelong and stage 3a in Melbourne, private washing of all vehicles is restricted to spot cleaning and window cleaning with a bucket (although the use of commercial car washes is allowed under stage 3a). In the ACT, washing of vehicles at private residences is banned. In Sydney, Brisbane and Adelaide buckets but not hoses are allowed. There are no restrictions on residential vehicle washing in Perth. There are various restrictions on commercial car wash operators (see section 7.1.2).

Box 2 Examples of water restrictions in locations other than the metropolitan water areas specified in the terms of reference

The terms of reference for this study focus on reviewing restrictions in metropolitan water areas, as defined by the National Water Initiative. However, water use restrictions have been imposed in many locations across Australia not included in the terms of reference, including:

- Restrictions were implemented in Townsville/Thuringowa, Queensland, limiting sprinkler use to 3 days per week (under the odds/evens system) and to certain times of the day. On 1 February 2007, restrictions were lifted and remain permanently at level 1, which allows sprinkler use any time of the day, 3 days per week.

- Toowoomba, Queensland is under level 5 restrictions, which involve a ban on all outdoor watering from mains water. A bucket may be used to spot clean cars, wheelie bins, pets and animals.

- Goulburn, New South Wales is under level 5 restrictions that were introduced on 1 October 2004. All outdoor water use of town water is banned and target water consumption is 150 L per person per day. Fines have been imposed on households that have exceeded this target – in effect, rationing is in place.

- Across Victoria, the total number of towns subject to water restrictions as at 31 January 2007 was 453. 115 of these were at Stage 1, 57 at Stage 2, 79 at Stage 3 and 202 at Stage 4 restrictions.

- Water restrictions apply in many towns in Western Australia, including level 4 restrictions (sprinklers 2 days/week) applying in towns in south-west Western Australia.
A widely raised concern about restrictions is the ability of certain customers, particularly the elderly, disabled or those with other health constraints, to meet restrictions rules. Utilities contacted reported that any customers who have difficulties in meeting restrictions can submit a written application for exemptions. Other forms of support have been provided in some locations. For example, in Victoria, a one-day forum was held to bringing together arthritis sufferers and representatives from the trigger nozzle hose manufacturers to inform future nozzle design (Victorian Drought Coordinating Committee, pers. comm. March 2007). However, differences exist in the degree to which these types of exemptions are publicised.

Another area of concern raised by the nursery/garden industry is whether exemptions are available to establish new gardens and lawns. In Sydney, a time-limited exemption from restrictions is available for the establishment of new lawns in new homes or lawn areas damaged through renovations. In Perth, time-limited exemptions are available (on application) to establish new gardens and lawns. In contrast, in the ACT and Melbourne, where lawn watering is banned, exemptions to establish new lawns are not available currently.

In Canberra, although the restrictions rules currently specify sprinkler bans, “general exemptions” have applied at various times allowing sprinkler use (by all users).

### 7.1.2 Restrictions on non-residential water use

A range of approaches is taken to restricting non-residential water use across metropolitan locations.

- **In Victoria**, (state-wide) uniform drought water restriction guidelines specify rules for several non-residential industries or water uses including nursery and market gardens, public pools, commercial car washes, commercial poultry farms, food transport vehicles, sportsgrounds, building and construction and motor vehicle dealers. This approach has been taken also (applying to a less extensive range of non-residential users) in Adelaide.

- **In Sydney**, the same rules apply across residential and non-residential sectors. However, many businesses and organisations are eligible to apply individually for exemptions from the restrictions.

- **In Gosford/Wyong**, the general approach to restricting water use is a combination of specifying rules for certain industries and requiring organisations to develop Water Management Plans, depending on the user and type of use.

- **In Brisbane/SEQ**, businesses using more than 10 ML/year of town water are required to meet certain restrictions on a range of water uses (or overall water consumption reduction targets) or to submit a Water Efficiency Management Plan (WEMP) to the relevant local government area for approval. WEMPs are required for air conditioner cooling towers and all businesses using more than 1 ML/year are required to ensure taps, showerheads and trigger sprays are water efficient.
Stage 4 restrictions were introduced on 1 November 2006 and businesses were given between 6 and 9 months (depending on volume of water use) to submit WEMPs.

- In **Perth**, there are no specific rules for non-residential users imposed by the WA Water Corporation (However, licence conditions exist for all users of groundwater).

Few non-residential water uses face outright bans in any location. However, in Victoria, commercial car wash operators are allowed to operate up to stage 3. Under stage 4, commercial car wash operators in Victoria are effectively limited from operating because, like households, they are limited to spot and window-cleaning with bucket and sponge.

As discussed in chapter 12, the impact of restrictions on businesses is dependent on the nature of water use restrictions on their customers.

Impacts of restrictions on local councils are discussed in more detail in chapter 13.

### 7.2 Temporary restrictions stages, levels and recent history

In addition to differences in restrictions rules currently in place across Australia, substantial variation exists in the set of rules (the restrictions regime) and recent restrictions stages experienced. Dates and stages for each location are documented in detail in Volume 2 – Appendices.

**Figure 3 Restrictions in metropolitan Australia (November 2002 to February 2007)**

<table>
<thead>
<tr>
<th></th>
<th>Jan-03</th>
<th>Jul-03</th>
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<td>Hunter</td>
<td>?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perth</td>
<td>2*</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACT</td>
<td>1*</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hobart</td>
<td>?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Stage L* restrictions (previous rules) *Stage L* restrictions (current rules) Current level of restrictions
In different locations, variation exists in the “severity” of each restrictions stage/level – particularly the severity of the highest stage/level. For example, consider the rules in the following locations that are under their highest restrictions level:

- Bendigo, Ballarat, Geelong – total outdoor water ban
- Sydney – sprinklers are banned but other watering (including drippers) is allowed twice a week.

As illustrated in Figure 2, different approaches exist to increasing restrictions severity across stages. For example, concerning residential outdoor garden watering:

- In Victoria, days per week of allowable sprinkler use are restricted progressively as stages increase. At stage 3, sprinklers (other than drippers) are banned, as is all lawn watering. At all stages, automatic systems are restricted to 6–8am and 8–10pm and manual systems from 12pm–4am.
- In the ACT, watering is restricted to 3 days per week across all stages. At stage 2, sprinklers (other than drippers) are banned and at stage 3, all sprinklers and all lawn watering is banned and watering is restricted to 7–10am or 7–10pm.
- In Sydney, sprinklers are banned (but drippers allowed) across all restrictions stages. Days per week of watering are progressively restricted as stages increase. Watering is restricted to 4pm–10am.
- In Brisbane/SEQ, all sprinklers including drippers are banned from stage 2 and hoses are banned from stage 3. Buckets and cans are the only watering technology allowed from stage 3 onwards and are restricted to 4–8am and 4–8pm.
### Part III: Review and Analysis of Temporary Water Restrictions

#### Figure 4 Restrictions rules on residential gardens and lawns

<table>
<thead>
<tr>
<th>PWSR</th>
<th>Stage/Level 1</th>
<th>Stage/Level 2</th>
<th>Stage/Level 3</th>
<th>Stage/Level 4</th>
<th>Stage/Level 5</th>
<th>Stage/Level 6</th>
<th>Stage/Level 7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sprinklers and watering systems 7–10am and 7–10pm 3 days/week. Trigger hoses and buckets anytime.</td>
<td>No sprinklers or watering systems except drippers. Dippers, trigger hoses and buckets 7–10am and 7–10pm 3 days/week.</td>
<td>NOW – No sprinklers or watering systems. Dripper exemption currently applies. No lawn watering. Trigger hoses and buckets 7–10am and 7–10pm 3 days/week.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACT</td>
<td>Daytime sprinkler ban.</td>
<td>Has not been applied in Perth metropolitan area.</td>
<td>Has not been applied in Perth metropolitan area.</td>
<td>NOW – Sprinklers &amp; watering systems 2 day/wk, either morning (&lt;9am) or evening (&gt;6pm). Hoses, cans anytime.</td>
<td>Sprinklers &amp; watering systems 1 day/wk, either morning (&lt;9am) or evening (&gt;6pm). Hoses, cans anytime.</td>
<td>No sprinklers or watering systems. Hoses &amp; cans anytime.</td>
<td>No lawn or garden watering anytime.</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYD</td>
<td>None</td>
<td>No sprinklers or watering systems (excludes drip systems).</td>
<td>No sprinklers or watering systems (excl drippers). Hosing 4pm–10am 3 days/week.</td>
<td>NOW – No sprinklers or watering systems. Dippers &amp; hosing allowed 4pm–10am 2 days/week.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEQ</td>
<td>None</td>
<td>Voluntary.</td>
<td>No sprinklers or unattended watering devices. Hoses odds/evens 7pm–7am.</td>
<td>NOw – No sprinklers or hoses. Buckets and cans 3 days/week 4–8am or 4–8pm.</td>
<td>Proposed – No sprinklers or hoses. Buckets and cans 2 days/wk 4–8am or 4–8pm.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADL</td>
<td>Daytime sprinkler ban</td>
<td>Sprinklers (excl drippers) 3 days/week 8pm–6am.</td>
<td>NOW – sprinklers 1 day/wk for 3 hours either 5–8am or 8–11pm. Trigger hoses &amp; drippers 8pm–8am.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GOSWY</td>
<td>No sprinklers, hand hoses, microspray and drippers 1 hr/day &amp; drippers 1 hr/day 3 days/week 7–8am &amp; 6–7pm.</td>
<td>No sprinklers, drippers, hoses. Cans and buckets anytime.</td>
<td>NOW – Outdoor water ban. Water use from rain tanks subject to level 2a restrictions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No specific technology banned. Time restrictions (beyond daytime ban) apply. Sprinklers (excluding drippers) banned. Dippers, hosing, buckets and cans allowed – time restrictions may apply. All sprinklers banned. Hosing, buckets and cans allowed – time restrictions may apply. All sprinklers and hoses banned. Only buckets and cans allowed – time restrictions may apply. Total outdoor water ban.
7.3 Triggering temporary restriction stages

In many locations, water storage volumes or percentages are used as ‘triggers’ for different restriction stages. Trigger levels are calculated in various ways to meet the broad objective of maintaining supply throughout protracted drought (see, for example, Yurisich and Rhodes 1999). While trigger levels, once established, become an operational guideline, they also provide a potential means to communicate storage levels and the likelihood of upcoming restrictions to the public, thus allowing the community to prepare in advance to minimise the impact of restrictions.

These trigger levels were generally established prior to the current drought. However, as this drought has progressed, progressive introduction of restrictions stages have not always been introduced according to pre-specified trigger levels.

Table 4 Use of restrictions triggers in different locations

<table>
<thead>
<tr>
<th>State</th>
<th>Location</th>
<th>Restrictions triggered</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>ACT</td>
<td>Storage levels (%)</td>
</tr>
<tr>
<td>NSW</td>
<td>Hunter</td>
<td>Storage levels (%)</td>
</tr>
<tr>
<td></td>
<td>Gosford/Wyong</td>
<td>Storage levels (%)</td>
</tr>
<tr>
<td></td>
<td>Sydney</td>
<td>Storage levels (%)</td>
</tr>
<tr>
<td>QLD</td>
<td>SEQ/Brisbane</td>
<td>Storage levels (%)</td>
</tr>
<tr>
<td>SA</td>
<td>Adelaide</td>
<td>Not linked to fixed storage levels</td>
</tr>
<tr>
<td>VIC</td>
<td>Melbourne</td>
<td>Storage levels (volume)</td>
</tr>
<tr>
<td></td>
<td>Ballarat</td>
<td>Storage levels (volume)</td>
</tr>
<tr>
<td></td>
<td>Bendigo</td>
<td>Storage levels (volume)</td>
</tr>
<tr>
<td></td>
<td>Geelong</td>
<td>Storage levels (volume)</td>
</tr>
<tr>
<td>WA</td>
<td>Perth</td>
<td>Not linked to fixed storage levels (adaptive)</td>
</tr>
</tbody>
</table>

See Appendices for further details of restrictions trigger levels.

In the ACT, trigger levels (and expected savings) were revised between droughts during 2005–2006 to take into account “demand hardening” – permanent changes in behaviour from the previous restrictions periods that limit further reductions likely to follow from the same level of nominal restrictions. During the current drought, restrictions stages have been introduced according to these pre-specified triggers, although during 2006/07 summer months, general exemptions applied at some times which relaxed restrictions rules (and allowed the use of sprinklers for certain periods).

Victoria is the only state in which trigger levels vary according to month; i.e. in summer, a given restrictions level would be introduced earlier (at a higher storage volume) than in winter. Current trigger levels and state-wide rules were established in 2005. Such an approach might be justified as part of an efficient regime by either or both of seasonally varying system capacity to meet immediate demand and seasonally varying likelihood of good rainfall in the short term.

During this drought, in the Victorian towns of Geelong, Bendigo and Ballarat, restrictions stages have been introduced according to triggers. In Melbourne, stage 3a
restrictions were introduced on 1 April 2007 although these were not part of the predetermined schedule of restrictions stages and triggers, with the stated aim of reducing the likelihood of entering stage 4 restrictions.

Triggers based on storage percentages apply to Sydney and Brisbane. However in both these locations, variations to pre-specified stages have occurred during the current drought. In Sydney, the triggers set for levels 4 and 5 in the 2002 Drought Response Plan were made redundant when levels 4 and 5 restrictions were removed from the regime in February 2006. In contrast, in Brisbane, a more severe restrictions level (level 5) has been introduced recently, where previously the regime did not extend beyond level 4.

*Fixed* restrictions triggers based on storage volumes do not apply in Perth or Adelaide. In these locations, due to mixed sources of water supply, the volume of water stored in dams is not a good indicator of system security (WA Water Corporation pers. comm. January 2007 and SA Water pers. comm. December 2006). In Perth, level 4 restrictions have applied continuously since November 2001. However, in Adelaide, which has been under stage 3 restrictions since January 2007 (ie. sprinkler use allowed once a week) the Minister for Water Security recently suspended domestic outdoor watering for the months of July and August.
8 Education, promotion and enforcement of temporary restrictions

Across Australia, organisations responsible for implementing restrictions have emphasised that education, awareness-raising and promotion are central to achieving water savings through restrictions. Enforcement of penalties is viewed generally as a supporting mechanism, although approaches vary. This chapter reviews education strategies and enforcement approaches.

Restrictions may have provided a focal point for education on broader water management issues. Although focused on changing behaviour in relation to outdoor water use, some research suggests that they may influence indoor water use and result in associated reductions in demand (White et. al. 2000). One community/consumer organisation (pers. comm. March 2007) noted that "restrictions have raised public awareness of the water supply crisis".

8.1 Education and promotion strategies

8.1.1 Restrictions rules

Diverse media, including television, radio, newsprint and bill inserts have been used to varying extents to provide information about restrictions rules.

Encouraging compliance with restrictions is undertaken as part of a broader strategy to promote water conservation and water use efficiency. To varying degrees, organisations responsible for restrictions have advertised and promoted restrictions in conjunction with demand management programs such as rebates (for water efficient appliances and devices), showerhead exchanges, general education and information about water efficiency and in some locations through public forums or workshops about specific water use practices such as garden irrigation.

The main channels of communication to customers about restrictions rules appear to be a combination of:

- Dedicated mail outs or inserts in water bills on restrictions rules and water-saving types (for example, a large mail out to Victorian households of a magnet with restrictions rules).
- Water utility websites.
- Public place advertising.

Some evidence can be found that the community generally is satisfied with the clarity and availability of information provided to householders about restrictions regimes and rules in each locality (Community/consumer organisation, pers. comm. March 2007). However, there could be a disparity between people's self-reported awareness of restriction regimes and their actual understanding. A survey by Newton Wayman and Chong (2005a) revealed that 42% of respondents claimed that they understood restrictions but were not actually certain about the rules. They...
conclude, "There appears to be a continuing need to clearly communicate the nature of and expectations required for each restriction – or now, the individual Permanent Water Saving Rules" (Newton Wayman Chong 2005a, p. 3).

Box 3 Perspectives – A consumer/community organisation on the Victorian approach

“We are generally happy with the Victorian model – clear and transparent trigger points, quite incremental, not until it's very drastic that no watering will be introduced. When restriction levels have changed, it's been well advertised – on water business websites, in papers etc.”

Pers. comm. March 2007

While there has been widespread information about restrictions regimes, direct consultation with residents about the design of restrictions appears less extensive and limited to standard statutory consultation periods. Where targeted and extensive consultation has taken place, it has often been focused on affected industry groups or local government, because it is perceived that they have the ‘most to lose’ or the biggest costs to incur from restrictions. This is not exclusively the case, however. For example, in Victoria, specific consultation was held with arthritis sufferers around the implications of the Draft Permanent Water Conservation Plan. Design and manufacturing solutions were sought for the challenges that arthritis sufferers face when using some trigger nozzle hoses (Drought Coordinating Committee VIC, pers. comm. March 2007).

8.1.2 Restrictions exemptions

Less information appears to be available about exemptions. As one organisation observed, ‘people are often not aware they can seek exemptions, nor are they sure how to go about doing it’ (Consumer/community organisation, pers. comm. March 2007). This is supported by some water utilities, which noted that the availability of exemptions is ‘not widely publicised’ and instead, information is provided on application (Drought Coordinating Committee, VIC pers. comm. March 2007).

8.1.3 Water use targets and savings

Restrictions are often promoted alongside per capita or total water use targets. The per capita targets in place in Brisbane/SEQ (an aspirational 140 L per person per day) and Goulburn (mandatory 150 L per person per day) are substantially lower than historical average per person water use across different locations (see Box 4).
Box 4 Examples of water use targets

The majority of water management strategies established across Australia have set per capita water use targets. In some locations, volumetric water use or percentage reduction targets have been communicated in order to promote restrictions.

Water use targets based on total consumption (volume supplied) include:

- ACTEW set a summer target of 139 ML per day when level 3 restrictions were introduced on 16 December 2006, that has been reduced recently to 112 ML per day (ACTEW 2006).

- Gosford/Wyong, NSW is currently under level 4 restrictions and has a weekly total consumption target of 474 ML (Gosford/Wyong Councils’ Water Authority 2007).

Water use targets based on per capita water use include:

- A target of 150 L per person per day is enforced in Goulburn, NSW.

- In south-east Queensland, the QWC recently introduced per-capita aspirational targets under the “Target 140 campaign”, which aims to reduce the region’s average residential consumption from 180L/p/d to 140 L/p/d. Actual water consumption is also updated daily on the QWC website. Elizabeth Nosworthy (Chair of QWC) noted that:

  “…So far we have not banned outdoor watering, however, if we do not see good progress being made towards Target 140 within several months, we will have to look at this issue again, even before Level 6” (QWC 2007).

These per capita water use targets are substantially lower than the historical average actual domestic or residential water use per person in various locations (chosen for illustrative purposes only)

<table>
<thead>
<tr>
<th>L/p/day</th>
<th>2001/02</th>
<th>2002/03</th>
<th>2003/04</th>
<th>2004/05</th>
<th>2005/06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brisbane</td>
<td>292</td>
<td>278</td>
<td>280</td>
<td>286</td>
<td>n/a</td>
</tr>
<tr>
<td>Perth</td>
<td>312</td>
<td>287</td>
<td>307</td>
<td>296</td>
<td>282</td>
</tr>
<tr>
<td>ACT</td>
<td>309</td>
<td>305</td>
<td>242</td>
<td>235</td>
<td>n/a</td>
</tr>
<tr>
<td>Sydney</td>
<td>250</td>
<td>256</td>
<td>226</td>
<td>214</td>
<td>204^2</td>
</tr>
<tr>
<td>Geelong</td>
<td>231</td>
<td>255</td>
<td>253</td>
<td>240</td>
<td>n/a</td>
</tr>
</tbody>
</table>

These figures are based on actual total volume of residential water supplied, divided by population.

Data from WSAA Facts 2005 unless otherwise specified:

1 Based on residential supply volumes and population data provided by WA Water Corporation (pers. comm. February 2007).
2 Based on data from Sydney Water (2006) on observed per capita demand in 2005/06 (341 L/p/day, based on bulk supply) and proportion of bulk supply supplied to residential single dwelling (44%) and residential multi unit (17%) sectors.

The water use savings due to restrictions are summarised in chapter 7. These savings figures, however, which generally take into account the effects of weather and other variables, are not widely used in utilities communication strategies. Water consumption and savings during restrictions are communicated in terms of total or per capita daily consumption volumes, and compared against historical averages.

NWC Review of water restrictions
PART III: REVIEW AND ANALYSIS OF TEMPORARY WATER RESTRICTIONS
Table 5 Communicating use consumption volumes during restrictions on websites

<table>
<thead>
<tr>
<th>State</th>
<th>Location</th>
<th>Website</th>
<th>Water consumption and savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>ACT</td>
<td>ACTEW</td>
<td>Total daily water consumption (ML/day) data available for last 8 days.</td>
</tr>
<tr>
<td>NSW</td>
<td>Sydney</td>
<td>Sydney Water</td>
<td>Total daily water consumption (ML/day) data available for last 7 days. Earlier consumption data available in archive.</td>
</tr>
<tr>
<td>NSW</td>
<td>Gosford/Wyong</td>
<td>Gosford/Wyong Water Authority</td>
<td>Total weekly water consumption (ML/week) compared against level 4 weekly consumption target, consumption last week, consumption for same time last year. Year-to-date total consumption also reported.</td>
</tr>
<tr>
<td>QLD</td>
<td>Brisbane/SEQ</td>
<td>QWC</td>
<td>Individual daily water use (L/p/day) reported for last 7 days and compared to L/p/day target.</td>
</tr>
<tr>
<td>SA</td>
<td>Adelaide</td>
<td>SA Water</td>
<td>Total weekly water consumption (ML/week) data available since restrictions commenced. Actual water consumption graphed against 10-year average consumption for same period of year and against consumption during 2002/03 restrictions.</td>
</tr>
<tr>
<td>VIC</td>
<td>Melbourne</td>
<td>Melbourne Water</td>
<td>Average seasonal (e.g. autumn) total water use reported (ML/day) for last 8 years, last 5 years, last year and this year.</td>
</tr>
<tr>
<td>WA</td>
<td>Perth</td>
<td>WA Water Corporation</td>
<td>Total daily water supply (ML/day) data reported for last 7 days.</td>
</tr>
</tbody>
</table>

Note that this list is not comprehensive.

8.2 Approach to enforcement

Although there are legal provisions in most states for enforcing restrictions through the courts, this mechanism has not been implemented to date, due to the expense and difficulties associated with obtaining evidence. In most locations, utilities implement a provision to issue on-the-spot fines (usually between $100 and $500) to individuals.

As illustrated in Table 6, the number of fines issued varies according to location, partly reflecting:

- The continuous duration of restrictions for several years, such as in Sydney and Perth.

- The relatively recent provision for on-the-spot fines in some areas, such as in Victoria and Adelaide. However, although more fines have been issued per residential connection in Perth than elsewhere, this still represents a relatively small proportion of households and, as noted in Chapter 9, enforcement has not appeared to reduce overall community support for restrictions.
In most locations, monitoring compliance is conducted through a combination of telephone "dob-ins" from the community and active patrol by utility (or council) staff. Warning notices that include educational material are usually issued for the first offence and fines are not issued until breaches are confirmed by on-site inspection.

While telephone "dob-ins" are an important component of monitoring restrictions, in many locations a large proportion of reports has subsequently been revealed to concern use of greywater or rainwater (which are not generally restricted). Visible monitoring of restrictions, for example through staff or meter readers wearing identifiable clothing, is supported generally by the community, as an indication that utilities and organisations intend to enforce restrictions rules (Victorian Drought Coordinating Committee, pers. comm. March 2007).

Box 5 Perspectives – approach to achieving restrictions compliance, Melbourne

In Melbourne, water meter readers now wear ‘water patrol’ vests. These staff visit 6 000 properties a day – providing a strong visual reminder of restrictions to the community, contributing to community confidence in enforcement of restrictions. Although not directly charged with powers of enforcement, they are able to report any observed offences to the call centre for further investigation.

One issue raised by community groups and the utilities themselves is the potential for water restrictions to exacerbate or provide an avenue for expression of neighbourhood disputes. Nevertheless, it appears that enforcement programs are being designed to minimise this risk:

- For example, any ‘dob in’ call results in an education-based letter. Only on a second ‘dob in’ or observed breach would a site visit eventuate.
- Another strategy for responding to such complaints as been the development of a ‘witness form’, which requires neighbours to provide their details in written form if they wish an alleged breach of restrictions to be investigated beyond initial warning.


Box 6 Perspectives – community groups on enforcement and compliance

The community and consumer groups contacted for this study (listed in Volume 2 – Appendices) did not report experiences with residents complaining about restrictions enforcement.

Generally, these groups expressed more concern about the principles associated with enforcement – that people’s basic right to access water be protected and that socially positive and cooperative ways of enforcing restrictions were implemented.
### Table 6 Penalties issued for restrictions non-compliance

<table>
<thead>
<tr>
<th>Location</th>
<th>Utility/ Council</th>
<th>Penalty</th>
<th>Notices issued</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>ACTEW</td>
<td>$200 (individuals); $1,000 (corporations)</td>
<td>66 instances of authorised persons on site witnessing a breach; 32 directions to comply issued; 30 verbal reminders to abide by the restrictions; 14 infringements issued; 385 courtesy letters sent (statistics for period 1 Jan – 23 Feb 2007).</td>
</tr>
<tr>
<td>Adelaide</td>
<td>SA Water</td>
<td>$315 expiation notices</td>
<td>During level 2 restrictions (23 Oct 05 – 31 Dec 06), 222 friendly reminders, 474 warning notices and 3 expiation notices have been issued.</td>
</tr>
<tr>
<td>Brisbane/SEQ</td>
<td>Brisbane Council</td>
<td>$150 for first offence</td>
<td>865 fines were issued from May 2005 to 12 April 2007.</td>
</tr>
<tr>
<td></td>
<td>Logan Council</td>
<td></td>
<td>Since level 2 restrictions were introduced on October 2005, 97 fines have been issued (to 13 April 2007).</td>
</tr>
<tr>
<td></td>
<td>Gold Coast Council</td>
<td></td>
<td>During level 3 restrictions (1 June 06 – 31 October 06), 25 warnings and 29 fines were issued.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>During level 4 restrictions, 10 warning and 16 fines were issued (statistics for period 1 November 06 – 31 March 08).</td>
</tr>
<tr>
<td>Ballarat</td>
<td>Central Highlands Water</td>
<td>$107 to $535 depending on level of restriction, option to restrict supply to 2L/minute</td>
<td>No fines have been issued since restrictions commenced.</td>
</tr>
<tr>
<td>Melbourne</td>
<td>City West Water</td>
<td>Penalties include lowering water pressure.</td>
<td>TBA.</td>
</tr>
<tr>
<td>Eyre Peninsula</td>
<td>SA Water</td>
<td></td>
<td>No fines issued.</td>
</tr>
<tr>
<td>Geelong</td>
<td>Barwon Water</td>
<td></td>
<td>No fines have been issued since restrictions commenced. One customer has been restricted.</td>
</tr>
<tr>
<td>Gosford/Wyong</td>
<td>Gosford/Wyong Council’s Joint Water Authority</td>
<td>Warning for first offence, $200 penalty for individual breaches</td>
<td>In 2006, 115 fines were issued.</td>
</tr>
<tr>
<td>Perth</td>
<td>WA Water Corporation</td>
<td>Warning for first offence, $100 fine for second and subsequent offences</td>
<td>6114 fines and 17,426 warning notices issued from 1 Jul 03 to 14 Feb 07.</td>
</tr>
<tr>
<td>Sydney</td>
<td>Sydney Water</td>
<td>$220 fines issued via infringement notices</td>
<td>1735 fines issued in 2005/06.</td>
</tr>
</tbody>
</table>

* Restrictions implemented by the Queensland Water Commission apply to 12 local government areas in the SEQ region. Restrictions may apply in other SEQ local councils. The three councils listed in this table are the largest by population of the 12 councils under restrictions, and together represent approximately 75% of the SEQ population (based on 2006 population projections from PIFU (2006)).
9 Water savings due to temporary restrictions

There are many factors which influence how much savings can be achieved from temporary restrictions. Some of these are specific to the design of rules and stages, as well as promotion, education and enforcement activities. But there are also a number of “external” factors affecting water restrictions, such as climate and also the availability and costs of other sources. Temporary restrictions, at least at lower levels, may also indirectly result in water savings elsewhere (eg. inside the house) by communicating broader water efficiency messages and thus changing consumer attitudes and behaviour. However, there have also been reports that restrictions, when first introduced at two days a week, could result in an increase in garden watering.

The effectiveness of restrictions also depends particularly on the history of restrictions, the extent to which attitude and behaviour changes during previous restrictions episodes were sustained following restrictions, and the extent to which changing attitudes and water use behaviour in general over time also limit savings from future restrictions.

Demand hardening is a term used to describe the reduced effectiveness of restrictions (in terms of achieving water savings) in subsequent applications. Demand hardening may occur because, over time, there may be improvements in the water-use efficiency of outdoor water use, or decreases in the total volumes or proportion of water used outdoors. Demand hardening may therefore be caused by permanent changes in behaviour or outdoor water use technology due to temporary restrictions – for example, in response to restrictions, households may improve their garden irrigation efficiency or change to less water-intensive plant types. Demand hardening may also be caused by any of a range of demand management initiatives targeting outdoor water use – such as outdoor retrofit programmes, or general education about water efficiency. Reductions in garden sizes and the nature of the housing stock over time (eg. proportion of flats and apartments) may also cause demand hardening.

The issues of demand hardening is significant because in many locations, the supply security of the system throughout droughts depends on savings from restrictions. Unfortunately, as discussed in section 9.1, to date there is very limited available data on how end-uses are affected by restrictions, and therefore modelling of demand hardening. Nevertheless when setting (predicting) target savings from future restrictions episodes, system planners should use the best available information about types and volumes of end-uses in their location.

Another related issue of interest to system planners is that of bounce back, which is the extent and rate of increase of water use after restrictions have been lifted. There is also limited data on end-uses to quantitatively evaluate bounce back after restrictions. However, it is likely that measures such as a strong educational and promotion campaign and the timely introduction of demand management programmes targeting water-use efficiency would limit rapid bounce back.
9.1 Methods to estimate savings due to restrictions

9.1.1 Bottom-up method: attribute changes in end use volumes to specific restrictions rules

Ideally, measuring water savings due to restrictions would be estimated by collecting information and data about the extent to which specific water restrictions rules affect residential and non-residential water use behaviour. These end-uses would include those types of water use directly targeted by the restrictions rules – such as changes to the volumes of water used on gardens and pools. Attributing changes in water use to specific restrictions rules would enable thorough evaluation of the cost-effectiveness and distributional impacts of different restrictions rules. For example, if data was collected about the water saved under a sprinkler ban compared to water saved allowing sprinklers two days a week, then the cost-effectiveness of this ban could be assessed against other approaches for reducing water use, such as further investment in demand management programmes promoting outdoor water-use efficiency or pricing strategies.

Measuring and attributing water savings to specific restrictions rules, or individual restrictions levels, would require, at least, longitudinal (time series) surveying and metering of a representative sample of water users in each location. Furthermore, additional data and information would be required in order to predict the savings from restrictions in the next episode of drought, due to demand hardening and other changes in behaviour and attitudes over time (see chapter 20).

To date, comprehensive data on water savings due to current, specific restrictions rules does not exist for any of the metropolitan areas in the terms of reference for this review. In many locations, this is because the current severity of water restrictions is greater than that experienced in the recent past.

However, although detailed end-use measurement has not been conducted, a range of other sources of information could be used to estimate, or predict, savings from restrictions. For example, in the development of the Uniform Water Restrictions Guidelines currently in place across Victoria, in 2005 a technical working group (comprising representatives from Victorian water businesses) assessed savings from the previous restrictions stages (levels 1 and 2) using metered data. They also used customer survey data (for example on proportion of water used on lawns, and garden watering frequency) to predict savings from different restrictions rules (TWGWSA 2005).

Nevertheless, the wide data gap has prevented this review from evaluating the cost-effectiveness of specific restrictions rules or levels, either relative to other restrictions rules or to other options for reducing demand. Guidance for conducting end-use measurement is provided in chapter 20.

9.1.2 Top-down method: using total consumption data
Given the absence of end-use data, estimating savings due to temporary restrictions is limited to using available data on total consumption – that is, **metered total consumption observed during restrictions** less **total consumption estimated to have occurred in the absence of restrictions**. However, inferring savings from total consumption volumes does not enable analysis of the relative savings by residential and non-residential sectors. This method does not enable precise analysis of specific savings due to different restrictions rule combinations.

Metered consumption data is often available as “bulk supply” volumes – that is, the volume of water supplied to residential, non-residential uses, as well as environmental flows, leakages, losses and other uses.

There are two main ways to estimate total consumption in the absence of restrictions – by comparing to historical water use, or by modelling demand correcting for the influence of weather (and other variables). Due to the aggregated nature of these methods, neither necessarily provides an accurate estimate of savings due to restrictions:

1. **Historical water use**: water use reductions due to restrictions are estimated by comparing actual water use (during restrictions) to historical unrestricted consumption levels.

   This may allow correction for population growth, if water use is measured per capita or per household, but does not separate the influence of other variables that affect demand, including weather (e.g., the effect of drier or hotter conditions than historical averages) or water conservation programs. These variables could be particularly influential during droughts, when unrestricted water use may rise (due to garden watering needs) or fall (due to ‘community conscience’ effects).

   That is, the difference between historical unrestricted water use and observed restricted water use will be partly due to restrictions, but also partly due to other factors. Depending on the balance of these factors, this method could either underestimate or overestimate savings due to restrictions.

2. **Modelling demand, correcting for the influence of weather and other variables**: water savings due to restrictions are estimated by comparing actual water use (during restrictions period) to water use estimated to have occurred in the absence of restrictions, modelled correcting for weather (and possibly, although not necessarily, other influences such as population growth, promotion of water efficiency and demand management).

   This method is generally more accurate than comparing to historical water use records.

### 9.2 Savings due to restrictions

#### 9.2.1 Public accessibility to information on savings due to restrictions
The extent to which information on savings due to restrictions is publicly accessible through websites, media releases or publicly available reports varies between metropolitan locations. For example:

- SA Water publishes on its website a time-series chart comparing Adelaide’s current actual water consumption (under restrictions) to historical average consumption for the same time of year.

- Sydney Water publishes on its website time-series data comparing Sydney’s current actual water consumption (under restrictions) to historical average consumption for the same time of year. Sydney Water also provides data on modelled consumption without restrictions (corrected for weather and demand management) in its annual Water Conservation and Recycling Implementation Report, from which savings due to restrictions can be inferred.

- Gosford/Wyong publishes on its website time-series charts comparing current actual water consumption (under restrictions) to unrestricted demand, as well as progress towards per capita consumption targets.

- Queensland Water Commission and ACTEW do not specifically report savings due to restrictions, however during restrictions’ periods report progress towards per capita consumption targets.

### 9.2.2 Savings due to restrictions estimated using information provided for this review

For this review, each utility or agency responsible for restrictions was requested to provide any estimations of savings due to restrictions, preferably estimated using weather-corrected demand.

Savings from restrictions estimated by comparing observed restricted consumption to weather-corrected modelled unrestricted demand were provided by Yarra Valley Water for Melbourne, ACTEW for the ACT, WA Water Corporation for Perth and Sydney Water for Sydney. Savings estimates were not available for the current or recent restrictions episodes for ACT and Melbourne. For other metropolitan locations that have experienced restrictions, either weather-corrected demand modelling has not yet been conducted or estimated and the information was not available. Table 7 summarises available evidence on the effectiveness of restrictions in reducing total demand. These figures reflect changes in total bulk water supplied during restrictions. Bulk supply includes all water supplied, including residential, non-residential, leakage and losses. These figures therefore do not distinguish between savings made by residential and non-residential sectors and enable relative consumption savings (under different stages and rules) to be assessed only roughly. Practical conclusions on data needs to improve the assessment of restrictions effectiveness are described in chapter 18.

The method for modelling unrestricted demand varies in different locations. Unlike other locations, the modelled demand in Sydney has taken into account not only the
effects of weather, but also of demand management programmes – this means that the estimated savings are not due to weather or demand management. However, for other locations, at least part of the savings estimated could be due to demand management and other measures, not just restrictions. Nevertheless, due to the relatively small contribution of savings from demand management in these locations, this will not be significant.

Noting these constraints on the accuracy of savings estimates, the following observations can be made:

- In Sydney and Melbourne, increasing the severity of restrictions has (in the past) been effective in further reducing consumption.

- However, in the ACT, when stage 1 was increased in May 2003 to stage 2, apparent savings decreased, which suggests that either percentage savings are greater in summer than in winter or that the modelling was unable to resolve seasonal changes.

These weather-corrected savings are not generally used to communicate the effectiveness of restrictions to the public (see section 9.2.1).

Table 7 also lists, for information, target savings for various locations from different stages of restrictions. These targets are estimated in various ways. In Sydney, target savings are estimated relative to the ten year average demand figure of 600 GL pa (whereas actual savings are measured relative to weather-corrected modelled demand, net of demand management programmes). In Canberra, both target and actual savings are estimated relative to weather-corrected modelled demand.
Table 7 Summary of reductions in water use due to restrictions

<table>
<thead>
<tr>
<th>Location</th>
<th>Restrictions level</th>
<th>Target savings</th>
<th>Dates</th>
<th>Savings</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total L/p/day</td>
<td>L/hh/day</td>
<td></td>
</tr>
<tr>
<td>Perth</td>
<td>Level 4</td>
<td>45 GL/yr</td>
<td>Sep01–ongoing</td>
<td>44 (or 58)</td>
<td>GL/yr</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>117</td>
<td>331</td>
<td></td>
</tr>
<tr>
<td>Sydney</td>
<td>Level 1</td>
<td>7%</td>
<td>Oct03–May04</td>
<td>13%</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Level 2</td>
<td>12%</td>
<td>Jun04–May05</td>
<td>16%</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Level 3</td>
<td>15%</td>
<td>Jun05–ongoing</td>
<td>17%</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Savings from July 2006 not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACT</td>
<td>Stage 1</td>
<td>15%</td>
<td>Dec02–Apr03</td>
<td>14%</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 2</td>
<td>25%</td>
<td>May03–Sep03</td>
<td>13%</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 3</td>
<td>40%</td>
<td>Oct03–Feb04</td>
<td>33%</td>
<td>204</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 2</td>
<td>13%</td>
<td>Mar04–Aug04</td>
<td>13%</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 3</td>
<td>40%</td>
<td>Sep04–Feb05</td>
<td>33%</td>
<td>188</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 2</td>
<td>13%</td>
<td>Mar05–Oct05</td>
<td>11%</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 3</td>
<td></td>
<td></td>
<td>Savings from current restrictions episode not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melbourne</td>
<td>Stage 1</td>
<td>n/a</td>
<td>Nov02–Jul03</td>
<td>7.8%</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 2</td>
<td>n/a</td>
<td>Aug03–Apr05</td>
<td>10.7%</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 3</td>
<td></td>
<td></td>
<td>Savings from current restrictions episode not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geelong</td>
<td>Stage 1</td>
<td>n/a</td>
<td>Jan98–Dec00</td>
<td>8%</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 2</td>
<td>n/a</td>
<td>Dec00–Oct01</td>
<td>20%</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 3</td>
<td>n/a</td>
<td>Oct06 – Dec06</td>
<td>6%</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 3</td>
<td>n/a</td>
<td>Jan07 - ongoing</td>
<td>24%</td>
<td>140</td>
<td></td>
</tr>
<tr>
<td>Adelaide</td>
<td>Stage 2</td>
<td>15%</td>
<td>Oct05–Jun06</td>
<td>25%</td>
<td>111</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 3</td>
<td>20%</td>
<td>Jun06–Oct06</td>
<td>30%</td>
<td>129</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 4</td>
<td>25%</td>
<td>Nov06–Mar07</td>
<td>34%</td>
<td>155</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 5</td>
<td></td>
<td></td>
<td>Savings from current restrictions episode not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brisbane</td>
<td>Stage 2</td>
<td>15%</td>
<td>Oct05–Jun06</td>
<td>25%</td>
<td>111</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 3</td>
<td>20%</td>
<td>Jun06–Oct06</td>
<td>30%</td>
<td>129</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 4</td>
<td>25%</td>
<td>Nov06–Mar07</td>
<td>34%</td>
<td>155</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage 5</td>
<td></td>
<td></td>
<td>Savings from current restrictions episode not available</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Assumes all savings under restrictions attributable to residential sector. Savings per person and per household were calculated by the Institute for Sustainable Futures using data on number of households and population from WSAA Facts (2005) or utilities.

1 Depends on modelling method. Savings estimated to 15 December 2006 (WA Water Corporation, pers. comm.).
2 Actual savings should not be compared to target savings because the latter are measured relative to a baseline of 600GL pa (the ten-year average demand), whereas actual savings relate to a baseline of modelled demand (weather-corrected and net of demand management programs, which are adjusted for the effect of restrictions).
3 In the ACT, the restrictions regime has since changed from 5 stages to 4, with equivalence between previous Stage 1 now permanent water conservation measures, to previous stage 5 now stage 4. Note that savings are estimated relative to weather-corrected modelled demand which has not been adjusted for the influence of other factors such as demand management programs.
4 Previous restrictions rules. Note that savings are estimated relative to weather-corrected modelled demand which has not been adjusted for the influence of other factors such as demand management programs. For current restrictions rules, on an annual basis the target savings (post introduction of PWCM) are as follows – stage 1 2.5%, stage 2 8%, stage 3 12% and stage 4 17.5%. These targets vary considerably by month and are higher in summer than winter months.
5 Assessed against 10-year historical average consumption.
6 Assessed against 10-year historical average consumption. Savings estimated to 30 April 2007.
7 Assessed against 5-year, seasonally adjusted historical average consumption. Level 1 restrictions are voluntary in SEQ. Savings for stage 5 restrictions (which commenced on 10 April 2007) are not yet available. These savings are estimated using monthly consumption figures and population for June 2006 data supplied by QWC.
PART IV – DIRECT COSTS AND BENEFITS OF TEMPORARY WATER RESTRICTIONS
10 Approaches to identifying and measuring the costs and benefits of temporary restrictions

The costs and benefits of temporary restrictions arise through many pathways – directly through restricting timing, types and technologies of water use, as well as through flow-on effects arising from changes in water users’ choices, attitudes and preferences. Restrictions also result in indirect impacts through their potential as a portfolio option, in terms of the “avoided” costs which would arise if other options had to be implemented to ensure supply-demand balance for long-term planning and throughout droughts.

Restrictions rules are largely designed on the premise of limiting discretionary uses. The concepts of discretionary versus non-discretionary water uses are also used in the reasoning behind using inclining pricing block tariffs. The distinction generally refers to differences in the willingness to pay for different uses of water, which would vary between individual consumers (Sibly 2006). Consequently, the impacts of water restrictions are unevenly distributed, both across user groups and through flow-on effects on industries.

Box 7 Perspectives – Victorian Drought Coordinating Committee on restrictions and equity

Utilities in Victoria recognise that some industries regard restrictions, which focus on outdoor water use, as inequitable. However, the utilities noted that other strategies are being developed to help industrial and commercial customers achieve long-term conservation, but that this work often involves large-scale infrastructure change and therefore takes place on a different time scale to restrictions on outdoor use. They consider that this message is difficult to convey at times.

In Victoria, a 4-stage Uniform Water Restriction Schedule was developed as an initiative of the 2004 White Paper on Water. This Restriction Schedule has been adopted by all water authorities across the State (with some minor variations to allow for local conditions) and is an integral part of the broader Drought Response Plans that have been developed for all water supply systems across the State (over 200 supply systems). The Uniform Water Restriction Schedule was based on an adopted hierarchy of water use which informs the sequence of restrictions on various types of water use. In developing this hierarchy of use, consideration was given to a range of factors including the amount of water used, whether the use was essential from a health point of view, whether the use was an integral part of manufacturing and commercial business and the extent to which the use provides community recreation and amenity benefits compared with private benefits. As such, the hierarchy is value-based and debatable, but at least provides some transparency around the rationale for the design of restrictions. One of the key features of the restriction regime is that private lawn watering is banned from Stage 2 onwards. Subsequent market research has shown that strong community support for this provision exists.


This chapter outlines a framework to identify types of costs and benefits (also referred to collectively as “impacts”) of restrictions according to:

- Types of costs and benefits – according to who is affected: residential water users, non-residential water users, governments/regulators, and the community more broadly.
• Economic, social and environmental impacts of restrictions rules and the indirect impacts through avoided portfolio costs and benefits effects.

This chapter also outlines approaches to measuring the costs and benefits of restrictions, including assessment of when monetary quantification might be appropriate.

### 10.1 Identifying categories of costs and benefits

#### 10.1.1 Who is affected by restrictions?

As described in chapter 5, in most Australian locations there are broadly three sets of restrictions rules and/or exemptions (which may overlap):

- Restrictions on **residential (or private) outdoor water uses** – eg. gardens, pools and spas, car washing, outdoor surfaces.

- Restrictions on **business (commercial/industrial) activities** which specifically use water as a factor of production – eg. nurseries, market gardens, commercial car washes.

- Restrictions on the use of water for **community outdoor facilities**, usually operated by local governments or community organisations, such as public parks, public gardens and sportsgrounds.

A conventional framework for measuring the impact of policies or programme (see for example OBPR 2006) is to consider the impacts on three types of economic agents:

- Consumers, or households - residential water users
- Producers, or businesses, and other non-residential water users
- Government (implementing and regulating policies and programmes)

Although individual households or businesses respond to water restrictions, and governments/regulators design and implement restrictions, this categorisation of parties affected by restrictions leads to a degree of overlap. For example, residential users might be affected by restricted types of water uses on private properties, but also as employers and employees in businesses, and as members of the community affected by flow-on effects such as reduced availability of recreational spaces. Restrictions might also have broader impacts on the community, for example through contributing to cooperative action and cohesiveness – or, on the other hand, creating frustration and dividing communities if restrictions are perceived as “unfair”. There are also government organisations – particularly local councils – who must respond to restrictions rules. Some local governments also have water utility functions including implementing and promoting restrictions.

This study identifies impacts on:

- Residential water users – impacts arising from restrictions on residential water use, directly within private residences.
• Businesses – impacts arising either from restrictions on non-residential water uses or from restrictions on uses that subsequently affect sales.
• Local government – impacts arising from responding to restrictions on water uses.
• Water utilities – impacts arising from designing and implementing restrictions
• Community – impacts not accounted for in above groups, which affect members of the community indirectly (i.e., beyond the impact within private residences or businesses), such as community harmony/disharmony and flow-on effects from reduced recreational spaces.

10.1.2 What are the economic, social and environmental costs and benefits?
The terms of reference for this review require an assessment of the “economic, social and environmental” costs and benefits of restrictions.

The identification of impacts according to economic, social and environmental categories is consistent with the “triple bottom line” approach to reporting and measuring performance in a way which reflects the principles of transparency, accountability and sustainable development. The Global Reporting Initiative, which is the internationally accepted framework for sustainability reporting, focuses on the performance of organisations (GRI 2007). The framework provides guidance on establishing indicators of economic, environmental and social performance (see Table 8).

Table 8 Global Reporting Initiative – Indicator protocol aspects*

<table>
<thead>
<tr>
<th>Economic</th>
<th>Environmental</th>
<th>Society</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market performance</td>
<td>Materials</td>
<td>Community</td>
</tr>
<tr>
<td>Economic performance</td>
<td>Energy</td>
<td>Corruption</td>
</tr>
<tr>
<td>Indirect economic impacts</td>
<td>Water</td>
<td>Public Policy</td>
</tr>
<tr>
<td></td>
<td>Biodiversity</td>
<td>Anti-competitive behaviour</td>
</tr>
<tr>
<td></td>
<td>Emissions, Effluents and Waste</td>
<td>Compliance</td>
</tr>
</tbody>
</table>

*Other indicator categories include product responsibility, customer health and safety, and product and service labelling.

The categories of “economic, social and environmental” costs and benefits are also used widely in the design and evaluation of public policies and programmes, although there is less formal guidance on the boundaries of these categories. For example, a key step in the Australian Government’s Best Practice Regulation Handbook 2006 (OBPR 2006), which provides guidance on the design of regulation and preparation of Regulation Impact Statements, is to “identify and categorise the expected economic, social and environmental impacts of the proposed options as likely benefits and costs”. However, in the subsequent sections and examples of the Handbook, further guidance is not provided as to the best way to identify “environment, economic or social” costs and benefits, but rather identification according to affected parties - businesses, consumers, the community/environment, and government.
Despite a lack consistently applied, specific or formal guidelines for categorising impacts of policies or programmes, the grouping of “economic, social and environmental” is useful to ensure as wide a range as possible of impacts are identified. Impacts for which monetary values can be assigned using market price and cost information are commonly categorised as “economic” costs or benefits. Examples of possible “economic” costs or benefits of restrictions include the reduced profits from businesses affected by restrictions, or the avoided construction costs of supply augmentation that would have been required if restrictions were not in place. The terms “social” and “environmental” impacts are generally used to refer to goods, services or other attributes not valued by markets. For example, the HM Treasury (2003, p. 19) guidelines for appraisal and evaluation of publicly-funded policies, programmes and projects state that “Costs and benefits should normally be based on market prices as they usually reflect the best alternative uses that the goods or services could be put to…. wider social and environmental costs and benefits for which there is no market price also need to be brought into any assessment.”

In this study, the framework of “economic, social and environmental” costs and benefits has been used to ensure the identification of costs and benefits was not been limited to those impacts which can be valued using market prices – however noting that:

- There are potential overlaps between the categories, for example the extent to which a specific industry is affected by restrictions could be described as an “economic” cost, but there are also “social” consequences for example through the uneven distribution of impacts including the loss of jobs.

- Where market prices do not exist, alternative methods can be used to place a monetary value on many “social” or “environmental” impacts – for example, the extent to which individuals as residents are affected by restrictions through WTP surveys; or the greenhouse gas emissions which could possibly be “avoided” through implementing restrictions rather than other more greenhouse gas-intensive options. However, there are limitations to the extent to which monetising cost and benefits provides a meaningful indicator of society’s values and preferences (discussed further in chapter 9).

10.1.3 Summary of costs and benefits identified in this review

Two key research methods were used in this study to identify restrictions costs and benefits:

- Review of literature, including quantitative and qualitative studies (such as consumer attitudes surveys).

- Targeted interviews with representatives from industry, community and consumer groups, utilities and local governments (noting, however, that full public consultation was not specified by the terms of reference and was not conducted as part of this study).
Restrictions effectively limit the ways in which water can be used. However, there are a range of possible impacts, because there are many ways in which water users adapt or subsequently change their related choices and behaviour. For water-using businesses such as nurseries, there may be costs involved (staff and technologies) with changing water-use practices. However, as detailed in chapter 12, the major costs of restrictions to businesses are through reduced sales of goods and services associated with restricted water uses (eg. irrigation equipment). Some businesses may experience changes in sales due to water users substituting or adapting their practices (eg. installation of rainwater tanks and greywater diverters).

A further challenge in categorising and identifying costs and benefits is that, like all policies and regulations, restrictions result in changes in attitudes and preferences over time. Notwithstanding that certain restrictions may lead to severe costs on at least some sectors of society, if implemented in conjunction with broader information-raising about water conservation and efficiency, water restrictions may result in a combination of attitudes and behaviour changes that, over time, benefit the individual as well as improve water use efficiency (Consumer/community organisation, pers. comm. March 2007). However, it is possible that many specific restrictions rules (such as those which ban certain water use technologies) may conflict with other programmes to promote innovation in the technology or communication of water efficient practices.

Table 9 lists possible benefits and costs of restrictions, identifying how they might be categorised according to “economic, social and environmental” groupings, or by who in society is affected. This list is not intended to be exhaustive, but to provide an indication of the range of types of benefits and costs.
Table 9 Possible benefits and costs of restrictions

<table>
<thead>
<tr>
<th>Economic</th>
<th>Social</th>
<th>Environmental</th>
<th>Households (private impacts)</th>
<th>Households (as community)</th>
<th>Businesses</th>
<th>Utilities</th>
<th>Local govt</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Personal and community satisfaction from saving water</td>
<td>- Community disharmony from “dob in neighbour”</td>
<td>- Loss of amenity, recreational, health and/or cultural values from private gardens and pools</td>
<td>- Loss of amenity, recreational, health and/or cultural values from public gardens and pools</td>
<td>- Additional travel time to recreational spaces</td>
<td>- Financial costs or additional time associated with changing private gardens or watering technologies</td>
<td>- Financial costs associated with changing public gardens/parks or watering technologies</td>
<td>- Time and/or financial savings from more efficient watering technologies and practices</td>
</tr>
<tr>
<td>+/- Property values (depending on changes to gardens)</td>
<td>- Financial costs of garden/park restoration after restrictions</td>
<td>+ Increased sales/employment from goods or services that are arise from responses to restrictions (eg. rainwater tanks)</td>
<td>- Decreased sales/employment from goods or services that are restricted (eg. pools, irrigation technologies, garden products)</td>
<td>- Increased financial costs to outdoor water-using businesses whose activities are directly restricted (eg. carwashes, nurseries)</td>
<td>- Advertising, education, promotion and enforcement costs associated with restrictions.</td>
<td>- Financial Costs associated with using alternative sources of water.</td>
<td>+/- Reduction in runoff and associated environmental impacts</td>
</tr>
</tbody>
</table>

10.2 Methods for measuring the costs and benefits of temporary restrictions

There are many techniques available to measure the costs and benefits of restrictions. These may be quantitative – including measurement in monetary or physical terms – or qualitative. Not all costs and benefits are amenable to meaningful measurement in dollar terms. Furthermore, of measuring costs and benefits in dollar values, care should be taken in aggregating costs and benefits, because some impacts are distributional effects rather than net aggregate costs or benefits – for example, a reduction in revenue to the government would be offset by a reduction in the amount paid for water by users, so the net effect to the total economy would be zero.
This chapter outlines monetary valuation techniques and their limitations, including data requirements, and describes the approaches taken to quantitative or qualitative assessment used in this review.

### 10.2.1 Quantitative monetary valuation techniques

There are a range of techniques available to measure, in monetary terms, the impacts of policies or programmes such as water use restrictions. Where the impacts affect goods or services directly traded in markets (e.g., sales of restricted water-using technologies), standard market prices can be used to calculate changes in **producer surplus** or **consumer surplus**, which are conventional economic measures of welfare (discussed below).

Where the impacts affect non-market values (e.g., environmental externalities, or the amenity and recreational value household gain from private gardens and public parks), a range of “non-market” measurement techniques exist. These are described briefly in Table 10.

**Table 10 Non-market valuation techniques**

<table>
<thead>
<tr>
<th>Non-market valuation technique</th>
<th>Description</th>
<th>Possible restrictions example*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hedonic pricing</strong></td>
<td>Variations in values of marketed goods or services (e.g. property prices) used as a proxy for non-marketed values that affect the market prices.</td>
<td>Changes in house prices near recreational spaces affected by restrictions.</td>
</tr>
<tr>
<td><strong>Travel cost method</strong></td>
<td>Used to estimate the benefits or costs resulting from changes to recreational site.</td>
<td>Calculate changes in visitation rates and cost per trip to recreational spaces affected by restrictions.</td>
</tr>
<tr>
<td><strong>Substitute cost</strong></td>
<td>Cost to substitute for lost value with other goods or services, to maintain same value.</td>
<td>Additional costs from purchasing water from non-mains sources to maintain garden watering.</td>
</tr>
<tr>
<td><strong>Replacement cost</strong></td>
<td>Cost to replace lost good or service.</td>
<td>Cost of replanting private gardens or public parks affected by restrictions.</td>
</tr>
<tr>
<td><strong>Contingent valuation</strong></td>
<td>Respondents state their “willingness to pay” or “willingness to accept” a policy change or change in scenario.</td>
<td>The community could be surveyed to determine the extent to which they value avoiding restrictions of different frequencies, durations or severities.</td>
</tr>
<tr>
<td><strong>Choice modelling</strong></td>
<td>Respondents choose between one scenario or situation, at a given price or cost, and another choice or scenario, at a given price or cost.</td>
<td>The community could be surveyed to determine the preference of a range of portfolios of options, which include water restrictions in different ways.</td>
</tr>
</tbody>
</table>

*Note that these refer to theoretically possible applications of the measurement technique to restrictions costs or benefits. However, these techniques have not necessarily been applied in this review because of data limitations or because there may be more appropriate, accurate and meaningful quantitative or qualitative approaches to assessing the cost or benefit examples.*

Some of these valuation techniques, and their applicability in determining the costs and benefits of restrictions, are discussed below.

**Market prices methods for consumer and producer surplus**
The conventional approach for measuring the economic impact on households is to use market prices to calculate change in consumer surplus. Measuring changes in consumer welfare due to restrictions could involve establishing a household demand curve for water and gauging the effective “price” increase that restrictions impose, and thus calculating the difference in consumer surplus. However, this approach is problematic for many reasons, including:

- Determining the price elasticity of demand of outdoor water use during drought conditions.
- Assuming that the welfare loss from restrictions on specific timing, technologies and types of water use is equivalent to rationing total water use.

Producer welfare is the conventional economic approach to measuring costs to firms. For example, if restrictions result in a loss of sales,

However, it is not possible to attribute changes in output directly to restrictions. In this review, a qualitative approach is used to assess costs to industries. Quantitative evidence, which could be used to approximate economic costs – at least in the short-term (including reports on losses of revenue and sales) – is compared with feedback from industries about the impact of specific rules in different locations.

Restrictions on industries that translate into changes in consumer prices or availability of goods and services have implications for consumer surplus and consumer welfare. This study has not addressed these effects directly.

Contingent valuation method for consumer surplus

Another way to measure consumer welfare changes is to use consumer surveys to gauge how much households would be willing to pay (WTP) to avoid restrictions, or to gauge how much compensation households would be willing to accept (WTA) so that they would have the same level of welfare (all other things held constant) as without restrictions. This “stated preference” technique can be used to elicit values when market prices are not available.

In most cases, WTP and WTA are not equal (Hanley & Spash 1993) and in the case of restrictions, WTA studies have not been undertaken. WTP figures may or may not be realistic measures of the impacts on households. Several factors can potentially influence WTP results (Arrow et. al. 1993):

- **Method of elicitation** – results depend on whether contingent valuation or choice modelling surveys are used.
- Whether survey participants respond as consumers (how will this affect me, directly?) or citizens (what ought we to do as a society?).
- The extent to which survey respondents have information about the decision-making context, the alternatives to the restrictions and how the impacts of the alternatives would affect them or the environment.
Inconsistency of preferences and sensitivity of respondents to situation framing
- for example, small changes in information available, or the ordering of information, can result in large variation in response and/or inconsistency in responses from the same individual.

Nevertheless, estimation of WTP can be a useful when it is necessary to compare restrictions within a portfolio of other options whose impacts may be estimated in monetary terms. Although care should be taken in relying on results, well-designed WTP studies (e.g., Hensher et al. 2006) can help inform relative differences in how much respondents are willing to pay to avoid the different severity or frequency of restrictions.

Depending on the framing of questions in a contingent valuation study, and depending on the situation of the individual, participants responses may reflect their willingness to pay (or accept compensation to avoid) a combination of several "household - private", "community" and "business" impacts listed in Table 9.

Theoretically, results from a contingent valuation survey that was representative across the entire population affected by restrictions (including businesses, water utilities and local governments) would reflect a society-wide cost of restrictions, and not just the costs borne by private households. Adding costs measured using other techniques (such as by using market prices) to the results of a contingent valuation survey could therefore result in an overstatement of the total society-wide costs of restrictions. Nevertheless, due to resource requirements it is unlikely that a "whole-of-society" contingent valuation study could be implemented, and careful design will reduce the degree of overlap in measuring costs.

Market price technique – direct costs to utilities

Restrictions impose direct costs on utilities (and local councils that are water providers). These costs mainly relate to additional staff time associated with assessing exemption applications, advertising, promotion, monitoring and enforcement. For this review, utilities were asked to provide information about the costs of activities associated with restrictions.

Water restrictions also pose revenue implications, particularly by increasing the volatility of cash flow that already exists due to weather and other short-term factors that influence demand. This revenue loss can be of importance to the utilities (especially when positively correlated with the costs they incur in promoting reduction in demand for their primary services). However, from a whole-of-society perspective, losses in revenue are transfer payments and therefore have not been canvassed in this study.

Market price technique – local governments

Local governments bear costs of restrictions in terms of extra staff and other costs associated with responding directly or indirectly to restrictions (for example, to
maintain or restore public parks and gardens). For this review, it has not been possible to comprehensively estimate quantitative costs attributable to restrictions.

Any loss of amenity value in parks and gardens because of restrictions could be viewed as a component of consumer surplus, potentially captured within a household WTP assessment that includes restrictions that affect public as well as private gardens.

### 10.2.2 Measurement approaches used in this review

Only a limited range of costs and benefits identified in this review were valued in monetary terms:

- For water restrictions impacts which could be valued using market prices, data which attributes changes in market prices to impacts of restrictions is not comprehensively available – nevertheless, a range of available costs have been reported.

- For impacts which can only be valued using non-market price techniques, few studies have been conducted and are available, and these do not capture the full range of restrictions frequencies, durations or severities.

- For the avoided costs of restrictions through portfolio effects, available data on avoided financial costs is reported (to varying levels of detail) in case studies.

Not all impacts of policies or programmes, such as water restrictions, can be quantified in monetary terms, whether due to data or methodological limitations. Australian and international best-practice guidelines for policy evaluation firmly recommend that care should be taken to ensure impacts that can be easily quantified in monetary terms do not dominate important qualitative factors (HM Treasury 2003, OBPR 2006, Arrow et al 1992).

In this review, quantitative evidence about the dollar costs of restrictions examined in conjunction other, non-monetary quantitative evidence (such as survey results) as well as qualitative information (such as opinions and information provided in interviews) about impacts and attitudes towards restrictions.

The approaches included:

- Review existing studies (which use willingness to pay or market price methods) that quantify monetary costs.

- Undertake “basic” consumer welfare loss calculations for the cost of restrictions in case study locations.

- Report on available avoided financial costs for case study locations

- Undertake targeted interviews with representatives from industry, community and consumer groups, utilities and local governments (noting, however, that full public consultation was not specified by the terms of reference and was not conducted as part of this study).
Review non-monetary studies (including consumer attitudes surveys).

### Table 11 Measurement methods for direct costs and benefits of temporary restrictions

<table>
<thead>
<tr>
<th>Economic</th>
<th>Social</th>
<th>Environmental</th>
<th>Measurement method for possible benefits (+) and costs (-) of restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Contingent valuation studies†</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Basic Consumer surplus method†</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Changes in revenue or expenditure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Qualitative evidence including surveys</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Not specifically measured or</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+ Personal and community satisfaction from saving water</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Community disharmony from ‘dob in neighbour’</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Loss of amenity, recreational, health and/or cultural values from public parks and sportsgrounds</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Loss of amenity, recreational, health and/or cultural values from private gardens and pools</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Additional travel time to recreational spaces</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Financial costs associated with changing public gardens/ public parks or watering technologies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Financial costs or additional time associated with changing private gardens or watering technologies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+ Time and financial savings from more efficient watering technologies and practices</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+/- Property values (depending on changes to gardens)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Financial costs of garden/park restoration after restrictions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+ Increased sales/employment from goods or services that are arise from responses to restrictions (eg. rainwater tanks)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Decreased sales/employment from goods or services that are restricted (eg. pools, irrigation technologies, garden products)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+ Increased costs to outdoor water-using businesses whose activities are directly restricted (eg. carwashes, nurseries)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Advertising, education, promotion and enforcement costs associated with restrictions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Costs associated with using alternative sources of water.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Biodiversity impacts associated with parks and gardens</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+/- Reduction in runoff and associated environmental impacts</td>
</tr>
</tbody>
</table>

* This method is approximate only  

**Used in this review**
11 Costs and benefits of restrictions on households and the community

This chapter reviews quantitative and qualitative evidence on the costs and benefits of restrictions on households and the community. As discussed in chapter 10, households are directly affected by the impacts of restrictions on residential water use on private gardens and pools, as well as through their activities and interactions as members of the wider community. A summary of potential impacts is listed in Table 12.

Table 12 Potential impacts of restrictions on households in private residences and as members of the community

<table>
<thead>
<tr>
<th>Private residences</th>
<th>Community</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Economic</strong></td>
<td></td>
</tr>
<tr>
<td>- Financial costs associated with changing private gardens or watering technologies.</td>
<td>Note that economic costs to industry are discussed in chapter 12.</td>
</tr>
<tr>
<td>- Financial costs associated with garden restoration after restrictions.</td>
<td></td>
</tr>
<tr>
<td>+ Financial savings from more efficient watering technologies and practices.*</td>
<td></td>
</tr>
<tr>
<td>- Financial costs associated with using alternative sources of water</td>
<td></td>
</tr>
<tr>
<td><strong>Social</strong></td>
<td></td>
</tr>
<tr>
<td>+ Personal satisfaction from saving water</td>
<td>+ Community satisfaction from saving water</td>
</tr>
<tr>
<td>- Time associated with changing public gardens/ public parks or watering technologies</td>
<td>- Community disharmony from “dob in a neighbour” enforcement.</td>
</tr>
<tr>
<td>- Loss of amenity, recreational, health and/or cultural values from private gardens and pools</td>
<td>- Loss of amenity, recreational, health and/or cultural values from public parks and sportsgrounds.</td>
</tr>
<tr>
<td></td>
<td>- Additional travel time to recreational spaces</td>
</tr>
</tbody>
</table>

* All impacts listed in this table are potential impacts, and depend on specific situations. For example, financial savings from more water-efficient watering technologies will not accrue if restrictions ban the use of these technologies.

11.1 Identifying costs and benefits of restrictions on households and the community

Three main types of costs and benefits are discussed in this section:

- Impacts on private residences, which arise directly from restrictions on residential outdoor water use

- Impacts on community cohesion, which arise from enforcement of restrictions

- Impacts on recreational and amenity values of sportsgrounds and parks.

11.1.1 Residential garden watering

As discussed in chapter 7, the key restricted outdoor residential water uses are garden and lawn watering, and topping up and filling swimming pools and spas. In terms of impacts on households, various groups interviewed in this review raised the issue of restrictions on garden watering.
Box 8 Perspectives – Community/consumer organisations on equity of restrictions

- Many organisations stated that they prefer restrictions to increased pricing, noting that there is widespread perception that restrictions are a more equitable policy instrument because it targets discretionary uses. Community groups also raised concerns that price rises are unlikely to reduce water use by lower income customers.

- Some concerns have, however, been raised about community frustration due to perceived inequity between or within sectors – such as industries, or the ability for wealthier households to purchase water to maintain gardens.

- Certain sectors of the community may be unable to comply with particular restrictions rules (such as the use of trigger hoses or hand watering) due to ill health or frailty. In response to this, most utilities have an exemptions program. For example, one organisation expressed confidence in the exemptions process and Sydney Water’s ability to manage individual situations fairly.

- Some community groups noted that tenants may have less flexibility to adapt to restrictions than owner-occupiers. For example, landlords may expect tenants to maintain gardens despite restrictions, and some tenants have also expressed frustration that, despite restrictions on outdoor water use, landlords are slow to repair leaking pipes.


The scope of possible responses and impacts depends on specific restrictions rules. For example, households and others with private gardens may let part of their gardens die (incurring costs of reduced amenity), adapt their watering times and technologies to those allowed by restrictions, change their gardens to more water-tolerant plants, or, in the case of outdoor water ban, purchase water from other sources. These impacts affect water users’ time, convenience, and many also involve out-of-pocket expenses.

Several industry groups interviewed expressed concern that restrictions negatively affected the social, cultural and health benefits of gardening. Community groups also reported that they were concerned that restrictions would affect people’s relationship with gardening. A specific issues raised by community groups was the restriction of watering to specific times of the day:

- In Melbourne, morning watering times may be too early (especially with daylight savings) and shift workers may not be able to water within these times.

- One reported suggestion was to reduce the hours of watering but make them more frequent – and that ‘sensible’ watering times would enable community goodwill and commitment to restrictions to be maintained.

- Volunteers who visit people in their homes as community outreach in Victoria have reported water-hoarding behaviour in some householders. They raise the concern that inflexible time-based rules could undermine the credibility and effectiveness of restrictions.
Community groups also highlighted that relationship with gardens and gardening is particularly important for many elderly people who might find the loss of gardens traumatic (Consumer/community organisations, pers. comms. March 2007).

11.1.2 Community cohesion

Anecdotal evidence suggests restrictions have become an accepted part of the recent landscape of drought response and that in some ways the experience of drought and drought response has been a unifying force in communities – a common cultural reference and talking point.

Although community and consumer groups contacted for this study did not report complaints from the community of the general enforcement approach (involving at least one prior warning, and educational material), many groups noted that the “dob-in-a-neighbour” aspect of enforcement has in some cases become a divisive tool in the community. Although this approach is not an underlying cause of community friction, there have been reports that this reporting system has become a vehicle for exacerbating existing neighbourhood disputes (Consumer/community organisations, pers. comms. March 2007). Nevertheless, at least some utilities have implemented strategies to streamline the mechanisms for reporting restrictions breaches, to minimise these potential negative impacts.

11.1.3 Irrigated recreational areas

Several of the industry groups contacted for this review have highlighted the potential impacts of reduced recreational possibilities – in terms of health impacts and on the social and cultural values associated with sportsground and park use.

Areas of irrigated recreational areas affected by restrictions

To various extents in different locations, water restrictions have reduced the area and/or quality of publicly accessible irrigated recreational spaces. Rules and exemptions for sportsgrounds and parks vary significantly between locations. In some locations, restrictions have not significantly affected the irrigation of recreational space:

- In Adelaide (level 3), parks and sportsgrounds can be irrigated (although restricted to one day of the week

- In Perth, local councils responsible for managing parks and sportsgrounds are not subject to restrictions per se as implemented by the WA Water Corporation. However, they are required by the Department of Water to develop water conservation plans which limit their water use to 7.5 kL per hectare per annum (WA Water Corporation pers. comm. May 2007).

- In Sydney, current stage 3 restrictions include a general exemption which applies to sports grounds and marked playing fields, allowing sprinklers and watering systems to be used on Mondays only.
• In south-east Queensland under current stage 5 and recent stage 4 restrictions, parks cannot be watered however sportsgrounds can be irrigated, provided that a Water Efficiency Management Plan (WEMP) has been submitted and approved.

The greatest impacts on recreational areas appear to have been in the ACT and Victoria:

• In the ACT, since 2002, 44 hectares (20 sportsgrounds) of a total of 320 hectares of irrigated grassed sportsgrounds are no longer watered due to percentage reductions required by the restrictions regime. Fifty percent of public parks and gardens are no longer watered (TAMS pers. comm. March 2007).

• In Victoria, under stage 3 or 3a water restrictions, councils and sporting clubs cannot water lawns and are required to prioritise their sportsgrounds by nominating one in four that can be watered, provided that they make a 25% saving in other areas. Under stage 4 water restrictions, there is no watering of sportsgrounds or lawns. However, bowling greens, cricket pitches and golf tees and greens can still be watered.

• GHD (2007) estimated that 90% of sportsgrounds in Victoria are capable of being automatically irrigated. However, with Stage 3a water restrictions in Melbourne and stage 4 water restrictions in many regional Victorian towns, they estimated that less than 1% of these sportsground were irrigated, and only with non-potable water.

Impacts of reduced recreational areas

The community and consumer groups interviewed for this review (in March and April 2007) did not specifically emphasise the potential loss of recreational values from sportsgrounds and parks. However, one community/consumer organisation noted that, although anecdotal, there have been some concerns about injuries from dried sportsgrounds. They also recognised that in some situations the social impacts of restrictions could be significant, citing the situation in Broken Hill where the community opposed restrictions because of the risk of exposing lead contaminated soil (ABC 2006b).

There is, however, widespread concern that the values of recreational areas which could be affected by restrictions are not considered in the design or implementation of restrictions rules (Industry organisation, pers. comm. March 2007). The direct impacts on loss of sportsgrounds relate to reduced playability and safety. Longer term social impacts have also been identified in a report for the Municipal Association of Victoria Sports Surfaces Task Force (GHD 2007) including:

• Loss of sporting organisation as a source of community pride and spirit
• Loss in employment
• Loss of participation in sport and associated impact on community health
• Rise in antisocial behaviour
• Decline of particular sports in Victoria

This report also highlighted that due to the importance of sportsgrounds, and the context of other social pressures facing rural and regional Victoria, these communities are less likely to have the capacity to adapt and respond to loss of recreational areas than urban communities, and would be disproportionately affected.

11.2 Measuring costs and benefits of restrictions to households and the community

In this review, the costs and benefits of restrictions to households and the community are measured in two ways – firstly, through a review of available evidence from monetary valuation studies, and secondly through a review of non-monetary quantitative and qualitative evidence, including surveys conducted and interviews. This section reveals that large data gaps exist about the costs and benefits of restrictions, particularly more recent severe rules.

11.2.1 Costs and benefits of restrictions to households and the community – evidence from monetary valuation studies

See Volume 2 – Appendices for a critique of currently available studies on the costs of restrictions, including explanation of why the values derived in some studies have not been used in this review.

Very few studies explicitly evaluate households’ willingness to pay to avoid or reduce the frequency, severity and duration of water restrictions. In the context of water supply planning, contingent valuation and choice-modelling techniques are more commonly used to elicit willingness to pay for (or accept) improvements to service reliability (e.g. to reduce the frequency of unexpected service interruptions); or maintenance of environmental, recreational or amenity values (e.g., to avoid damage to wetland ecosystems).

The results from available WTP studies related to restrictions vary for several reasons, including different:

• Research methods – including types of questions, information provided to respondents and methods of questioning.

• Scenarios evaluated (and hence tradeoffs considered) – including the type, timing, duration and frequency of restrictions.

• Contexts of each study area and group (which would affect attitudes and behavioural responses) – including past restrictions, nature of water use and users, climate and water tariffs.
Table 3 summarises results from WTP studies conducted in the United Kingdom and United States, all of which focussed on the residential sector. Although many of these studies indicate a high WTP to avoid or reduce restrictions, differences in survey types limit the usefulness of generalising across studies. Due to differences in restrictions rules and other location-specific factors, it is also not possible to transfer these figures to determine WTP to avoid restrictions in Australia.

Table 13 International studies – willingness to pay to avoid or reduce restrictions

<table>
<thead>
<tr>
<th>Authors</th>
<th>Study area and year</th>
<th>Study group</th>
<th>Methods</th>
<th>Sample results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garrod G, Power N and Willis K (2000)</td>
<td>Sussex, Southern England, United Kingdom (2000)</td>
<td>412 randomly selected households</td>
<td>Contingent ranking – choice experiment</td>
<td>The authors concluded that the study clearly showed that people are not willing to accept improved water supply (including reduced frequency of hosepipe bans) at the cost of environmental degradation.</td>
</tr>
<tr>
<td>Griffin R and Mjelde J (2000)</td>
<td>Texas, United States (2000)</td>
<td>4856 households in 7 cities.</td>
<td>Contingent valuation – dichotomous choice and open-ended.</td>
<td>The average WTP to avoid water restrictions during the current three-week shortfall of 20% was $29.86/month (1995 US$). The WTA to avoid future shortfalls were larger than WTP values. WTP/WTA for future shortfalls appeared inconsistent [lower] than values for the current shortfall.</td>
</tr>
<tr>
<td>Green C et al. (1993)</td>
<td>England, United Kingdom (1992)</td>
<td>997 households.</td>
<td>Contingent valuation – iterative bidding (face-to-face surveys).</td>
<td>Of the 42% of the sample who agreed to pay something for various service improvements, the mean per household per annum WTP ranged from £11 to £41/a (1992 GBP) to reduce the risk of supply restrictions.</td>
</tr>
<tr>
<td>Howe C and Smith M (1994)</td>
<td>Boulder, Aurora and Longmont, Colorado, United States.</td>
<td>588 residential respondents.</td>
<td>Contingent valuation – open ended</td>
<td>In response to proposition that residential outdoor water use be restricted to three hours every third day, 41%–58% of respondents were not willing to accept a decrease in supply reliability. Of those willing to consider a change in supply reliability, WTA between $4.53 and $13.99/month (1994 US$)</td>
</tr>
</tbody>
</table>

In Australia, WTP to avoid restrictions would be likely to vary significantly between different metropolitan areas. However, WTP survey evidence is only currently available for the ACT (see Table 14), and it would not be meaningful to transfer results to other locations. Great caution should also be taken when interpreting these results, particularly if attempting to extrapolate total costs on households. The approach taken by CIE (2005) which uses WTP results to infer costs is discussed in the Canberra case study.
Table 14 ACT studies – willingness to pay to avoid or reduce restrictions

<table>
<thead>
<tr>
<th>Authors</th>
<th>Study year</th>
<th>Study group</th>
<th>Methods</th>
<th>Sample results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blamey R, Gordon J and Chapman R. (1999)</td>
<td>1999</td>
<td>321 surveys, 294 responses providing 2544 completed choice sets</td>
<td>Conjoint analysis (in-person interviews)</td>
<td>Residents were willing to pay, on average $10 per year to prevent a 10% reduction in water use (1997 AUD). Residents were willing to pay $18 per annum to improve Canberra’s general urban appearance from ‘brown’ to ‘some brown’, but not willing to pay for further improvements to ‘green’.</td>
</tr>
<tr>
<td>Hensher, Shore and Train (2006)</td>
<td>October 2002 – April 2003 (stage 1 and stage 2)</td>
<td>211 Canberra households</td>
<td>Choice modelling</td>
<td>Respondents were willing to pay to avoid restrictions that lower than stage 3 (even if these restrictions were imposed all the time). Respondents were not willing to pay to avoid restrictions of any severity that only lasted part of the year (one month, or summer), or that allowed a relaxation of restrictions every second day. On average, households were willing to pay $239 per annum to move from a situation where stage 3 restrictions applied continuously (every day, all year, every year) to never. Respondents were not willing to pay to avoid brown lawns in public areas.</td>
</tr>
</tbody>
</table>

Nevertheless, the study by Hensher et. al. (2006) is one of the few studies which examine responses to different restrictions rules. It reveals some useful insights for the design of restrictions to minimise impacts to households. Noting that the WTP surveys were conducted in 2003, before the introduction of stage 3 restrictions (sprinkler ban), key findings are that:

- Respondents would have rather adjusted their watering schedules compared with paying higher water bills.
- Respondents were unwilling to pay to avoid low-level restrictions at all, or higher-level restrictions as long as they are not applied every day.
- On average, respondents were willing to pay $239 to move from a situation where stage 3 restrictions applied continuously (ever day for all year, every year) to never.
- Respondents were unwilling to pay to avoid brown lawns in public urban areas.

A report prepared by CIE for ACTEW Corporation in 2005 used the 90% upper and lower bound estimates for the cost of restrictions from the WTP survey used in Hensher et. al. (2006) to “calibrate” a demand curve for water in order to calculate the cost of restrictions, at different stages, if applied continuously for one year. The study included the costs of stage 1 and 2 restrictions, which Hensher et al (2006) found to be statistically insignificant. In 2003 prices and incomes, these costs ranged from a lower-bound estimate of $70 per household per year for one year of continuous Stage 2 (now Stage 1) restrictions, to an upper bound estimate of $529 per household per year for one year of continuous stage 5 (now stage 4) restrictions.
The upper bound costs, which were used in subsequent calculations including aggregated costs of restrictions, were found to be comparable in order of magnitude to costs inferred from stakeholder workshops conducted by ACTEW, in which participants were asked their willingness to pay to reduce the frequency of restrictions. Nevertheless, translating cost figures which were derived from attitudes about frequency of restrictions to estimate the costs associated with different stages of restrictions involves making arbitrary assumptions about the relationship between the cost of frequent restrictions and the cost of different stages of restrictions. These methodological issues are discussed further in Appendix 2.

The report by CIE (2005) also estimated the costs in terms of lost utility due to reduced recreational spaces. The cost estimates were based on arbitrary assumptions about the proportion of time that individuals had to “reallocate” to other activities, due to restrictions (at different stages). These assumption are not explicitly linked to the restrictions rules on watering sportsgrounds, parks and gardens at different levels, nor to empirical evidence about impacts on public recreational spaces, nor on how the community would actually respond. Cost estimates ranged from zero for stage 1 restrictions to $16.8 million for stage 4 restrictions. Reallocated time was valued at the full adult wage rate, which the study notes is likely to result in an over-estimate of the costs of recreation. In adding these recreational costs to the household costs estimated based on the WTP survey, the study by CIE (2005) could potentially double-count the recreational costs, because respondents to a survey examining WTP to avoid restrictions are likely to reflect recreational costs, as well as costs to private gardens and lawns, in their responses.

A study by Brennan et. al. (2006) estimated the welfare loss from a proposed sprinkler ban in Perth by modelling household demand, including taking into account different preferences for “lawn greenness” and income levels. This study is summarised in Volume 2 – Appendices.

11.2.2 Costs and benefits of restrictions to households and the community – non-monetary evidence

This section examines evidence on the impacts of restrictions on households and the community. A range of sources have been used, including community attitudes surveys and interviews with representatives from community, consumer and public interest organisations.

11.2.3 Support for low levels of restrictions

The severity of restrictions is related to the way in which they place limits on the timing, technologies and types of water use. The impacts of restrictions vary depending on rules.

Low level restrictions that do not impose technology constraints but limit watering to “no daytime” and to certain days/week broadly (if somewhat bluntly) reflect “efficient” watering practices. Although they do reduce flexibility, these types of
restrictions tend to have limited impacts on lifestyle and are generally accepted by the community.

Significant support for low level restrictions – including restrictions at levels up to a sprinkler ban, but allowing drippers and other watering 2 days a week not in the daytime – is widely indicated by surveys of community attitudes. Community groups have noted general support for restrictions (see box 9). This community acceptance is also reflected in the community WTP survey conducted for Canberra households (Hensher et al. 2006).

Note that at the time of this review, information from community attitudes surveys relating to restrictions in the Brisbane/SEQ area was not publicly available.

Box 9 Community attitudes surveys indicating support for low-level restrictions

- The most recent Consumer Sentiment Monitor survey (Oct 2005 – Sep 2006) indicates that support by Sydney residents for stage 3 restrictions has been increasing since the end of 2005. By September 2006, 92% of respondents supported continued restrictions should the drought continue (Sydney Water, pers. comm. February 2006). Survey evidence about whether residents supported higher levels of restrictions was not publicly available at the time of this study.

- A survey of Adelaide, Darwin, Melbourne, Perth and Sydney households in 2005 indicated: high levels of commitment by households to saving water; belief that individuals can contribute to water savings during drought; and belief that water-saving changes could be made without detracting from quality of life. When presented with the statement “I will be really annoyed if water restrictions get any tougher than they already are”, the majority of respondents in all locations surveyed either disagreed or strongly disagreed. (Roseth 2006).

- Community surveys conducted in Adelaide (SA Water, pers. comm., December 2006) under level 2 restrictions reveal that 89% of respondents were in favour of restrictions. Another independent survey indicated that 54% of Adelaide households felt that water restrictions were the best way to ensure reliable and secure water supplies during drought (Roseth 2006).

- Evidence from WA Water Corporation surveys of Perth residents show continuing strong support of restrictions - at least 85% across all surveys conducted since 2001 and 94% in the latest available survey results of July 2006. Survey results also demonstrate strong support for restrictions in the future should supply continue to be limited (WA Water Corporation, pers. comm. December 2006). This evidence is consistent with the findings of a community consultation Water Symposium held in October 2002 in WA, in which delegates broadly supported the ‘continuation of a domestic restriction regime indefinitely’ (Department of Water (WA) 2002).

- IPART (2004) research during a period when Sydney was under voluntary water restrictions indicated that that 63% of Sydney households would be willing to be under restrictions once every year. Subsequent Taverner Research (2005) survey results indicated that 62% of people in the Sydney area believed that the restrictions at the time were about right, 28% believed they were not severe enough and 7% believed that the restrictions were too high.

- Research conducted in Melbourne in 2003 indicated that the majority of respondents were strongly in favour of stage 1 restrictions. Many believed that there should be greater enforcement (Newton Wayman Chong and Associates 2003). In subsequent research, many households reported negative impacts on gardens, 40% reported positive lifestyle impacts of restrictions and only 5% reported financial losses (Newton Wayman Chong and Associates 2005a).

- Hensher et al. (2006) observed that in focus groups, residential participants indicated that they could live with regular restrictions provided that the restrictions did not exceed level 3 (then, in the ACT, broadly equivalent to a total sprinkler ban). Such restrictions were not perceived as lowering water supply standards but instead viewed as a ‘sensible way of doing things’ which reinforced non-wasteful behaviour and was to the benefit of customers.
**Box 10 Perspectives – Community groups on community attitudes**

Community groups observed general support for restrictions, including that
- A general desire exists in the community to support the restrictions and become more water efficient and that in some places restrictions have become part of watering culture.
- The community understands the cost involved with not having water restrictions, both in terms of infrastructure costs and future water availability.


11.2.4 Impacts of more severe restrictions

There is a lack of comprehensive or robust surveys of community attitudes towards higher levels of restrictions which they have actually recently experienced in practice, such as total sprinkler and dripper bans or total outdoor garden watering bans. Various utilities have reported a desire, but a lack of resources to conduct such surveys during the recent, severe drought and restrictions periods. Evidence from earlier studies is summarised in box 11.

Nevertheless, anecdotal evidence suggests that at least in some locations there has been community support even for high levels of restrictions. For example, in Coliban Water (pers. comm. December 2006) noted strong community support for restrictions in Bendigo, Victoria. This enabled them to introduce restrictions – including total outdoor water bans (level 4) before trigger levels were reached.

A comprehensive measurement, for example through surveys, of the impacts on the community of restrictions affecting sportsgrounds and parklands has not yet been conducted. However, GHD (2007) identified several representatives from councils and sports associations in Victoria who suggested that, given the proportion of sportsgrounds affected in Victoria under stages 3 and 4 (see chapter 11), the risk of long-term negative impacts was great. The impacts of restrictions associated with loss of recreational areas are likely to be relatively less severe in locations where sportsgrounds and parks have not been as severely affected.

**Box 11 Community attitudes on more severe or more frequent restrictions**

- Some Canberra residents participating in focus groups in 2003 (before experience with current restrictions levels) thought that restrictions of longer than 8 weeks would “become a chore”. In other focus group discussions, one group concluded that permanent Stage 1 water restrictions ‘made sense’. Another group concluded that Stage 3 restrictions and above would ‘affect Canberra’s garden city image’. (Hensher et. al. 2006).

- Residents in the Sydney and Gosford/Wyong areas were asked in 2005 ‘Do you think the current water restrictions are too severe, about right for these conditions or not severe enough?’. Responses were: 62% and 66% ‘About right’; 28% and 27% ‘Not severe enough’; 7% and 6% ‘Too severe’. (Taverner Research 2005).
12 Costs and benefits of restrictions on businesses

12.1 Identifying costs and benefits of restrictions on businesses

Several industry sectors have been affected by restrictions – both directly, through specific rules, and indirectly through restrictions imposed on their customers. Many industry representatives suggested that the impact of revenue losses was greater than the direct restrictions rules on their businesses (see also survey data such as Newton Wayman Chong and Associates 2005b).

The industry organisations contacted for this review (listed in Volume 2 – Appendices) suggested that there are a number of reasons for the differences in impacts, particularly the different rules and consultation strategies adopted in different locations.

However, industries across the country have expressed concern that restrictions are inequitable. Representatives from industries consistently suggested that as they are perceived to be high water users, they feel they have been targeted disproportionately compared with less visible, but higher, water users (such as manufacturing industries). In turn, they suggest that the design of restrictions rules has been motivated by public perception and political aversion to address high water uses. (see, however box 13 for an alternative perspective).

Some industry representatives have suggested that restrictions can stifle innovation. However, in many locations the car wash industry has been forced to innovate by implementing water reclamation systems in order to meet targets set under the restrictions.

In addition to those businesses directly and negatively affected by restrictions (through sales and/or changed water use requirements), some businesses may benefit from increase sales in products for which demand has growth in response to restrictions (eg. rainwater tanks and greywater reuse systems).

Several utilities have noted that some businesses (particularly those supplying rainwater tanks and greywater reuse systems) may benefit from restrictions. However, there has been no publicly available, comprehensive and verified data – for example through surveying such businesses – to determine the extent to which sales have increased. Should such sales data be available, it would also be difficult to attribute increases in sales to restrictions alone.
Table 15 Potential costs and benefits of restrictions on businesses

<table>
<thead>
<tr>
<th>Businesses</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic</td>
<td></td>
</tr>
<tr>
<td>- Financial costs or additional time associated with changing private gardens or watering technologies</td>
<td>Retail businesses which have outdoor lawns and gardens may have an increase in landscaping costs.</td>
</tr>
<tr>
<td>+ Time and/or financial savings from more efficient watering technologies and practices</td>
<td>Note that this depends on nature of restrictions rules.</td>
</tr>
<tr>
<td>+ Increased sales/employment from goods or services that are arise from responses to restrictions (eg. rainwater tanks)</td>
<td>In response to restrictions, residential users may install rainwater tanks and greywater reuse systems. Manufacturers, suppliers and retailers of these products will experience increase in sales.</td>
</tr>
<tr>
<td>- Decreased sales/employment from goods or services that are restricted</td>
<td>Pool and spa industry, irrigation industry, turf industry and the nursery and garden industry supply water-using products which are directly restricted.</td>
</tr>
<tr>
<td>- Increased financial costs to outdoor water-using businesses whose core business activities are directly restricted (eg. carwashes, nurseries)</td>
<td>Car washes may need to change systems to comply with water use targets. Nurseries may need to change staffing arrangements or technology to comply with water restrictions.</td>
</tr>
<tr>
<td>- Financial costs associated with using alternative sources of water.</td>
<td>Any business that decides to use alternative sources of water.</td>
</tr>
</tbody>
</table>

12.1.1 Nurseries/garden centres

There are widespread reports from the nurseries and garden centre industry that restrictions have severely affected their businesses, including that falling retail sales have led to staff retrenchment.

However, the industry also noted that restrictions have motivated the adoption of more water efficient practices within the nursery industry itself, such as those recommended by Nursery Industry Accreditation Scheme Australia. This national scheme for production nursery (growers) and growing media (potting mix) businesses operates in accordance with a set of national 'best practice' guidelines.

Nevertheless, the industry reported that the overall impact has been negative and significant:

- The main impacts of restrictions on nurseries have arisen through the impact of restrictions (particularly those concerning sprinkler uses) on households, who are increasingly reluctant to purchase new plants.

- There is a particular lack of uniformity in rules across locations.

- Restrictions are imposed unevenly and inequitably across industries.

- Temporary restrictions rules that ban specific technologies (eg. sprinklers) act as a disincentives for the wider industry to develop water-efficient irrigation systems and garden types better suited to dry climates. In many locations, this is exacerbated by the uncertainty created by the way in which temporary restrictions are introduced, particularly if stages and rules are developed or announced with
little notice as a drought continues (as opposed to developed with consultation prior to or in the early stages of a drought).

**Box 12 Perspectives – Industry organisations on the effect of restrictions on innovation**

Frustration exists within some industries that they are being targeted unfairly and that restrictions stifle innovation. Industry organisations noted that:

- Other sectors, including those supporting indoor water uses, are free to use all the water they require.

- Gardens add value to houses and communities and that water conservation could be achieved using “Smart Approved WaterMark” products such as water controllers and soil additives.

- The industry’s perspective is that restrictions that ban technologies are short-term fixes, and that little has been done to pro-actively encourage long-term behaviour change.

Pers. comms. February 2007

**12.1.2 Turf industry**

The turf industry reported a sharp downturn in sales, in most states about a 20 to 25% reduction in turnover, since restrictions commenced (Industry organisation, pers. comm. March 2007):

- One industry organisation (pers. comm. March 2007) reported that Victorian companies have been worst affected, due to stage 3 regulations which were introduced on 1 January 2007 which mandate a total ban on sprinklers and watering of lawns. They suggested that they were not informed before the change of restrictions levels and that exemptions have not been issued. However, the DSE (pers. comm. May 2007) has suggested that the turf industry was extensively consulted during the process of developing the Uniform Water Restriction Schedule.

- One industry organisation (pers. comm. March 2007) reported that in Western Australia sales have increased since restrictions commenced, due to the ongoing, collaborative consultation process between industry and government. They note that the WA Government has pursued a number of options to explore alternative water supplies.

**Box 13 Perspectives – Industry organisations on equity and consultation around restrictions on turf watering**

**Equity**

“Without an exemption under Stage 3, the turf and lawn industry would be the only industry in Victoria to be prohibited from having any water at all. Other industries do not even have restrictions and can conserve or waste as much as they like... This is a clear case of discrimination against one industry.”

**Consultation**

“In Western Australia, consultation continues to be an effective two-way process, with monthly meetings between Turf Producers Australia, the WA Water Corporation and the State Minister for Water.”

12.1.3 Urban irrigation industry

The urban irrigation industry, which supplies equipment and services for urban irrigation and covers a number of sub-sectors, reported that the overall impacts have been ‘negative and significant’, except for in Western Australia.

The industry noted that:

- Efficient irrigation technologies have been encouraged in rural areas but banned in many urban locations including New South Wales, Queensland and Victoria.

- Irrigation in urban areas is incorrectly perceived by planners as superfluous to the basic needs of the domestic gardener.

- Water restrictions are a short-term fix and that meaningful water conservation strategies would have to be supported by long-term behavioural changes.

Box 14 Perspectives – Nursery/garden/turf/irrigation industry on rebate schemes

The industry has suggested applying rebate schemes to a greater variety of products which could include effective irrigation technologies to enhance water conservation outdoors. The rebates could be linked to the products approved under the Smart Approved WaterMark Scheme (a labelling initiative for water efficient products).

Pers. comms. March 2007

12.1.4 Pool and spa industry

The pool and spa industry reported that impacts vary significantly according to region:

- In the ACT, where topping up of pools has been banned since December 2006, the industry predicts the closure of 20 businesses in the coming months (Industry organisation, pers. comm. March 2007.)

- In Victoria, the “top end” of the market has experienced little impact, whereas inquiries about “low end” pools ($3000 to $4000) has fallen significantly (Industry organisation, pers. comm. March 2007).

Like other industries, the pool industry reports that restrictions are driven by perceptions of large and discretionary water use.

Box 15 Perspectives – Swimming pool and spa industry

The pool and spa industry reports that they have been proactive in exploring opportunities to source alternative water supply for their customers

- The industry is exploring the use of recycled water as an alternative source of supply. Access to portable plants for water recycling and treating is available, although the use of recycled water for swimming pools has not been approved.

- The industry assumes that restrictions seem like a ‘given’. Thus they have decided to ‘fight the government regarding the use of recycled water’. They suggest that the technology for portable treatment exists now and would be a practical way to provide water for pool filling (it is used elsewhere overseas).

Pers. comms. March 2007
12.1.5 Commercial car wash operators

The Australian Car Wash Association observed different impacts in different locations:

- Closures have occurred in areas with severe restrictions (such as in some locations in Victoria, where stage 4 restrictions require car wash operators to use non-mains water supplies). Nevertheless, some of these may have been prevented by more proactive action by business, particularly early investment in water reclamation systems.

- In many locations restrictions have forced the industry to become more water efficient. The industry has had the opportunity to educate policy makers and the public about the advantages of commercial car washes, in terms of water efficiency (with reclaim technologies, car washes use 40–70 L per wash) and that car wash operators channel wastewater into the sewer system rather than the stormwater system.

- The car wash industry has continued to consult with authorities to reduce their targets for water efficiency.

12.2 Measuring the costs and benefits of restrictions to businesses

12.2.1 Costs reported by industry representatives

In this review, industry representatives were the primary source of information and data about the magnitude of costs to businesses. Further research and analysis would be required to attribute the costs specifically to restrictions.

Data about the costs of restrictions, as reported in personal communications by industry in February and March 2007, include:

- According to a position paper from the Irrigation Association of Australia produced in April 2006, in NSW it is estimated that the productivity of the sector has declined by about $200 million since water restrictions were introduced in October 2003, with the subsequent loss of 2,000 jobs.

- The industry also estimates that there has been an overall decrease in turnover of 40% across the south-east Queensland, Sydney metropolitan, greater Sydney and Melbourne regions. In the greater Sydney region, which spans Wollongong to Newcastle, the industry estimates that five to six thousand jobs have been lost since restrictions were introduced in 2003, and that 24 businesses closed in 2004.

- Job losses due to restrictions reported by industry organisations included: 4000 jobs had been lost across Australia from the landscape industry; and in Victoria, 20 car wash sites had temporary closed (but could reopen with installation of reclaim systems), and 24 sites had permanently closed.
• One industry organisation estimated that across Australia there had been a 20 to 25% reduction in turnover in the turf industry, with a 75 to 80% reduction in Victoria where lawn watering is banned under stage 3 or higher.

• The WA Water Corporation (pers. comm. December 2006) reported that through consultation with the nursery and garden industry, they estimated that there would be negligible long-term negative impact of current stage 4 restrictions, but that stage 6 restrictions would result in a loss of $385m turnover and 3800 jobs in year 1 and $384m turnover and 4000 jobs lost in year 3. Under stage 7 restrictions, 6,960 jobs and $502m turnover would be lost in Year 1 to $502m and 5,820 jobs and $696m turnover lost in Year 3.

12.2.2 Other cost information

Although some utilities have questioned the accuracy of industry-reported costs, to date there has been limited independent monetary valuation of the costs to businesses.

The study commissioned by ACTEW in 2005 reports on total costs to businesses in the ACT, but does not base its estimates on examining impacts on individual industries or specifically attributing changes in sales in water use to restrictions.

• The cost of restrictions to water using activities (which are not identified in the report) are estimated at $1.9million for stage 1 to $4.5m for stage 4 restrictions, approximated with the scenario that all businesses would be subject to water rationing. The assumptions behind this estimate are not detailed.

• CIE (2005) also estimates that, “based on confidential sales data”, the reduction in nurseries sales under restrictions would lead to revenue losses of 25% under stage 2, 50% under stage 3, and 75% under stage 4. The breakdown or assumptions behind these estimates, and whether they were based by examining how restrictions at different levels would affect garden behaviour and subsequent purchases, were not provided.
13 Costs and benefits of restrictions on local governments

13.1 Identifying costs and benefits of restrictions to local governments

The impacts of restrictions on local governments arise mainly through their key roles in managing public recreational spaces - irrigated outdoor sporting grounds, public parks and gardens. In Sydney, for example, 82% of active sport parks are managed by local councils, 7% by private entities, 5% by State Government Trust and 1% by State government departments (NSW Parliament Legislative Assembly 2006).

The impacts of restrictions vary depending on the nature of the restrictions regime, availability of exemptions and the situation of the particular Council. As the rules on watering of parks and sportsgrounds vary significantly by location, the impacts of restrictions on local governments are also varied in different. As noted in chapter 11, restrictions to date have had the greatest impact on recreational spaces in Victoria and the ACT.

Costs include those associated with:

- Changing behavioural or technological approaches to watering and cleaning (i.e., equipment or staff costs of compliance)
- Seeking alternative water sources (purchasing recycled water, installation of water treatment devices).
- Responding to community inquiries and complaints.

Table 16 lists some of the potential impacts of restrictions on local governments.

<table>
<thead>
<tr>
<th>Cost or benefit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic</td>
<td>- Financial costs (staff or equipment) associated with changing public gardens/parks (eg. turf types) or watering technologies</td>
</tr>
<tr>
<td></td>
<td>+ Time and/or financial savings from more efficient watering technologies and practices</td>
</tr>
<tr>
<td></td>
<td>- Financial costs of garden/park restoration after restrictions</td>
</tr>
<tr>
<td></td>
<td>- Financial costs associated with using alternative sources of water</td>
</tr>
</tbody>
</table>

*Some local governments also function as water businesses. However, the costs and benefits identified in this table reflect those which affect local governments through their role managing irrigated public spaces.

Some councils are being required or encouraged to create water savings plans by state and territory governments. Completion of these plans is being linked to funds for water conservation, recycling or use of stormwater. ACT Territories and Municipal Services (TAMS) Strategic Planning section (pers. comm. March 2007) noted that councils which have already made significant water savings would find it difficult to meet targets. They suggest that targets for water use per hectare would be
an alternative which would not unfairly penalise councils that have already made water use efficiency improvements. In contrast, water conservation plans in Victoria take into account improvements in efficiency that have been made prior to the introduction of restrictions (DSE pers. comm. March 2007).

Restrictions on local governments have resulted in a reduction in the area of irrigated public spaces. As many councils already report efficient watering technologies, they have responded to restrictions by reducing the number of grounds watered (see Box 19).

Box 16 Impacts of restrictions: less irrigated public space

Public sports fields, parks and gardens offer recreational opportunities to large sectors of the community, for pursuits such as walking and dog walking, social events, organised sport and personal training; and play an important role in supporting recent government campaigns on physical activity for health and fitness. A reduction in area of open space which is suitable for organised sports or less amenable to other forms of recreation may have social and health impacts on the community.

- In the ACT, a manager of sportsgrounds reported that, as sensitive irrigation technology is already widespread and watering closely linked to soil moisture loss, there was little scope to conserve water on a site-by-site basis. Therefore, the response has been to turn off irrigation in some sites and maintain others to full condition. (Sports and Recreation Services, Territories and Municipal Services (TAMS), ACT pers. comm. March 2007). In contrast, parks and garden watering is prioritised according to high use, high visibility and high replacement costs (Conservation and Lands, Territories and Municipal Services ACT pers. comm.).

- Under Stage 3 restrictions in Victoria, which commenced 1 January 2007, councils and sporting clubs cannot water lawns and are required to prioritise their sports grounds by nominating one in four that can be watered, provided that they make a 25% saving in other areas. Bowling greens, cricket pitches and golf tees and greens can still be watered (Municipal Association of Victoria (MAV) pers. comm. March 2007).

Use of more efficient irrigation technology, changes in turf selection and use of alternative supply sources are adaptations which councils are making that may extend water efficiency benefits beyond the life of the current water restrictions. For example:

- In Victoria, Frankston City Council is using piped, treated effluent piped to irrigate eleven grounds – including Carrum Downs Recreation Reserve, Baxter Park reserve and Centenary Park Golf Course (MAV pers. comm. March 2007).

- In Sutherland, NSW, a return line is being installed between the water recycling plan in Cronulla to feed schools, sports fields, golf courses and a local manufacturing plant, tanks will be installed to ensure enough volume is retained (Sutherland Shire Council, pers. comm. March 2007).

- In the ACT, playing fields were (until recently) planted with cool climate grasses, because warm climate turfs tended to die back in winter and were not as resilient to high use levels. However, as restrictions have resulted in several playing fields not being irrigated, warm climate turf such as couch is now being considered for replanting those grounds after restrictions are lifted. (TAMS pers. comm. March 2007)
The experience of parks and gardens managers in the ACT has been largely positive, because restrictions have enabled flexibility to prioritise areas for watering and make tradeoffs between areas irrigated (Conservation and Lands, TAMS ACT pers. comm. March 2007).

13.2 Measuring costs and benefits of restrictions to local governments

As identified in section 13.1, the impacts of restrictions rules on recreational areas – including parks and sportsgrounds managed by local councils – is likely to be greatest in the ACT and Victoria. Local government organisations in these locations reported a number of case studies of costs incurred by councils in adapting to restrictions rules:

- In Victoria, Boroonda City Council spends $550,000 over summer months to purchase recycled water to keep sporting fields from drying (MAV pers. comm. March 2007). The Council plans to install recycled water storage tanks at seven gardens and three sportsgrounds to allow irrigation with recycled water, as well as installing sixteen rainwater tanks at council premises.

- The Nillumbik WaterSmart Initiative, Victoria, involves water-saving changes to four sports grounds including stormwater harvesting from sports pavilions, sand carpets, drainage, warm season grasses, sub-surface drip irrigation. The total cost of all measures under this Initiative, including funding from DSE, will be $2.6 million (MAV pers. comm. March 2007).

- In the ACT, some floral displays have been maintained for community reasons – particularly those sites which are used to display community group logos and have been booked months or years in advance. TAMS reports that if outdoor water use is banned, they would bear the cost of purchasing alternative water supplies in order to maintain these sites (Conservation and Lands, TAMS, ACT pers. comm. March 2007.).

- Landscape restorations will be a future cost borne by local government and their communities. ACT Territories and Municipal Services, Sports and Recreation Services estimate that the cost of restoring sports grounds is $10,000 per hectare.

Over the longer term, the cost of obtaining alternative water supplies may be reduced as councils invest in infrastructure to allow ongoing access to alternative water sources, with the assistance of grant funding such as through the NSW Water Savings Fund and various Victorian Council water saving initiatives.

The differing ability of councils to afford alternative water sources for irrigation in the short term could compound regional trends of advantage and disadvantage and create resentment between communities (TAMS, ACT pers. comm. March 2007). For example, it has been observed that in Victoria wealthier councils may be in a position to purchase recycled water at a high cost, to maintain their parks, gardens and sports fields, while less wealthy councils are unable to do so.
14 Direct costs of restrictions to utilities

Water businesses (utilities) incur various costs due to restrictions, including those associated with:

- Advertising and marketing
- Monitoring and enforcement
- Processing business exemptions.

Table 17 lists costs of restrictions, as reported by utilities.

**Table 17 Summary of costs of restrictions activities undertaken by utilities**

<table>
<thead>
<tr>
<th>Area</th>
<th>Utility</th>
<th>Activity</th>
<th>Approximate cost</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sydney</td>
<td>Sydney Water</td>
<td>Processing business exemptions</td>
<td>$5.0 million from September 2003 to December 2006 (90% labour costs)</td>
<td>No exemptions are automatic. 79123 applications for exemptions were made over this period.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water patrol (2005/06).</td>
<td>$5.9 million 2005/06.</td>
<td>In 2005/06, water patrol issued 1735 water restriction infringement fines. Water patrol includes inspections relating to applications for exemptions.</td>
</tr>
<tr>
<td>ACT</td>
<td>ACTEW</td>
<td>Advertising, publicity, monitoring and enforcement.</td>
<td>Stage 1 - $1.0 million per year Stage 2 - $1.8 million per year Stage 3 - $2.7 million per year</td>
<td>Reported by ACTEW in CIE (2005)</td>
</tr>
<tr>
<td>Perth</td>
<td>WA Water Corporation</td>
<td>Enforcement of restrictions rules</td>
<td>$400 000/year</td>
<td>8 staff carry out enforcement activities</td>
</tr>
<tr>
<td>WA state-wide</td>
<td>WA Water Corporation</td>
<td>Water conservation advertising and marketing</td>
<td>$800 000/year</td>
<td></td>
</tr>
<tr>
<td>Brisbane / SEQ</td>
<td>Gold Coast City Council</td>
<td>Enforcement</td>
<td>$77 592 during level 3 (1 June 06 – 31 October 06). $85 439 during level 4 (1 November 06 – 31 March 07).</td>
<td>2.5 FTE staff undertake enforcement activities.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marketing and promotion</td>
<td>$70 000 during level 3 (1 June 06 – 31 October 06). $135 000 during level 4 and 5 (1 November 06 – 31 March 07).</td>
<td>Costs are for advertising, marketing, workshops, mail correspondence and up to 1 FTE staff member at peak periods.</td>
</tr>
<tr>
<td></td>
<td>Brisbane City Council</td>
<td>Monitoring and enforcement</td>
<td>$410 000 (July 05 – June 06)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advertising and promotion</td>
<td>$850 000 (July 06)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Answering phone inquiries</td>
<td>$327 000</td>
<td></td>
</tr>
</tbody>
</table>
PART V – CASE STUDIES: COSTS AND BENEFITS OF TEMPORARY RESTRICTIONS IN THE PORTFOLIO OPTIONS
15 Case study approach: temporary restrictions in the portfolio of options

Each of the four case studies presented in this section evaluates the cost-effectiveness of restrictions to contribute to supply-demand balance, with regards to the portfolio of options relevant at each location. Quantitative and qualitative information is examined consistent with the framework outlined in Chapter 2.

In each case study, the implications of past restrictions for the portfolio of options are reviewed and the role of restrictions in future portfolios are evaluated. Where possible, the frequency, duration, severity and specific attributes of design and implementation are considered.

As noted in chapter 1, the analysis and research for these case studies, as for the rest of the report, was conducted prior to August 2007.

15.1 The recent drought and planning for the future

Each case study draws on recent location-specific experiences with water restrictions in the recent drought. The case studies evaluate the role that restrictions have had in securing water supplies and the extent to which they have prevented the need for other or earlier investment in demand management or supply augmentation options. Where possible, these “avoided costs” are compared to the impacts of restrictions on the community – including households, industries, utilities and local governments.

The potential role of restrictions in each case study location was assessed by examining the portfolio options (and their costs) required to ensure system security under different “restrictions scenarios”. These scenarios might, for example, include different frequency (reliability) of restrictions. Where possible and relevant, these scenarios have been chosen to reflect the current and actual restrictions being considered in each location. The least-cost portfolios required were then compared to the costs imposed by different restrictions alternatives.

When examining the portfolio of options in planning for the future, note that the estimated (theoretical) average annual yields do not account for variations in the quantity of water available from year to year. Therefore restrictions (like other readiness-options) have a further dimension in that they could effectively reduce demand during severe droughts when yields are less than average or expected.

The least-cost planning (LCP) approach (also known as integrated resource planning – IRP) has been adopted to evaluate restrictions in the portfolio of options. LCP is an economic assessment method applied widely to utility planning (energy and water) to determine the most cost-effective program to implement. LCP identifies the optimal mix of supply-side and demand-side management practices while balancing system security and affordability, thereby producing planning alternatives with the lowest costs to the utility and to customers (ISF 2005). It is for these reasons that LCP
is widely recommended and accepted as a framework across Australian water utilities and regulators. This approach is discussed in more detail in Volume 2 – Appendices.

The key components of cost-effective portfolio analysis are summarised in box 17.

Box 17 Summary of cost-effective portfolio analysis: reflecting the benefits and costs of restrictions

- For each location, a “merit order” of available options can be developed. A useful metric to determine an appropriate merit order, is to determine the risk-weighted present value levelised cost per kL (consistent with least-cost planning approach) of contribution to yield. This allows options to be ordered in terms of lowest cost.

- Different restrictions scenarios can then be developed. For example, a relevant decision for a particular location might be to determine the appropriate frequency of a particular type of restriction (e.g., a sprinkler ban).

- To determine the effectiveness of existing restrictions regimes, observed per capita consumption is compared against modelled weather-corrected consumption. Depending on the model, this isolates the effect of restrictions in reducing outdoor water use from factors such as climate, population growth and any demand management programs. The expected savings under restrictions can then be used to model expected yield.

- Each restrictions scenario requires different expenditure on other options to maintain supply–demand balance – depending on location-specific characteristics.

- By evaluating the portfolio costs of different restrictions scenarios (including the economic, social and environmental costs of all major portfolio options), the potential contribution to portfolio cost-effectiveness of restrictions can be assessed.

15.2 Avoided portfolio costs and benefits

As discussed in chapter 3, restrictions can play an important role as a drought response measure, potentially deferring or preventing the need for expenditure on other supply augmentation, reuse, source substitution or demand management options. Depending on situation-specific factors, the benefits and costs of restrictions include the avoided financial (and other social and environmental) impacts associated with other options.

The financial costs associated with other options – including those associated with design, construction, operation, maintenance and administration - are identified (to varying levels of detail) in the case studies. However, there are also many social and environmental impacts of other options which can be “avoided”, to varying extents, by the application of restrictions (see Table 18).

Information and data constraints have limited the extent to which these have been identified and assessed (measured either physically or in monetary terms) in the case studies. However some of these possible impacts (avoided costs and benefits) are described in Box 18.
Table 18 Environmental and social impacts of other portfolio options

<table>
<thead>
<tr>
<th>Portfolio options and examples of possible types of environmental and social impacts</th>
<th>Biodiversity and ecosystem functioning</th>
<th>Greenhouse gas emissions</th>
<th>Salinity</th>
<th>Nutrient/chemical pollution</th>
<th>Human health</th>
<th>Flow-on local or regional economic impacts</th>
<th>Social impacts from relocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater extraction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+/⁻</td>
<td></td>
</tr>
<tr>
<td>Desalination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+/⁻</td>
<td></td>
</tr>
<tr>
<td>Large-scale recycling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>?</td>
<td>+/⁻</td>
</tr>
<tr>
<td>Transfers from within existing system (increase pumping)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+/⁻</td>
<td></td>
</tr>
<tr>
<td>Dam expansion or construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+/⁻</td>
<td></td>
</tr>
<tr>
<td>Demand management – eg. washing machine rebate, MWEPs</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+/-</td>
<td></td>
</tr>
<tr>
<td>Source substitution – eg. Smart Growth for new developments</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+/-</td>
<td></td>
</tr>
</tbody>
</table>

A comprehensive economic analysis would also adopt a whole-of-society perspective and include assessment of social, environmental and financial impacts of restrictions and portfolio options. For example, ideally, an assessment of the economic impacts of a portfolio of supply and demand options would also consider:

- The environmental and costs and/or benefits associated with the construction and implementation of supply augmentation, re-use and demand management options (e.g. greenhouse impacts, air and water pollution).
- The social costs and/or benefits of supply augmentation, re-use and demand management options (e.g. dislocation of communities, adjustment).

Possible environmental and social impacts of some supply augmentation and reuse options are listed in box 18 below. Demand management options are also likely to result in environmental and social impacts, although these are likely to be less significant.

Information available at the time of this project did not allow environmental and social impacts to be assessed for each portfolio scenario in each case study location. To the extent that these environmental and social impacts could be assumed to impose net costs, the reported financial costs of portfolio options (the “avoided costs” of restrictions) could be interpreted as underestimating total economic costs.
### Box 18 Possible environmental and social impacts of portfolio options

- **Groundwater extraction systems**, both centralised and decentralised, have the potential to affect ecosystem functions and biodiversity. Depending on the rate of extraction and recharge, streamflows may be reduced. Groundwater extraction can result in seawater intrusion in coastal areas. There are also potential greenhouse gas emission externalities associated with energy use for extraction, treatment and pumping.

- **Desalination** of ocean water supplies is a rainfall-independent option which involves reverse osmosis. There are two main potential environmental impacts associated with desalination:
  1. **Greenhouse gas emissions** from intensive energy use. Note that in many cases, greenhouse gas impacts are “off-set” by the construction of renewable energy sources (such as wind turbines) or through the purchase of ‘green energy’ (such as GreenPower). However, assessments of off-sets should take into account that they can apply to any option, and can also add significantly to capital costs (depending on the choice of offset).
  2. **Saline discharge** to marine and coastal environments may be highly concentrated in salt and other chemical pollutants, including nitrogen from biocides, acid detergents and polyelectrolytes. This may result in stratified and lower dissolved oxygen levels and changes to biogeochemical and ecological processes including excessive algal growth and alterations to the composition and abundance of benthic fauna communities.

- **Large-scale recycling** has potential greenhouse gas emissions impacts from energy use and ecological impacts from infrastructure development. Although perceived risks may differ from actual risks, water quality concerns have been raised in relation to human and environmental health. It has also been proposed that using recycled water can result in environmental benefits, through reducing the total pollutant load returned to the water cycle – although the actual risks and impacts are site-specific and technology-dependent. Nevertheless, nutrients removed through the water recycling process could also be applied for beneficial agricultural use. Carefully targeted recycling schemes can also avoid downstream wastewater system costs – for example, by avoiding the cost of increasing treatment capacity.

- **Dam expansion and construction** poses a number of potential environmental and social impacts, in addition to the upfront financial costs associated with infrastructure construction. During dam construction and operation changes to hydrological flow regimes can impact ecosystem functions and biodiversity, as well as associated recreational and tourism values. Possible social impacts include loss of cultural heritage sites, impacts on industry through the loss of productive land and forced relocation from homes and properties.

- **Demand management** can reduce the energy required to deliver water and wastewater services, thus reducing associated greenhouse gas emissions. Reducing the amount of water required from supply side options also reduces the environmental impact of such options (eg. the impact of building additional storage capacity, recycling, desalination etc). Demand management programs can also deliver savings to households, through lower water and energy bills.


### 15.3 Measuring the direct cost of restrictions

As discussed in Chapter 8, many alternatives exist for evaluating the costs to key groups in the community – households, industries, utilities and local governments. In the case studies, existing available quantitative and qualitative information has been used to evaluate the costs of restrictions. As this information is neither comprehensive nor consistent across case study locations, an additional analysis has been conducted to evaluate the costs to households using a consistent method across...
locations. This “basic consumer surplus method” is described in detail in Volume 2 – Appendices. Although this method can be applied consistently with currently available data, consistency and simplicity should not be mistaken for accuracy or robustness. Therefore, the results from this method have been interpreted in conjunction with other evidence.

Table 19 Basic consumer surplus method

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Implication for cost estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price elasticity of demand</strong></td>
<td>Price elasticities during drought conditions or for outside water use are largely unknown. Depending on choice of elasticity, method could overestimate or underestimate costs to households.</td>
</tr>
<tr>
<td><strong>Price of water</strong></td>
<td>Top tier prices of water $/kL have been used. However, not all households would pay this top marginal rate (either with or without restrictions). This assumption results in an overestimation of costs to households.</td>
</tr>
<tr>
<td><strong>Total or outdoor water use</strong></td>
<td>Water restrictions target outdoor water use (water management plan offsets are an exception). Therefore, estimating welfare loss from reductions in total water use is likely to overestimate costs to households. However, estimating welfare loss only from reduction in outdoor water use is likely to underestimate costs to households, due to attributing all reductions in water during restrictions to outdoor use. Both methods have been used in this study.</td>
</tr>
<tr>
<td><strong>Actual restrictions are equivalent to quantity restrictions and that welfare losses are independent of frequency and duration</strong></td>
<td>Water restrictions target types, method and timing of water use, but not the total volume of water used. This method assumes that the loss of welfare under restrictions is equivalent to that under rationing, and does not account for differing impacts depending on the frequency, duration and severity of restrictions. This could result in costs being underestimated (for more severe restrictions) or overestimated (for less severe restrictions).</td>
</tr>
<tr>
<td><strong>Aggregation</strong></td>
<td>This method aggregates water use over time and across households, which could result in overestimation or underestimation of costs.</td>
</tr>
<tr>
<td><strong>Accuracy of water use data</strong></td>
<td>In many locations, savings are calculated based on reported volumes of bulk water supply and were adjusted for actual residential use and outdoor use (where applicable). Attributing all savings under restrictions to the household sector is likely to have resulted in an overestimate of welfare costs.</td>
</tr>
</tbody>
</table>

15.4 Selection of case study locations

The selection of case study locations was determined by available data and information including:

- Recent and lengthy experience with restrictions (more than 3 years).
- Available weather-corrected modelled demand, to enable estimation of savings due to restrictions.
- Information on the costs and impacts of restrictions (qualitative and/or quantitative).

Differences in climate can influence the nature and extent of the impacts of restrictions, particularly restrictions on garden and lawn watering. As illustrated in Figure 5, a basic analysis of average monthly rainfall for the months of November to March over the last three years reveals very different total rainfalls, evaporation rates and frequency of rain. Figure 5 illustrates that average monthly rainfall in Sydney has been substantially greater than that in Perth. To illustrate the relevance of this
rainfall difference in terms of garden watering, indicative monthly garden and lawn water uses (irrigated, not including rainfall) for Sydney are also shown (although Maheshwari (2006) notes that some of the gardens in the sample may have been “over watered” in excess of plant requirements).

In the absence of evidence on lawn and garden irrigation in other locations, conclusions cannot be drawn about whether greater rainfall in Sydney affects the costs of restrictions.

**Figure 5 How much does it rain in summer during a drought?**

Due to variability in rainfall across Sydney metropolitan area, the Sydney data presented in this figure was obtained for the Sydney airport weather station, which is in the middle band of rainfall across Sydney (Bureau of Meteorology 2007). Note that this figure is illustrative only. Equivalent data on lawn and garden irrigation water use is not available for Perth and Canberra. Note also that irrigation water use is not necessarily representative of irrigation water requirements, for which ranges exists for different plant, soil types and climates.

These case studies have been developed in collaboration with the utilities and organisations responsible for developing and implementing restrictions. Due to differences in public availability of information and data for each case study location, the scope and approach taken also differs between case studies.
16 Case study – Perth

16.1 Looking back – restrictions in response to drought (2001–ongoing)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Start</th>
<th>End</th>
<th>Key rules</th>
<th>Consumption savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>8 Sep 01</td>
<td>Ongoing</td>
<td>Sprinklers allowed 2 days/week</td>
<td>140 GL = 58 GL/year*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>= 100 kL/household/year</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>from Sep 2004 to Dec 2006</td>
</tr>
</tbody>
</table>

*Combined effect of restrictions, advertising and other water conservation initiatives.

Currently available information from WA Water Corporation does not enable accurate isolation of the effect of restrictions (on reducing consumption) from the impact of other water conservation initiatives. For illustrative purposes, in this case study the historical effectiveness of restrictions is assumed to be at most, 58 GL/year and likely to be around 44 GL/year.

16.1.1 Restrictions in the portfolio – the avoided cost of alternatives (2001–ongoing)

Evaluation of historical dam levels for the Integrated Water Supply System reveals that if restrictions had not been in place since 2001, no additional supply sources and reuse schemes had been introduced, and no further demand management programs were implemented, dam levels would have fallen below safe useable levels by autumn 2002 and (theoretically) fallen to zero in mid-2004.

One method of examining the role of restrictions in ensuring system security over the period 2001–2006, is to consider what other or additional supply, demand management and reuse portfolio options (in addition to the $122 million program initiated in 2001) would have been required in the absence of restrictions (to save or supply the equivalent 44 to 58 GL per year).

In present value terms, the additional investment in these alternatives – earlier than would have otherwise been required with restrictions – would have resulted in
greater costs being incurred. The absence of restrictions would have meant that, in the future, other potentially more costly options would be required (see Section 6.3.2).

Box 19 Could desalination have been an alternative to restrictions in Perth?

A 45 GL/year desalination plant commenced operation to supply the Western Australian Integrated Water Supply System (including the Perth Metropolitan area) in November 2006.

If water use restrictions had not been in place since September 2001, earlier construction of this desalination plant could have supplied a volume of water per year roughly equivalent to those saved under restrictions.

In present value terms, commencing construction in 2000 rather than 2005 would have cost an additional $700 million (based on financial market rate of return of 7.5%) in construction and operating costs by 2007. In addition, without restrictions, a second desalination plant (or other options) would have had to be constructed around 2005 to attain the current supply/demand balance.

Note: Estimates are approximate and for illustrative purposes only. They depend on several assumptions including rate of return. Estimates do not include any externalities associated with the desalination plant.


Table 20 illustrates two possible combinations of alternative options, which would have been required (in the absence of restrictions) to save or supply the equivalent volumes of water. These options have been selected consistent with an Integrated Resource Planning approach, based on calculating levelised costs over a 25-year planning timeframe (Fane et. al. 2003). The “avoided costs” of restrictions, in terms of foregone financial return calculated assuming a rate of return of 7.5%, are approximately $202 million (if least-cost supply augmentation and demand management options had been implemented instead of restrictions) or $392 million (if only least-cost supply augmentation options had been implemented).

Note that pricing alternatives have not been considered in this analysis and could possibly have been a lower-cost option or addition to the portfolio of instruments.

Table 20 Present value cost of alternatives to restrictions to save or supply 58 GL/a 2001 to 2006 (Perth)

<table>
<thead>
<tr>
<th>Water saved or supplied 2001 to 2006</th>
<th>PV cost to 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. ALL OPTIONS CONSIDERED</strong></td>
<td></td>
</tr>
<tr>
<td>Catchment management, Wungong and other.</td>
<td>36 GL/a  $57m</td>
</tr>
<tr>
<td>Several new demand management programs, including extensions to existing residential and non-residential programs*</td>
<td>22 GL/a  $145m</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>58GL/a</strong> $202m</td>
</tr>
<tr>
<td><strong>2. SUPPLY AUGMENTATION OPTIONS CONSIDERED</strong></td>
<td></td>
</tr>
<tr>
<td>Catchment management, Wungong and other.</td>
<td>36 GL/a  $57m</td>
</tr>
<tr>
<td>New supply, Brunswick River.</td>
<td>25 GL/a  $335m</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>61GL/a</strong> $392m</td>
</tr>
</tbody>
</table>

* Some demand management options would have lesser volumes of water saved in earlier years of programs.

Note: Estimates are approximate and for illustrative purposes only. They depend on several assumptions including rate of return. Least-cost selection of options would not have minimised total PV cost to 2006, but rather the total PV cost over the lifetime of each program.

Source data: ISF (2005)

Households

Most of the available quantitative and qualitative evidence indicates that the cost of restrictions to Perth households from 2001 to 2006 has been low.

**Box 20 Evidence of the impacts of restrictions on households in Perth (2001–2006)**

- **Willingness to pay studies** by Hensher *et al.* (2006) for Canberra (a winter-rainfall-dominant climate) found that households were not willing to pay to avoid restrictions (at any frequency or duration) as long as sprinkler use was allowed at least some of the time, which has been the case in Perth since restrictions commenced.

- **Community attitudes surveys** conducted by the WA Water Corporation six-monthly since restrictions began show strong and consistent support for current restrictions (at least 86% “tending to agree” or “strongly agreeing” in each survey). Results from the public consultation *Water Symposium* conducted in 2002 demonstrated strong support for restrictions (WA Water Corporation, pers. comm. February 2007).

- **Community advocacy groups** report that the impact of restrictions on households has not been severe (see part III).

Using the basic aggregated consumer surplus method, the total welfare cost of restrictions to households ranges from $16 million to $92 million per year ($28 to $161 per household per year), depending on the choice of elasticity from -0.3 to -1.7. However, this method does not account for three key parameters influencing household welfare loss from restrictions – frequency, severity and duration. Reflecting on quantitative and qualitative evidence, it is likely that the costs calculated using the basic consumer surplus method significantly overestimate the cost to households *in this situation*. However, these costs are unlikely to be zero.

Industry

Available evidence suggests that the direct and indirect costs of restrictions to nursery, garden centre and irrigation industries of restrictions since 2001 have not been substantial:

- Information from the Garden Industry Reference Group suggests that current stage 4 restrictions would have negligible long-term impacts on the nursery and garden sector (WA Water Corporation, pers. comm. January 2007).

- An industry organisation (pers. comm. February 2007) noted that the WA Water Corporation consulted effectively with the irrigation industry before the introduction of restrictions and that because specific technologies have not been banned, the irrigation industry has not been negatively impacted in the Perth area.

There have not been substantial restrictions on pool water or commercial car wash operators’ use since 2001.

Local government

NWC Review of water restrictions

PART V: CASE STUDIES: COSTS AND BENEFITS OF TEMPORARY RESTRICTIONS IN THE PORTFOLIO OF OPTIONS
Many local governments source their water for outdoor use from bores, which are not affected directly by restrictions outlined by the WA Water Corporation. However, like all users of private bores, local governments are required by the WA Department of Water to obtain licences for bore water extraction. Recently, 75 kL per hectare volumetric use conditions have been placed on bore water use licences.

**Utilities**

WA Water Corporation reports that 8 staff are employed for enforcement activities, which costs $400 000 a year. Last financial year, 3173 warning notices and 1253 fines were issued and this financial year to March, 4674 warning notices and 1811 fines have been issued. Approximately $400 000 a year is spent on restrictions-related advertising and marketing.

**16.2 Planning for the future – restrictions in the group of options (2030)**

In Perth, WA Water Corporation’s 2005 planning is based on an expected frequency of a total sprinkler ban of 1-in-200 years, compared with previous planning based on 1-in-30 years. The Corporation is considering another change to 1-in-50 years in response to comments from the WA Economic Regulation Authority.

The application of sprinkler ban frequency of 1-in-200 years in system planning results in a decrease in average annual yield expected from the supply system, and hence poses different implications for alternative demand management, supply and/or reuse options required for the medium to long-term future.

In this section, the implications of 1-in-30 year and 1-in-200 year sprinkler ban scenarios are examined. Under each scenario, it is assumed that the savings achieved under stage 4 restrictions will be maintained into the future - whether this is through continued application of restrictions, or through improved water use efficiency.

Each scenario is examined under the two different assumptions about climate change identified in the WA Water Corporation 2005 Source Development Plan: whether future climate will be similar to 1975–2005 (30-year assumption) or the much drier 1997–2005 (8-year assumption).

**16.2.1 Cost of portfolio options required (2030)**

The expected annual system yield (surface and groundwater) under each restrictions scenario is listed in Table 21. These estimates are based on currently implemented supply and demand management options.

Total demand from the Integrated Water Supply System (which includes Perth metropolitan) without sprinkler ban restrictions is projected to increase to about 379 GL/year by 2030 (Water Corporation 2005 – Source Development Plan 2050). The
expected supply deficits (to 2030) under the different restrictions scenarios are also shown in Table 21.

**Table 21 Total system yield and supply deficit estimates under different restrictions scenarios and climate assumptions**

<table>
<thead>
<tr>
<th>Restrictions scenario</th>
<th>8-year climate assumption</th>
<th>30-year climate assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-in-30 year sprinkler ban</td>
<td>318 GL/year (61 GL/year deficit)</td>
<td>377 GL/year (2 GL/year deficit)</td>
</tr>
<tr>
<td>1-in-200 year sprinkler ban</td>
<td>299 GL/year (80 GL/year deficit)</td>
<td>347 GL/year (32 GL/year deficit)</td>
</tr>
</tbody>
</table>

Note: these yield estimates include the desalination plant that commenced operation in 2006 (45 GL/year) as well as expected transfers from water trading from Harvey (17.1 GL/year). Source: WA Water Corporation (pers. comm.)

These supply deficits would have to be met by a range of supply, demand and reuse options. The present value costs of meeting the supply deficit under different restrictions scenarios are listed in Table 22 (least-cost combination of supply and demand options). These costs are indicative and have not been risk-weighted. Depending on the climate assumption, $73m or $57m in additional investment is required if the probability of a sprinkler ban is 1-in-200 years (compared to 1-in-30 years). Note, however, that the total present value (cost) of portfolio options depends more on the climate assumption than the restrictions probability criterion.

**Table 22 Present value additional cost of supply, demand and/or reuse portfolio options.**

<table>
<thead>
<tr>
<th>Restrictions scenario</th>
<th>8-year climate assumption</th>
<th>30-year climate assumption</th>
<th>Additional portfolio cost – assuming drier climate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-in-30 year sprinkler ban</td>
<td>$80m</td>
<td>$0m</td>
<td>$80m</td>
</tr>
<tr>
<td>(current)</td>
<td>DM – Residential MWEPs, residential development consent conditions</td>
<td>Supply – catchment management</td>
<td></td>
</tr>
<tr>
<td>1-in-200 year sprinkler ban</td>
<td>$153m</td>
<td>$57m</td>
<td>$96m</td>
</tr>
<tr>
<td></td>
<td>DM – Residential MWEPs, residential development consent conditions, new washing machine rebate, new residential retrofits. Supply – catchment management, Yanchep supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>portfolio cost – less frequent sprinkler ban</td>
<td>$73m</td>
<td>$57m</td>
<td></td>
</tr>
</tbody>
</table>

Note that costs are additional to that already committed in various ongoing demand management programs
Source data: WA Water Corporation (pers. comm.).

16.2.2 Cost of restrictions (to 2030)

Limited quantitative evidence is available about the likely cost of a sprinkler ban on households, industries and local governments.

Evidence on likely costs of a sprinkler ban on households (of one year duration) is summarised in Table 23. Noting that caution is required when interpreting cost
estimates, these figures demonstrate that the likely cost to households of a 1-year sprinkler ban is comparable in order of magnitude to the benefits (in terms of avoided cost of investment in other supply and demand portfolio options).

**Table 23 Quantitative evidence on costs of a 1-year sprinkler ban to households (Perth)**

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Cost per household</th>
<th>Total cost for 1 year of sprinkler ban*</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP to avoid 1-year sprinkler ban (Hensher et al. 2006)</td>
<td>$239</td>
<td>$146m</td>
</tr>
<tr>
<td>Lost welfare from 1-year sprinkler ban (Brennan et al. 2005)</td>
<td>Ranges from $510 (low income, low preference for lawn greenness) to $16,057 (high income, high preference for lawn greenness).</td>
<td>n/a</td>
</tr>
<tr>
<td>Basic CS method</td>
<td>$24 to $187, depending on assumptions about elasticity and whether modelling total demand or outdoor demand only.</td>
<td>$15m to $112m, depending on assumptions about elasticities and whether modelling total demand or outdoor demand only.</td>
</tr>
</tbody>
</table>

*Based on current prices, levels of demand and number of households.

Similarly, limited quantitative evidence is available on the cost of a sprinkler ban to industries. However, an Economic Impact Assessment commissioned by the then Water & Rivers Commission, found that the short-term impact of a total sprinkler ban on the nursery and irrigation industry would be **$385m in lost revenue** (and 3800 in lost jobs) in the first year.

### 16.3 Summary

To date, the negative impacts of restrictions on households and industries have not been substantial. This is most likely because (through a process of consultation with industries and the community) the WA Water Corporation has limited the nature and extent of outdoor water restrictions. There are no specific restrictions applying to industries such as commercial car wash operators.

Although precise figures on reduced water consumption under restrictions are not available, it is likely they have reduced water use (although probably not to the same extent as more severe restrictions in other locations). Some “demand hardening” would have occurred because these restrictions, which have been in place continuously and at the same level for over five years, are likely (in combination with other water conservation and demand management programs) to have caused some permanent changes in watering practices and volumes of outdoor water use.

Unlike many other locations, the different restrictions stages in Western Australia are not linked to a fixed trigger storage level. The changing nature of surface water and groundwater contributions has required frequent review of trigger levels for introducing and maintaining various levels of restriction.

Plans exist to introduce a sprinkler ban triggered by a system security level, but these triggers have not been reached to date. It is perceived that a sprinkler ban would be
unpopular. However, tradeoffs exist in that a sprinkler ban would enable the costs (including environmental externalities) associated with infrastructure development to be delayed. Whether or not a sprinkler ban is justified will depend on further evaluation of the likely impact of this ban on the community and more detailed analysis of infrastructure options.

Nevertheless, assumptions about future climate scenarios have greater implications for decisions concerning infrastructure development than does the current discussion in Perth about the appropriateness of sprinkler bans.
17 Case study – ACT

The Australian Capital Territory (ACT), in which the city of Canberra is located, has relatively even rainfall throughout the year. However, rainfall is highest in spring, with the wettest month being October (average 65.3mm) and lower in winter, with the driest month being June (average 39.6mm). Average annual rainfall is 629mm, with an average of 108 rain days per year. Rainfall variability from year to year is very high. The drought has halved average flows and in 2006, the flow was only 13% of the long-term average. Rainfall across the ACT also varies considerably, with much higher rainfall occurring in the ranges to the west of the city and less rainfall to the east.

The ACT draws its water supply from two separate catchment systems: 1) the Cotter River catchment, which lies wholly within the ACT, and 2) the Googong system, which is located on the Queanbeyan River in NSW.

The combined long-term average annual inflow from the Cotter and Queanbeyan Rivers is 494 GL per annum. More than half of this inflow (272 GL per annum) is allocated to environmental flows. The remaining 222 GL per annum are available for human use. ACTEW extracts approximately 64 GL per annum of the human-use allocation, about half of which (31 GL per annum) is returned to the Molonglo River as treated effluent. In addition, all water that enters the ACT through the Murrumbidgee River (386 GL per annum) flows back into NSW. On average, in total, approximately 840 GL per annum flows from the ACT into NSW. (ACTEW pers. comm. April 2007).

Three dams have been built on the Cotter River and one on the Queanbeyan River. The ACT’s current storage capacity is 207 GL, about four times the 2004/05 demand (52 GL). Current storage levels are at 33%, or the equivalent of 1.3 years’ demand.

Dam storage levels have been declining steadily over time (ACTEW Corporation 2004). Figure 1 shows actual storage levels for the combined Corin Dam, Bendora Dam, Cotter Dam and Googong Dam (2001–2007), including the effects of temporary water restrictions, Permanent Water Conservation Measures (PWCM), bringing the Lower Cotter Dam ‘online’, the Cotter to Googong Bulk Transfer scheme and environmental flow adjustments. Dam levels are also shown for a ‘worst-case’
scenario had not these augmentations been undertaken and had not restrictions 
temporary and permanent been in place.

**Figure 6 Actual and ‘worst-case’ storage levels for Corin Dam, Bendoro Dam, Cotter 
Dam and Googong Dam (2001-2007)**


17.1.1 Canberra’s temporary restrictions regime (2002–2006)

The combination of recent record low inflows, predictions of continued hot and dry 
weather and higher than expected water consumption in the ACT, prompted the 
ACT authorities to apply stage 2 temporary water restrictions from 1 November 2006 
and stage 3 restrictions from 18 December 2006.

Key rules of the ACT’s stage 3 restrictions on households include a ban on sprinklers 
and irrigation systems, trigger hoses, buckets and cans used between 7-10am and 
7-10pm on alternate days, an exemption required for filling or topping up a pool, and 
no washing of vehicles except at commercial car washes that hold exceptions and use 
recycled water.

Before the 2006/07 summer, temporary water restrictions were first introduced in 
December 2002. PWCM were introduced on 31 March 2006. As illustrated in Table 
24, these effectively replaced what were stage 1 restrictions under the previous five-
stage regime.
**Table 24 Reviewed water restrictions scheme: four stages (plus PWCM)**

<table>
<thead>
<tr>
<th>Old Scheme</th>
<th>Reduction Target (%/y)</th>
<th>New Scheme</th>
<th>Reduction Target (%/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>15</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stage 2</td>
<td>25</td>
<td>Stage 1</td>
<td>PWCM + 10 = 18</td>
</tr>
<tr>
<td>Stage 3</td>
<td>40</td>
<td>Stage 2</td>
<td>PWCM + 25 = 33</td>
</tr>
<tr>
<td>Stage 4</td>
<td>55</td>
<td>Stage 3</td>
<td>PWCM + 35 = 43</td>
</tr>
<tr>
<td>Stage 5</td>
<td>60</td>
<td>Stage 4</td>
<td>PWCM + 55 = 63</td>
</tr>
</tbody>
</table>

The key PWCM is to limit sprinkler and other irrigation systems to the hours of 6pm to 9 am, except during winter. The intent behind PWCM is to discourage inefficient water use in ways that should cause very little inconvenience to the community (ACTEW 2006b). The ACT has estimated that PWCM will result in a reduction of approximately eight percent\(^1\) in annual per capita water use (ActewAGL 2006).

Currently, the consumption reduction from PWCM is estimated at about 15%.

On 25 November 2004, the ACT announced that Canberra water consumers had saved *eight months worth of water* since restrictions were introduced in 2002 (ABC 2004). According to figures from the Australian Bureau of Statistics, most savings were made in the house and the garden. More than half of all residents were taking steps to conserve water in their homes and 92% of households had reduced their water use in the garden.

Recent demand modelling by ACTEW suggests that the total (i.e. cumulative) savings due to restrictions between November 2002 and December 2006 are 54 GL. Table 2 shows total savings for each stage of the ACT restrictions’ regime since 2002. On average, restrictions saved about 14 GL per year.

Although this modelling corrects for the effect of weather on expected demand, it does not separate the effect of other water conservation programs. Therefore, the savings listed in Table 25 represent the cumulative effect of those achieved due to restrictions *and* other demand management.

**Table 25 Water savings from restrictions, Canberra 2001–2006**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Date</th>
<th>Approximate Savings#</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16 Dec 02</td>
<td>4.89 GL (227 ML/week)</td>
</tr>
</tbody>
</table>

\(^1\) Based on assumptions from the savings achieved in (the old) stage 1 and stage 2 drought restrictions and evidence from other jurisdictions (ACTEW, pers. comm.).
17.1.2 Restrictions in the portfolio – the avoided cost of alternatives (2002 – 2006)

Unlike the state capital cities, Canberra is inland and cannot realistically implement desalination as a water supply option or as a readiness option for contingency. However, the current physical infrastructure provides the ACT with several alternative drought response options, some of which were put in place after the drought of 2002. Indeed, model results suggest that if those plans had been in place in January 2001, the ACT would not have been in restrictions even once during the period (ACTEW 2006c). ActewAGL (pers. comm.) suggest that to have avoided all temporary water restrictions since 2002, the ACT would have needed to implement all of the following options before 2001 (noting that all these options have been introduced subsequently):

- Bring the existing Lower Cotter Dam ‘online’. The existing Lower Cotter Dam and Cotter pump station are part of Canberra’s present water supply system. They have always been in reserve for emergencies. The ability to use Cotter Dam water was enhanced on completion of the upgraded Mount Stromlo Water Treatment Plant. The existing Lower Cotter Dam was brought online in 2005.

- Introduce Cotter to Googong Bulk Transfer (CGBT). This option utilises existing infrastructure and allows an increase in yield. The scheme, designed during the Future Water Options I (FWO I) study, commenced in December 2005 and has a maximum yield of about 12 GL per annum, contingent on flows in the Cotter system, urban water demands and the capacity of the Mount Stromlo Treatment plant.

- Change environmental flow requirements to allow a reduction of environmental flows during severe droughts. The ACT’s Environmental Flow Guidelines are a disallowable instrument under the Water Resources Act 1998 that set out the

<table>
<thead>
<tr>
<th></th>
<th>Date</th>
<th>Volume</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1 May 03</td>
<td>2.57 GL (118 ML/week)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1 Oct 03</td>
<td>11.1 GL (508 ML/week)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1 Mar 04</td>
<td>3.82 GL (214 ML/week)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1 Sep 04</td>
<td>12.2 GL (472 ML/week)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1 Mar 05</td>
<td>2.97 GL (97 ML/week)</td>
<td></td>
</tr>
<tr>
<td>PWCM*</td>
<td>1 Nov 05</td>
<td>10.8 GL (107 ML/week)</td>
<td></td>
</tr>
<tr>
<td>2*</td>
<td>1 Nov 06</td>
<td>1.68 GL</td>
<td></td>
</tr>
<tr>
<td>3*</td>
<td>16 Dec 06</td>
<td>8.84 GL</td>
<td></td>
</tr>
</tbody>
</table>

*Restrictions regime changed from 5 levels to 4 levels. Level 1 became PWCM and levels 2–5 became levels 1–4.

# Based on monthly figures.
environmental flow requirements needed to maintain aquatic ecosystems. The guidelines are used together with the ACT’s Water Resources Management Plan “Think Water, Act Water”. The guidelines apply to all rivers and streams in the ACT. Environmental flow requirements were changed in December 2002.

- Introduce Permanent Water Conservation Measures (PWCM). As explained above, the old stage 1 restrictions effectively became PWCM in March 2006.

- Access the Murrumbidgee. A pump station exists to pump water from the Murrumbidgee to the Cotter pump station and then on to the Mount Stromlo water treatment plant. At present, due to water quality issues, the use of water from the Murrumbidgee will only be considered as an emergency measure. An extension of the CGBT (known as the ECGBT) would allow the use of Murrumbidgee water as a normal supply source. Access to Murrumbidgee water is planned for 2007, and is expected to yield about 12 GL per annum.

Capital expenditure for CGBT will be around $25M once completed (ACTEW 2006d) and $15M for the ECGBT (Chief Minister’s media release dated 16 October 2006). Capital expenditure for the other options noted above was reported as relatively insignificant (ACTEW pers. comm. April 2007). Information on operating expenditure regarding the emergency measures is currently unavailable.

Because all options have been implemented, it could be argued that the only costs incurred in the hypothetical case of no restrictions are those of bringing forward these augmentations by a few years (i.e., to have had them in place by 2001). Nevertheless, transfers from the Cotter Dam to prevent the need for restrictions would have had to be implemented well before 2001, to capture the high Cotter River flows before the 2002/03 drought. During the period of this drought, the ACT has used 8 GL of Cotter water and transferred 10 GL in the time it was available.

In addition, the ACT has put in place a number of demand management and water efficiency schemes, including a water efficient showerhead program; a rainwater tank rebate scheme; a stand-alone showerhead program; a dual flush toilet program; residential indoor and outdoor water tune-up programs; plumbing regulations and mandatory labelling of appliances. If fully implemented, the impact of these programs and those proposed as part of the analysis of ways to reach the ACT Government’s targets, would provide demand reductions of 15-20 GL per annum relative to the reference case demand at a (net) present value cost of $100 million.

17.1.3 Cost of restrictions (2002–2006)

Households

Two recent studies have investigated the costs of restrictions to households. Both of these are based on results from a survey conducted by NERA/AC Nielsen.

A recent study by Hensher et al (2006) reports households’ as well as business’ willingness to pay (WTP) to avoid drought water restrictions. The study finds that
customers are not willing to pay to avoid most types of drought-induced restrictions. Using a survey and subsequent choice modelling of the results, Hensher et al (2006) find a mean of $239 per year that Canberra households are willing to pay to move from a situation with continuous restrictions at stage 3 or above to a situation with virtually no chance of restrictions.

The Centre for International Economics (CIE), in its economic cost-benefit analysis of a set of new water supply options for the ACT, reported an average cost of restrictions of $486 per household (CIE 2005). This figure is based on a survey of consumer WTP for not having restrictions and choice modelling. The CIE approach involved using the WTP estimates from the NERA/AC Nielsen survey to calibrate a demand curve for water and subsequently calculating the cost of water restrictions as the loss of consumer surplus resulting from restrictions on quantity consumed. The methodology used by the CIE report, particularly the choice of upper bounds to calibrate costs and lack of sensitivity testing of key assumptions (such as elasticity of demand), is described and reviewed in detail in Volume 2, Appendix E.

Therefore, using the results from Hensher (2006), based on the average number of residential dwellings over the period 2002–2006, the total cost of restrictions to ACT households is $239 x 128,259 = $30.7 million per year (costs for the year 2003). However, as this study noted (and confirmed by qualitative information from Canberra and elsewhere, as discussed in Chapter 4), residents are only willing to pay to avoid stage 3 and higher restrictions under the old restrictions’ regime. Therefore, applying this cost estimate across the entire past restrictions periods — which included stage 1 and 2 restrictions — overestimates the costs of restrictions to households.

Using the basic aggregated consumer surplus method described in Section 5.1 and Appendix F, and assuming welfare loss only when stage 3 restrictions are in place, a per household range of $46 to $501 was calculated for the period from December 2002 to February 2007. On average, this amounts to $11 to $120 per household per year. The total costs to all households for the entire period is $5 million to $65 million (or an average $1.4 to $15.5 million per year). Note that these estimated ranges depend on critical assumptions as detailed in the Appendixes.

ACTEW has a consultation plan in place for collecting views through surveys, the Water Conservation Office, local events, meetings and briefings with stakeholders and the media. Overall, the consultation process has revealed strong support from the ACT community for the introduction of PWCM. ACTEW reports that all key industry groups were invited to participate in stakeholder meetings. However, industry perspectives on the consultation process were mixed.

Industries

The CIE study provides estimates of the costs of restrictions with respect to commercial and industrial activities in the ACT. Using an economy-wide input-
output (I-O) model, the costs of restrictions to the commercial/industrial sector are estimated to range from $0.5 million under stage 1 and $4.5 million under stage 5 restrictions. These results, including reasons for possible overestimation, are discussed in detail in the Appendixes.

Although quantitative estimates are unavailable, interviews with industry representatives conducted specifically for the current national review of restrictions reveal potentially significant costs. For example, the impacts of restrictions on the pool industry may be severe – the industry predicts the closure of 20 businesses in the coming months. Although the pool industry is exploring alternative sources and technologies (e.g., using recycled water), industry representatives perceive authorities as risk averse and reluctant to incorporate such ideas into the regulations. The ACT pool and spa industry reported minimal consultation before the introduction of stage 3 restrictions (which feature a ban on pool top ups) (see Chapter 4), although ACTEW (pers. comm. April 2007) suggest that the pool and spa industry was invited to participate in the consultation process.

Local government

An example of costs that ACT government may incur due to restrictions is turf loss from and/or damage to sports fields. The ACT Sport and Recreation Services Office, within Territories and Municipal Services, is responsible for managing 320 hectares of irrigated grass sports grounds. About ten percent of this area is irrigated using recycled water (treated sewage from wastewater plant, trucked to the sites), and an additional 44 hectares has been ‘turned off’ since late 2002 to comply with the restrictions’ regime. Owing to the water efficiency measures already in place, water levels were already at a minimum and soil moisture levels extremely low. Therefore, any further reduction in watering results in turf loss or damage across all sports fields. The total costs of such damage are not known. Loss of street trees is also a major cost.

Utilities

Over the last three financial years, ACTEW spent $1.2–1.4 million per annum (including estimated expenditure for financial year 2006/07) on its normal water conservation activities, on introducing PWCM and on the temporary water restrictions. This cost estimate is conservative, as it excludes the costs of related activities such as contingency plans, new supply options and annual reviews.

17.2 Planning for the future – restrictions in the portfolio of options (2050)

ACTEW previously determined that additional water storages were not needed until about 2017–2023. However, recent scientific information and natural disasters were used in a review of this position in 2005 during the development of Future Water Options-II.
• New scientific information has been obtained on the impacts of climate variability, climate change and the recent bushfires on the amount of water that is likely to run off into the Googong and the Cotter rivers and reservoirs. Owing to the risk and uncertainties of this information, a conservative approach has been taken by assuming climate variability and climate change has already happened and using the worst-case impact of bushfires on storage inflows in the ACT.

• The ACT Government has outlined population projections in the Spatial Plan and water efficiency targets in “Think water, Act water”. These projections have been adopted and include 1) a population growth to 500,000 in 2032 and servicing growth in the surrounding region, and 2) meeting the water use efficiency targets set in “Think water, Act water”.

• The ACT Government has the option to agree to alter the existing Environmental Flow Guidelines and/or accept a modified level of water restrictions. Factors include environmental flows of water between and from Googong Dam, Corin Dam, Bendora Dam and Cotter Dam required to maintain the health of the river ecosystems.

Acceptable levels for the duration, frequency and severity of water restrictions during droughts play a key role in the ACT’s planning for future water options. The methodology employs the restrictions’ regime as a constraint in the supply modelling, with the timing to the next supply storage as the key model outcome.

The ACT’s overall system security criterion specifies that the system must not (i.e., should never) run empty in a 10,000 year stochastic model run. In addition, the ACT should spend no more than five per cent of the time in any level of restrictions (excluding PWCM), while temporary water restrictions should not occur, on average, more than once every ten years. In terms of severity of restrictions, not more that one percent of the time should be spent in stage 3 restrictions and stage 3 restrictions should not occur more than once every 25 years.

17.2.1 Cost of portfolio options required (2050)

The ACT’s reference case demand is projected to increase from about 60 GL to about 85 GL per annum by 2050. In addition to temporary water restrictions, PWCM and the existing supply augmentations, the ACT has a range of potential demand management and supply options available.

Based on a system yield estimate of 64 GL per annum, a portfolio of demand management options, implemented consistent with meeting existing demand

---

2 Reduction in water consumption of 12% per capita by 2013 and 25% by 2023.
Institute for Sustainable Futures, UTS and ACIL Tasman

reduction targets\(^3\), would be sufficient to maintain a supply/demand surplus until about the year 2023.

Future demand management options available to the ACT include: mandatory water efficiency performance standards for clothes washers and showerheads; a washing machine rebate; pricing and information awareness; non-residential development control programs; greywater reuse for existing homes; general and targeted audits/retrofits for the commercial/industrial sector; smart growth for new developments; government indoor water tune-ups and the Canberra Integrated Urban Waterways scheme.

Total long-term average savings form the full portfolio of demand management options are about 15–20 GL per annum (ISF 2007), and would cover the average annual savings from temporary water restrictions between 2002–2007 (14 GL per annum, see above).

However, because of the extremely low inflows in 2006 and 2007, ACTEW now consider it prudent to provide additional supply augmentation. In addition to demand management and water efficiency schemes, currently the ACT is considering three supply-side options (FWO 2005):

- Four Cotter alternatives have been considered: retaining the existing Cotter Dam (4.7 GL); enlarging the existing dam to 45 or 78 GL; or constructing a new dam at an upstream site (Coree Dam). The large 78 GL Cotter Dam is the preferred option. ACTEW has calculated the source of development capital and operating expenditure to be $98 million and 1.4 million, respectively. In addition, there will be network connection (CAPEX) costs of $21 million. In present value terms, this amounts to about $130 million per annum.

- Four Tennent options have been considered: constructing small (43 GL), medium (76 GL) or large (159 GL) dams on the Gudgenby River near Mount Tennent, or implementing the Angle Crossing (formerly known as ‘Virtual Tennent’) option which would involve pumping a proportion of the monthly outflow (60 ML per day) from the Gudgenby/Naas catchment via an 18 km pipeline to Googong Reservoir. The Tennent 159 GL option would be the most expensive one: source development CAPEX $162 million; OPEX $2.8 million and network connection CAPEX 86 million (present value about $280 million).

- Several options have been considered for bringing water from the existing Tantangara Dam in NSW to the ACT. These options include tunnel and pipeline routes, as well as allowing up to 20 GL of water each year to flow 100 km down

\(^3\) A 12% reduction in mains water usage per capita by 2013, and a 25% reduction by 2023 (compared with 2003), achieved through water efficiency, sustainable water recycling and use of stormwater and rainwater.
the Murrumbidgee River to a diversion weir in the ACT. The source development capital expenditure for the ‘run-of-river’ option is $35 million.

17.2.2 Cost of restrictions (2050)

ACTEW is refining the CIE’s estimates (ACTEW 2006b) of the costs of restrictions in terms of customer WTP (see above), intending to use a least-cost approach to the design of a portfolio of future water options in line with WSAA guidelines. ACTEW is intending to conduct a new WTP survey to explore further the costs of restrictions to households (see ACTEW 2006b).

The potential future costs of restrictions to households, industry, the ACT Government and ACTEW will be revealed by ACTEW’s updated household WTP estimates and industry costs – these data will allow re-calibration of restrictions costs against which the costs of a portfolio of measures can be evaluated. The optimal portfolio minimises the cost of restrictions by bringing the percent time spent in restrictions as close to the agreed reliability criterion (e.g. 5%) as possible.

The actual reduction of percentage of time spent in restrictions is contingent on future weather. Therefore, assessing reductions associated with any portfolio requires stochastic modelling of the supply system. ACTEW has already undertaken such modelling to examine the impact of a 12% reduction being achieved by 2023 (instead of the target 25%). Under this scenario, the time spent in restrictions would be just over five percent. Similar sensitivity analysis was conducted for other planning variables (population growth, climate change, bushfires, etc).

17.3 Summary

17.3.1 Lessons from the recent drought and planning for the future

The various restriction stages applied in Canberra from December 2002 have been effective in reducing demand. Given the supply system characteristics and unexpected severity and duration of the drought, restrictions are likely to have been a cost-effective, flexible and adaptive demand management option relative to other available drought-response options.

Nevertheless, more evidence is required on the impacts and effectiveness of restrictions implemented since November 2006. The lessons described below largely apply to the temporary restrictions in place before the 2006/07 summer.

As discussed in this case study, if all other emergency supply options (which have since been implemented, or will be implemented soon) had been "brought forward"

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4 The NERA/AC Nielsen WTP survey was conducted before Canberra experienced the current levels of restrictions. ACTEW (pers. comm.) suggested that WTP could increase following the wider community’s experience with restrictions.
and implemented before 2001, these would have prevented the need for temporary restrictions since 2002.

However, although detailed cost information about these options is not yet publicly available, there is no conclusive evidence to suggest that these measures would have necessarily been less costly than other restrictions. For example, the capital cost alone of the Cotter to Googong Bulk Transfer (CGBT) option (ignoring operational costs) would have been $25 million.

Pre-emptive implementation of these options would have required the commitment of expenditure before knowledge about the likely severity or duration of the drought whereas temporary restrictions have been a fully adaptive and flexible instrument to manage water demand during drought. Further analysis – including consultation with industry and community – is recommended, to improve the design of restrictions’ rules in the ACT and to examine any potential for limiting impacts whilst maintaining effectiveness.

The evidence regarding the nature, extent and effectiveness of consultation about the development of restriction rules with industry and the greater community is mixed. An opportunity exists – following the recent experience with higher-level restrictions and after the current drought – to re-examine the design and impacts of restriction rules.

Looking forward, the ACT’s plans to undertake further WTP studies to gauge community attitudes towards restrictions is an important component of ensuring societal attitudes – including those towards restrictions – and values, are incorporated into water supply system planning:

The use of “point estimates” for costs can have significant implications for important – and potentially costly – decisions involving infrastructure construction and hence, further community engagement is essential to understand realistic ranges of costs of restrictions or willingness to accept restrictions.

Although several potential issues arise with the design and implementation of WTP studies, carefully designed and applied studies are one possible consultative mechanism to inform the community about the trade-offs between restrictions and other possible options to ensure system security and to gauge attitudes towards these tradeoffs. These options should include both demand management and supply augmentation options.
18 Case study – Sydney

A snapshot of Sydney’s profile is shown below. With respect to climate type, the city of Sydney itself has relatively even (uniform) rainfall, while areas of the catchment beyond the city limits have summer dominant rainfall. Sydney is subject to infrequent but severe droughts (indicated as a higher variability of yield on a year-to-year basis), which is the motivation for storage capacity being greater than four years of supply, much larger than most other cities. The current restrictions in Sydney tend towards moderate compared to other locations with more severe restrictions (e.g. Gosford, Ballarat, Geelong, Bendigo) and less severe restrictions (e.g. Adelaide, Perth).

* This is based on a restricted demand of 520GL/a and current storages of 985GL. This assumes zero inflows to the storages, a hypothetical scenario that has not occurred, and would not be expected to occur, even in the worst months of the current drought.

18.1 Recent restrictions – a response to severe drought

The impact of restrictions on demand

Sydney Water has analysed the impact of restrictions during the current drought, using a process to estimate savings resulting from restrictions that corrects for influences such as population growth and weather. This is illustrated in Figure 7 which provides a graphical representation of the difference between modelled and observed demand. As discussed further in this case study, restrictions play a dual role in terms of augmenting yield from the system (relevant for long-term supply-demand planning), but also dampening demand during periods of drought.

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Table 26 separates out the "restrictions" component of demand reduction from the effect of "demand management initiatives".

The methodology used to calculate the figures in Table 26 involves the following steps:

1. Develop a model that relates monthly (per capita) demand in the absence of restrictions and in the absence of demand management to weather conditions.

2. Using the model developed in step 1, estimate what monthly demand would have been during the period from October 2003 to June 2006 under the observed weather conditions if no restrictions had applied and no demand management had been undertaken.

3. Deduct from the monthly demand estimated in step 2, the estimated monthly savings from demand management. Demand management includes those programs administered by SWC and others, such as BASIX, which are not administered by SWC but impact demand. The savings for demand management are adjusted for restrictions (e.g. potable water savings from rainwater tanks are less in periods of restrictions).

4. The difference between the estimated monthly demand estimated in step 3 and the observed monthly demand is taken to be the reduction in demand that is due to restrictions.
Table 26 Water savings from restrictions in Sydney

<table>
<thead>
<tr>
<th>RESTRICTIONS LEVEL</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>1-Oct-03</td>
<td>1-Jun-04</td>
<td>1-Jun-05</td>
</tr>
<tr>
<td>To</td>
<td>31-May-04</td>
<td>31-May-05</td>
<td>30-Jun-06</td>
</tr>
<tr>
<td>Number of months</td>
<td>8</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Demand (a)</td>
<td>329,584</td>
<td>529,112</td>
<td>568,942</td>
</tr>
<tr>
<td>Estimated demand in absence of restrictions and demand management (b)</td>
<td>392,528</td>
<td>657,072</td>
<td>718,772</td>
</tr>
<tr>
<td>Difference between estimated and observed demand (b-a)</td>
<td>62,944</td>
<td>127,960</td>
<td>149,830</td>
</tr>
<tr>
<td>Estimated savings from demand management (c)</td>
<td>13,933</td>
<td>27,642</td>
<td>35,991</td>
</tr>
<tr>
<td>Estimated savings from restrictions (b-a-c)</td>
<td>49,011</td>
<td>100,318</td>
<td>113,839</td>
</tr>
<tr>
<td>% savings from restrictions (calculated (b-a-c)/(a-c))</td>
<td>13%</td>
<td>16%</td>
<td>17%</td>
</tr>
</tbody>
</table>

Source: Sydney Water.

18.1.1 The impact of restrictions on storage levels

Restrictions play an important role during drought, helping to slow dam depletion rates relative to what would occur in the absence of restrictions. Table 27 provides an indication of what Sydney storage levels during the current drought would have been, if restrictions had not been implemented.

The approach used is a simplification and involves summing estimated water savings due to the implementation of restrictions and deducting this volume of water from the volume of water in Sydney’s storages as at 1 March 2007. This analysis suggests that storage levels would be in the order of 25%, had restrictions not been imposed, rather than the situation current at the time of writing in April 2007 – when storages were at approximately 38%.

Table 27 Estimated dam levels in absence of restrictions

<table>
<thead>
<tr>
<th>RESTRICTIONS LEVEL</th>
<th>Observed</th>
<th>Estimated</th>
<th>Total</th>
</tr>
</thead>
</table>

6 This analysis has been undertaken by the ISF rather than relevant utilities. It is not based on hydrological modelling and does not take account of some complicating factors, including:

- A more rapid decline in dam levels (if restrictions were not in place) would reduce the surface area of the storages, and thus the evaporative losses that would be expected to occur.
- The analysis assumes that savings achieved under level 3 restrictions in the period from the end of June 2006 to 1 March 2007 are in line with the level of savings achieved in the period 1 June 05 to 30 June 06. However, the more recent period includes the summer months, so savings in this period would likely be higher than savings achieved in the preceding 12 month period.

The above have not been taken into account. Nonetheless, the analysis gives an indication of the effect of restrictions on dam depletion rates during drought periods.
PART V: CASE STUDIES: COSTS AND BENEFITS OF TEMPORARY RESTRICTIONS IN THE PORTFOLIO OF OPTIONS

### Table:

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<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>1-Oct-03</td>
<td>1-Jun-04</td>
<td>1-Jun-05</td>
</tr>
<tr>
<td>To</td>
<td>31-May-04</td>
<td>31-May-05</td>
<td>30-Jun-06</td>
</tr>
<tr>
<td>Number of months</td>
<td>8</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Estimated savings from restrictions (ML)</td>
<td>49,011</td>
<td>100,318</td>
<td>113,839</td>
</tr>
</tbody>
</table>

**Actual dam levels at 1st March 2007**: 972,300 ML (37.6% capacity)

**Estimated dam levels at 1st March 2007 without restrictions**: 639,077 ML (24.7% capacity)

*70,055 ML = 113,839 ML ÷ 13 months × 8 months

Source: ISF

By reducing pressure on rain fed supplies during drought, restrictions help to increase the probability that drought breaking rains will occur before critical storage levels are reached and costly decisions about alternative sources of supply are potentially required. Particularly in extreme drought (such as that currently being experienced), restrictions have an important role to play in deferring the point at which critical levels are reached and investment decisions are required. In the context of the current drought, Sydney storages would have reached critical levels much earlier had restrictions not been implemented.

This highlights the dual role that restrictions play, not only in augmenting the yield from the system, which is relevant for long term supply–demand planning, but in dampening demand during periods of drought, thus reducing the cost of securing supplies during drought.

As discussed below, reviewing the current restrictions regime would maximise its benefits while not imposing unnecessarily harsh costs on the community. Such a review has been committed to in the 2006 Metropolitan Water Plan and should consider:

- Trigger levels in the context of extended system storages being in operation.
- Expected savings at each level, updated in light of the experience of the recent drought and any potential for demand hardening.
- What activities should be permitted under each level of restrictions to ensure target savings for each level are met.
18.1.2 Costs of restrictions during current drought

This section considers the cost of restrictions from on householders, industry, local governments and utilities.

Households

Community attitudes surveys reveal strong support for restrictions at levels 1, 2 and 3, which suggests that the welfare costs on households have not been substantial:

- A Taverner Research (2005) household survey for IPART of 2021 residential households in Sydney and surrounds demonstrated that 62% of residents served by Sydney Water believed that restrictions were about right and that 28% believed that they were not strong enough. Only 7% of residents believed restrictions were too strong. Larger households were more likely to believe restrictions were too strong. (Residents were surveyed in January 2005 when Level 2 restrictions had been in place for 6 months.)

- A CRC for Water Quality and Treatment survey conducted in 2005 while Sydney was under level 2 restrictions showed that 65% of households surveyed disagreed or strongly disagreed with the statement “I will be really annoyed if water restrictions get any tougher than they already are” (Roseth, 2006).

- The Consumer Sentiment Monitor (October 2005 – September 2006) reports that, during a period of level 3 restrictions, support for tougher water restrictions should the drought continue has been trending upwards from the end of October 2005. By September 2006, 92% supported tougher restrictions in the face of continuing drought. Support exists for keeping some form of water restrictions when the drought breaks.

No publicly available studies have attempted to quantify the cost of restrictions on households in Sydney in monetary terms. Using the basic consumer surplus approach, it is possible to estimate a total welfare loss of between $8 million and $124 million per year (ISF/ACIL Tasman calculations). The Hensher et. al. (2006) willingness to pay study estimate of $239 per household per year (to avoid a sprinkler ban) is equivalent to about $374 million welfare lost per year, but this is likely to be an overestimate because the study was conducted for Canberra households. Sydney, in contrast, experiences wetter summers and rainfall uncorrelated with that in its catchment. The welfare losses estimated by either the basic consumer surplus approach or by transferring values from Hensher et. al. (2006) could result in an overestimate of costs to households, because level 3 restrictions in Sydney distinguish between sprinklers (which are banned) and drippers (which are allowed two days per week).

Industry
As with the residential sector, quantitative analysis is not publicly available on the costs of restrictions to industries in Sydney. As there are no specific rules on individual industries and most businesses can apply for exemptions, the impacts on industries most likely have arisen mainly from second-round effects – that is, through the changed behaviour of customers, which has affected the nursery, garden centre, irrigation and associated industries.

Other industries such as commercial car washes and the pool industry have not been as affected directly by restrictions, at least in part due to consultation with the industry in preparation for the introduction of restrictions (see Part II).

Outdoor water use restrictions in Sydney have targeted both timing and technology. The targeting of technologies (i.e. limiting sprinklers and watering systems) has resulted in impacts to residents (although drip systems have not been banned outright).

Utilities

The administrative costs to Sydney Water of handling restrictions are as follows:

- $5m from September 2003 to December 2006 in processing 79,123 business exemptions.
- $5.9m in water patrol 05/06 costs issuing 1,735 fines.

Given that fines range from $220 for individuals to $550 for corporations and $2,200 for water theft, the revenue from fines which would partially offset this cost is relatively small and has been estimated in this report as in the order of $0.4–$1m.

18.2 Planning for the future – restrictions in the portfolio of instruments

The 2006 Metropolitan Water Plan states that the sustainable yield (including level 1 to 3 Restrictions) is 575GL pa. This has been revised and in 2007, the current long-term yield is 570GL pa. Yield calculations are highly dependent on the estimated savings and trigger levels for restrictions.

The Sydney Catchment Authority estimates that if current level 1 to 3 drought restrictions were removed, system yield would drop from 570GL pa by 50GL pa (to 520GL) pa under the current system configuration and would be limited by security. (It is important to note that yield estimation techniques vary significantly from one jurisdiction to another and are not comparable.) This is a conservative estimate of yield impacts, based on conservative assumptions regarding the savings that result from restrictions. However, it is important to note that demand hardening may reduce the degree of demand reduction achieved by restrictions in future droughts.

This analysis demonstrates the other important function of restrictions – namely, boosting yield by reducing the size of the ‘buffer’ that needs to be maintained in
order to secure supplies during drought periods. If drought restrictions were not included in the supply-demand balance, significant investment in other measures would be required to make up for the negative impact on yield (as well as the negative impact on depletion rates during drought periods).

The 2006 Metropolitan Water Plan makes clear that restrictions play an important role by reducing demand during drought – thus easing pressure on storages and helping to defer or possibly avoid investment in more costly options. The Plan states that Level 1 to 3 restrictions remain key elements of Sydney’s drought response plans, recognising their role in delivering large savings without imposing undue impacts on the community.

As stated earlier, the Metropolitan Water Plan commits to a review of the restriction regime, so the current assumptions about savings and trigger levels are liable to change. Several factors make the case for future investigation of an optimised restrictions regime:

- insights from the current drought in Sydney and other jurisdictions relating to expected savings
- community and industry views
- potential demand hardening
- setting trigger levels for the operation of drought response measures such as groundwater and desalination
- potential changes to the manner in which water is transferred to Sydney from the Shoalhaven system
- potential changes to the reliability criterion: i.e. the amount of time that drought restrictions may be applied
- interactions between the above factors and the restrictions regime.
The 2006 Metropolitan Water Plan flagged a number of possible measures to boost water supplies in the future (noting that the supply–demand balance is met to at least 2015). These include the potential to revise the reliability criterion (meaning a marginal increase in the frequency of drought restrictions). This might be considered appropriate in light of newly availability, non-rainfall dependent options that can secure supplies during drought (whereas previously, drought restrictions were the principal means of securing supplies in drought).

Another option is to change the operating variables for transfers from the Shoalhaven system – that is, the trigger level for water transfers, the minimum operating level (the permissible drawdown of Tallowa Dam) and environmental flows in the Shoalhaven system. (A new environmental flow regime for the Shoalhaven River was recently announced.)

Important interactions occur between the trigger levels for desalination and groundwater, the reliability criterion and the Shoalhaven operating variables. These are explored in Figure 8, which shows that optimising the restrictions regime and desalination trigger would maximise the benefits for yield of any change to the reliability criterion and Shoalhaven operating variables.

**Figure 8 Supply availability (yield) with changes to Shoalhaven operating variables and reliability criterion**

Complexities within Figure 8 warrant further comment. With the reliability criterion remaining at 97% (3% of time in restrictions) changes to the operating variables associated with pumping water from the Shoalhaven River can alter the supply availability between 540 GL/a and 610 GL/a. At the current operating variables highlighted by the red line, relaxing the reliability criterion to 96.5% (3.5% of time in restrictions) would increase the supply availability to approximately 585 GL/a. However, at this point the supply availability becomes constrained. Any further relaxation of the reliability criterion will only deliver gains to supply availability with an optimised regime for restrictions and trigger levels for desalination and groundwater.

Figure 8 does not in itself suggest that the reliability criterion should necessarily be changed. However, should it be decided to change the criterion, then an updated restrictions regime would be required to realise the full benefits of such an approach.

18.2.1 Lessons for planning for the future

The analysis undertaken in this case study, including analysis of costs and benefits, confirms (as stated in the 2006 Metropolitan Water Plan) that drought restrictions have an essential role in a cost-effective portfolio of supply and demand management options to ensure water supply adequacy during drought and to optimise the use of storages during non-drought periods. As elsewhere, restrictions defer the need for potentially costly investment in supply infrastructure by allowing the supply–demand balance to be met during droughts without the need to "gold-plate" (over-design) the supply system. The avoided cost of supply infrastructure due to having a restrictions regime in place is particularly important in Sydney (and likely more so than for some other locations), due to great year-to-year variability in inflows from Sydney’s catchments. This is because severe droughts are not necessarily part of a continuing downward trend in water supply availability but are an expected, though infrequent, feature of supply availability in Sydney.

The current restrictions regime could be further optimised to fit with updated:

- Projected climatic conditions and inflow patterns to dams.
- Community expectations regarding the frequency, severity and duration of restrictions.
- Understanding of demand hardening potential.
- Infrastructure and operational characteristics of the water supply system.
The main elements that can be altered as part of a revised restrictions regime are described below.

1. Setting the reliability criterion (frequency of restrictions)

Using the current criterion for the expected frequency of restrictions (97% reliability), the average volume of water available to be supplied from the system is 570 GL/year. However, modelling demonstrates that with this criterion in place and with the implementation of environmental flow releases from Warragamba Dam after 2015, it is possible that the supply–demand balance will not be met beyond 2015 unless further sources of supply are implemented. The degree to which further sources of supply are required will depend on underlying demand trends and the scale and success of demand management programs. Decreasing the reliability criterion would mean that restrictions would be expected more often. However, this would increase the probability that supply augmentation and its associated costs, could be deferred. Community consultation, including informing the community of the tradeoffs, should be used to inform the selection of the reliability criterion for long-term system planning.

2. Trigger points

The trigger points for when each level of restriction is activated and de-activated should be developed together with trigger points for other elements in the portfolio of options, including groundwater and desalination and other operating criteria – which for Sydney relates predominantly to operating variables for Shoalhaven transfers.

3. Restrictions rules and levels

This refers to activities restricted under each level and consequently the expected demand reductions. As noted earlier, restrictions implemented to date have not imposed undue costs on households. There are several possible reasons for this – including that, during this drought and warmer months in general, monthly rainfall and rainfall frequency is greater in Sydney than elsewhere.

Following this drought would be a timely opportunity to review restrictions rules. In particular, given evidence of limited costs to date to Sydney households and widespread acceptance amongst households, potential exists to redesign rules to ensure increased effectiveness (in reducing consumption), but not necessarily impose further unacceptable negative impacts on households and industries. As noted in Chapter 18, "bottoms-up" analysis of savings due to restrictions on different end uses would help inform the design of rules that are both more effective and less costly.
19 Case study – Geelong

Information about the costs of restrictions is not currently available for the regional Victorian locations originally indicated for case studies. Therefore, the approach (presented in this case study) has been to focus on the Geelong region and to qualitatively describe the experience with restrictions and community responses and highlight experiences and responses from Ballarat and Bendigo.

Geelong is situated 75 km south west of Melbourne with approximately 250,000 people served by the Greater Geelong Supply System.

The Barwon and Moorabool storages which supply water to Geelong and surrounds usually fill between June and November from winter and spring rain and then decline during summer and autumn (Barwon Water, 2006).

19.1 Recent restrictions – savings during drought

Geelong has experienced two droughts in the past ten years, the 1997–2001 drought and the current drought. A brief timeline of the restrictions which have been in place in the Barwon region in response to these droughts is shown below. To date, Geelong has supported more than three months of a complete outdoor water ban with storages having dropped below 20%.

<table>
<thead>
<tr>
<th>Date</th>
<th>Level of Water Restriction</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 January, 1998</td>
<td>Stage 1 Water Restrictions</td>
</tr>
<tr>
<td>12 December, 1999</td>
<td>Stage 2 Water Restrictions</td>
</tr>
<tr>
<td>14 November, 2000</td>
<td>Stage 1 Water Restrictions</td>
</tr>
<tr>
<td>1 July, 2001</td>
<td>Restrictions in all regions were lifted</td>
</tr>
<tr>
<td>1 February, 2003</td>
<td>Water Conservation by-law 187</td>
</tr>
<tr>
<td>1 December, 2005</td>
<td>Permanent Water Saving Measures</td>
</tr>
<tr>
<td>1 July, 2006</td>
<td>Stage 1 Water Restrictions</td>
</tr>
<tr>
<td>16 September, 2006</td>
<td>Stage 2 Water Restrictions</td>
</tr>
<tr>
<td>1 November, 2006</td>
<td>Stage 3 Water Restrictions</td>
</tr>
<tr>
<td>9 December, 2006</td>
<td>Stage 4 Water Restrictions</td>
</tr>
</tbody>
</table>

A graph of total system storages in Geelong during the 1997–2001 drought is shown in Figure 9. Expected savings for each stage of restrictions varies per month and are shown in Figure 10.
The analysis of the 1997–2001 drought showed the following savings, which have been calculated by comparing observed consumption to weather-corrected modelled demand.
PART V: CASE STUDIES: COSTS AND BENEFITS OF TEMPORARY RESTRICTIONS

- Stage 1: 8% (in place for 23 months, Jan 1998 to Dec 2000)
- Stage 2: 20% (in place for 11 months from Dec 2000)

This is an informative historical record, as the water restrictions were in place for significant periods, allowing a representative average across the year to be inferred.

The situation for the current drought

- Stage 1 restrictions for the month of July and August 2006 show no apparent savings (as expected in winter months).
- Stage 1/2 restrictions for September 2006 show the demand was higher (2%) than normal (expected savings 1% – 4%). This is probably due to warmer than normal weather conditions.
- Stage 3 - 19% savings for the month of November 2006 (expected 17%).
- Stage 4 – 34% and 41% savings for the months of December 2006 and January 2007 respectively (expected 36% and 43%).

19.2 Community consultation and community response to restrictions

Community consultation for the Water conservation By-law 187 was undertaken in early 2006 for a period of three weeks. The consultation was widely advertised on the website and in local newspapers. Barwon Water (pers. comm. February 2007) reports that there was a low response rate to invitations for consultation, and comments received were generally supportive of the by-law. However, since the introduction of Stage 3 and stage 4 water restrictions, Barwon Water has noted a shift in attitudes and an expression of angst within the community, particularly regarding a perception that the non-residential sector makes relatively limited efforts to conserve water.

As stage 4 bans all outdoor watering, people have taken to installing grey-water diverters from their home or collecting buckets of shower water to keeping gardens alive as well as purchasing tanks and filling them with water trucked in from private dams in neighbouring regions.

The community’s response to pursuing activities despite the drought is demonstrated by the drought relief fund established by Football Geelong to help re-green selected sporting ovals in the region. This fund raised $220,000 in three weeks (Watters 2007).
19.3 **Barwon Water – implementing restrictions**

Barwon Water undertakes various approaches to promoting awareness of restrictions:

- A new hybrid car sporting distinctive branding is a highly visible and mobile reminder that water restrictions are in force across the greater Geelong region.
- Barwon Water has conducted a series of workshops to instruct residents how to maintain their gardens during the drought.
- Over the summer period, coastal townships in the region increase to four or five times the permanent population. During summer, Barwon Water conducted an extensive and varied community education campaign, which included print advertising in local and state-wide media, radio advertising, brochures, posters, mobile billboards and educational material aimed at tourists and visitors.

No contravention notices or fines have been issued since the introduction of stage 4 restrictions. However, in the first two months of stage 4 restrictions, Barwon Water received over 450 telephone enquiries from the community, which placed a significant administrative load on the utility. Barwon Water (pers. comm. February 2007) reports that, as a result of resources being allocated to manage queries and complaints, surveys or research into community attitudes has not yet been undertaken.

19.4 **Update from the region: Ballarat**

In neighbouring Ballarat, Central Highlands Water has responded to the critical water supply situation by commencing a targeted program of residential retrofits to bring forward savings to assist in the drought and are considering a washing machine rebate program as well as working with businesses and the community on water savings. Regional Development Victoria is offering “a free one-on-one business counselling program for non-farm businesses affected by the drought”.

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**NWC Review of water restrictions**

**PART V: CASE STUDIES: COSTS AND BENEFITS OF TEMPORARY RESTRICTIONS IN THE PORTFOLIO OF OPTIONS**
20 Practical conclusions and recommendations:

This chapter draws on the review and analysis of restrictions to draw some practical conclusions and recommendations for planners. It provides guidance on designing and implementing restrictions within the portfolio of options in a cost-effective way.

20.1 Permanent water conservation measures

As discussed in part II, permanent water conservation measures, as a way to reinforce other approaches to promoting water efficiency outdoors (eg. education, promotion, or product rebate schemes) receive strong support from industry, on the proviso that they are constructed effectively with a focus on water efficiency rather than volumes of water use.

While broad estimates from specific locations demonstrate a potential for significant water savings from PWCM, the information required to comprehensively analyse savings is not available. However PWCM have potential in terms of reducing long-term demand.

When a decision to employ PWCM is made, the implementation and promotion of these measures should form part of a water utilities larger demand management efforts. Permanent water conservation measures should be viewed as having a strong educational component and should be utilized to reinforce the messages of the wider 'water wise' education campaign. Disallowing water wasting activities reinforce the idea that 'every drop counts'.

The nature of PWCM - which reflect what are viewed as sensible water use practices - suggests that 'demand hardening' will be associated with these permanent measures. Demand hardening should not be viewed as a reason not to introduce PWCM. All other things being equal PCWM like other demand management measures will act to reduce demand. This increases the buffer between average demand and system yield and decreases the probability that the supply system will reach restriction trigger points. Demand hardening due to PWCM may become an issue for a water utility if supply augmentations have been avoided though the introduction of PWCM or similar measure.

For locations that have not yet implemented PWCM, opportunity exists following this drought to determine whether the permanent savings achieved by PWCM might play a valuable role in terms of utilities long-term demand management efforts. However, making such water use conditions permanent means they are no longer available managing future droughts. Introduction of PWCMs should therefore be accompanied by an analysis of potential savings and the potential impact of 'demand hardening' on temporary restrictions and associated system yields. Introduction of PWCM may also affect the cost-effectiveness of other demand management measures targeting the same outdoor end-uses as the PWCM. To appropriately analyse the savings potential of PWCM, an understanding of the individual components of demand is therefore desirable (see section 18.2) Similarly, for
locations that have already implemented “low-level” PWCM and are considering increasing their severity, further analysis should be undertaken. This should consider both the long-term demand management benefits of PWCM and the impact of losing further measures as temporary restrictions.

For locations where PWCM are in place, monitoring and analysis of the appropriateness of existing PWCM is warranted. To date estimates for the level of demand reduction from PWCM have not been adequately tested. This is despite these savings being built in to demand projections in some locations. Such analysis and testing needs to be prioritised to increase the accuracy of demand projections and could be conducted using the techniques for demand analysis and forecasting outlined in this chapter.

20.2 Filling information gaps about the cost-effectiveness of temporary restrictions

This review has identified a lack of required data and information to evaluate the cost-effectiveness of restrictions, particularly in terms of the costs and savings resulting from different types of restrictions rules – which would vary by location – and in turn, the costs and savings from a restrictions schedule or regime of rules, stages, triggers and levels of service:

- In terms of the effectiveness of restrictions, comprehensive evaluation or modelling has not been conducted to assess how restrictions rules affect individual end-uses (eg. by how much does a sprinkler ban affect volumes of water used outdoors compared to a lawn-watering ban?).

- In terms of the costs of restrictions, there are only a very limited set of monetary studies, and these do not examine the range of restrictions frequencies and severities – and furthermore may not be the most appropriate way to gauge impacts. Community attitudes surveys have been conducted, but these do not generally canvas views from industry and community following the experience of severe restrictions such as total outdoor water bans.

More detailed evaluation of the effectiveness of restrictions (including taking into account the effects of demand hardening) is important in terms of designing rules, stages, triggers and reliability criterion in a way which captures the potential of restrictions to slow down the rate of decline of storage levels during drought. Understanding how restrictions affect end uses will also help planners predict and manage the rate of bounce-back of demand once restrictions are lifted.

Importantly, evaluating the effectiveness of specific restrictions rules (eg. sprinkler ban, lawn watering ban) is essential to comprehensively evaluating the cost-effectiveness of these rules, including effective assessment and transparent communication of distributional effects. The philosophy behind restrictions rules and stages in many locations is broadly based on a “hierarchy of uses” (see chapter 10). Some utilities, acknowledging that it is value-based, also report that this is a transparent way to communicate the reasoning behind restrictions rules (Victorian
Drought Coordinating Committee, pers. comm. March 2007). Designing restrictions in this way is based on the premise of how discretionary (and consequently how costly, to users, it would be to restrict) certain types of water use are to the users of water – however, suppliers of associated products and technologies will necessarily have a different perspective than water users. Evaluating the actual savings from specific water restrictions rules would be an important step in determining whether restricting certain technologies or types of uses are justified, transparently weighing up the savings, distribution of impacts, and alternative options.

This section outlines some approaches to obtaining better information and data on the effectiveness and costs of specific restrictions rules.

**20.2.1 Effectiveness of specific restrictions rules**

Planners face many questions regarding designing restrictions rules and regimes, including:

- How much do individual restrictions – on timing, types, and technologies of water use, or residential vs. commercial – affect water use?

- What long-term demand hardening will result from restrictions, once removed? Will there be significant bounce-back after restrictions are removed, or will some savings be “permanent”? If so, does this mean future restrictions will be less effective?

- How can triggers be optimised to maximise savings from a restrictions regime?

Water restrictions rules, as currently designed, save water in two main ways. For example, as discussed in chapter 7, restrictions on outdoor garden watering save water through a mix of broadly (albeit bluntly) encouraging water-efficient timing and frequency of watering, but also by restricting potentially water-efficient technologies (eg. to bucketing only) thus achieving savings by making water use more “costly” in terms of water users’ time and energy.

However, as noted in chapter 7, currently available information has enabled only “top-down” analysis of aggregate water use to determine the effectiveness of restrictions in reducing water consumption. *This top-down analysis is not sufficiently precise to enable fine-tuning of restrictions rules nor to accurately predict demand hardening.*

Therefore, further information gathering and analysis is warranted to assist planners to better design restrictions rules. The methods outlined below will enable greater insight into the savings achieved by specific restrictions rules and stages.

These methods will also enable more cost-effective planning in general:

- More accurate forecasting of future demand will enable better determination of future supply/demand management requirements.

- Greater understanding of the individual components of water use (end-uses) will enable better prediction of the effectiveness of future demand management
programs and any incentive mechanisms such as scarcity-based pricing or rationing.

1. Consider the use of more detailed demand forecasting methods

The three main demand forecasting methods currently used are:

- **Historical forecast** – this method is the most commonly used and involves forecasting demand by determining current or historical per capita demand (for example, litres per capita per day). It involves multiplying bulk water volume records per population served by the projected population over an agreed timeframe. The forecast is particularly dependent on the reference period used.

- **Sector-based forecast** – this method involves disaggregating historical water demand into sectors (usually single residential, multi-residential, commercial, industrial, institutional, high water uses and non-revenue water). Both bulk water and customer water meter records are analysed and where possible regression analysis is used to assess how weather-related variables affect the historical demand being analysed.

- **End-use forecast** – this method involves disaggregation of demand into sectors but also uses a bottom-up approach for residential demand using end use analysis. Household demand is further disaggregated into specific indoor end uses (eg. toilets, showers) and outdoor end uses (eg. garden watering, swimming pools). The bottom-up disaggregation is then calibrated against historical, customer-metered demand. Changes in the volumes of water use may, however, occur not just because of mandatory restrictions rules, but also due to possibly voluntary savings, such as inside the house.

To determine the impact of individual restrictions rules (or any targeted demand program or incentive mechanism) on water use, the baseline demand forecasting method needs to capture *individual end uses* of water, by sectors. For example, to determine the overall impact of a particular restriction on lawn watering by households, demand forecasting would need to model water used on lawns as a separate component.

The above forecasting methods are generally based on cross-sectional multiple regression analysis. However, end-use forecasting necessarily requires more resources and data than forecasting based on historical use or forecasting disaggregated only by sector.

2. Obtain information for end-use modelling

A number of methods can be used to obtain data disaggregated to individual end-uses. Data on individual end-uses is generally calibrated against total household water use measured by household meters and/or data loggers. Commonly used methods for data collection on individual end uses are:
• Time diaries in which individual households record different water uses over time.

• Household interviews and questionnaires.

• Water meters attached to specific end uses.

• “Smart metering” which involves the use of equipment (data loggers) to read the volume of water consumed over time, and to transmit this data to a computer. Analysis of the data can identify individual end uses by examining the “patterns” of water use over time.

Various studies have been conducted which illustrate the use of these methods, including:

• **Perth (WA) Domestic Water Use Study 1998-2001** (Loh and Coghlan 2003) – This study, conducted by the WA Water Corporation, collected data on household water usage and identified water usage patterns and trends. The pilot study monitored 120 single-residential homes over 20 months. Data was collected using data loggers, allowing trace analysis to identify the volume of key end uses. Household interviews were also undertaken. This study, the largest in Australia, complemented a 1985 study that used time diaries.

• **Yarra Valley Water (VIC) Residential End Use Measurement Study 2005** (Roberts 2005) – This project evaluated end uses by attaching data loggers to the water meters of 100 homes over a two week period in summer and a two week period in winter.

• **Wyong – Domestic Potable Water Demand on the Central Coast, NSW** (Foody 2006) – In this pilot study on a single residential detached household in Wyong Shire, NSW (two hours north of Sydney), data was collected before and after water efficient devices were installed to measure the changes in water consumption.

Currently available ‘smart metering’ technologies log water flows and use these to determine the water consumed by particular end uses. Analysis of flows over time for a household allows identification of water uses which have a particular “time stamp” of water use, such as the water used by a toilet flush or a washing machine load. Although analysing flows over time can be used to identify individual indoor uses, it is more difficult to identify outdoor uses such as garden watering by different mechanisms – which is what would be required to better understand the impact of restrictions.

However, a number of developments in smart metering technology will soon enable outdoor end uses affected by restrictions to be identified. A project funded by the Victorian Smart Water Fund and conducted by CSIRO in collaboration with the Institute for Sustainable Futures is currently exploring smart metering technology which measures household water pressure as well as flows (Victorian Smart Water Fund 2007).
This technology is currently being developed for wider-scale research use. Planners will be able to log water use by a sample of households during restrictions at different stages, and following their removal, to identify how much water use was reduced by and the extent to which water use “bounced-back” after restrictions are lifted. In the meantime, qualitative research techniques such as survey methods, time diaries and interviews should be implemented during restrictions (and after they have been lifted) to obtain valuable information about the influence of restrictions on demand.

20.2.2 Extend understanding of the costs, impacts and acceptability of restrictions

As discussed in Chapter 1, assessing the costs of restrictions is key to understanding their appropriateness in managing drought situations. For example, restrictions on outdoor water use that target methods (eg. banning sprinklers) are effective not through promoting water-efficient irrigation technology, but by making it more difficult for households to use water. Therefore, there are likely to be significant difference in cost depending on how severe the restrictions rules are (eg. whether certain types of water use are banned or only restricted to certain times of the week), and also the duration and frequency (eg. all summer, or many summers in a row).

However, the nature of the impacts of restrictions on residential and non-residential sectors poses a number of challenges when attempting to quantify costs of restrictions in monetary terms. There are currently very few studies which attempt to evaluate the monetary cost associated with restrictions – whether through modelling preferences for time and garden value (welfare), or conducting willingness to pay studies (stated preference).

Willingness to pay studies, if designed well and supported by other qualitative research mechanisms, do have the potential to better inform decision-makers about the magnitude of costs associated with restrictions. However, as there are many dimensions to restrictions – including frequency, duration, specific rules, exemptions, history of recent restrictions, approach to communication – these surveys invariably only capture responses to stylised restrictions sets, from which conclusions cannot safely be extrapolated or inferred for different restrictions frequencies, durations or severities. For example, if a willingness to pay study reveals that households are willing to pay $300 per year to avoid restrictions of duration six months, it is entirely incorrect to infer from this study that households would be willing to pay $300/6 = $50 to avoid restrictions of duration one month.

Further location-specific analysis of the costs of restrictions is required. However, importantly, due to the uncertainties associated with estimated dollar costs, these monetised values should be viewed in conjunction with other relevant information such as attitude and preference surveys.

A direct way to incorporate assessment of the impacts of restrictions into planning would be in the review of reliability criteria (see section 20.3.2)
20.2.3 Community and industry engagement in decision-making

This chapter has identified several processes in the design and implementation of restrictions which should reflect community values. These include:

- Determining the reliability criteria.
- Assessing the costs of restrictions on the community and businesses.
- Reflecting community values about the impacts (e.g. externalities, upfront and ongoing opportunity costs of investment) of developing supply infrastructure.
- Reflecting community attitudes towards tradeoffs between different portfolio options, including attitudes towards uncertainty such as the risks posed by climate change on water supply security.

A number of techniques such as surveys and interviews have been discussed to help elicit quantitative and qualitative information about community values. This information can and should be used by planners as inputs to decisions about the preferred portfolio of supply and demand options (including the severity, duration and frequency of restrictions).

However, there are also emerging evidence that key decisions about resource allocation best reflect society’s values when the community themselves are involved in decision-making processes (DSE 2006). Deliberative processes (e.g. citizen juries, deliberative polls, consensus conferences) which combine representativeness (random selection of participants), deliberation (informed dialogue over a period of at least two days) and influence (participants make a meaningful contribution to decision-making) are improved means to engage the community in decision making (Carson and Hartz-Karp 2005).

Following the recent, extensive restrictions, there will be a timely opportunity to ensure that there is adequate community engagement in relation to restrictions and also more generally regarding decisions between different drought response and system security options. This will help achieve decision outcomes that are better reflective of society's preferences. There are several sources of guidance on methods for public participation and community engagement, as applicable to planning in the urban water sector, including for example information provided by the International Association for Public Participation (IAP2 2004).

20.3 Temporary water restrictions - design considerations

20.3.1 Flexibility, water-use efficiency, incentives and certainty

In combination with information about the effectiveness of restrictions, further analysis of the costs of specific restrictions rules will assist in the design of more cost-effective restrictions, possibly to incorporate some flexibility.
This review identified several applications of restrictions rules which have been designed to enable at least some flexibility for water users in how the reduce water use. Although data is not available to assess the water savings by these types of rules, increasing flexibility is likely to reduce the impacts on households and the industries which support specific uses. For example:

- **Incentives** after drought breaks and restrictions have been lifted to help households re establish water efficient gardens would also limit any longer-term impact on nursery and garden and associated industries.

- **Offset schemes**, which allow households and businesses to offset specific outdoor water uses for savings on other outdoor or indoor uses, would enable flexibility.

Exemptions, such as those which enable individuals to water to establish gardens, could address concerns about both the short-term and longer-term impact on the nursery and garden and associated industries. Savings may be affected but could be offset by a scheme to target savings in other areas, such as indoors.

As noted in this review, some applications of restrictions on outdoor garden use achieve savings by limiting flexibility on the types of irrigation technologies that can be used, thus making it more difficult (in terms of time and energy) for water users to use water on their gardens. Buckets and cans, however, do not have the same potential for water-use efficiency as at least some types of sprinklers and drippers. Flexibility to use various technologies could enable savings through *water-use efficient* practices and promote the longer-term development and up-take of such technologies and practices.

### 20.3.2 Review reliability criterion

As discussed in chapter 4, reliability criterion (which are an input into system modelling to specify the expected minimum proportion of time spent without restrictions) are usually set at around 90%, 95% or 97%. The reliability criterion is generally determined by planners without specific reference to community preferences or values.

Selecting reliability criterion has implications for supply system costs as well as the costs of any potential restrictions on the community. Setting the criterion “too high” would create unnecessary additional costs of supply augmentation – the broader community may well be willing to bear more frequent restrictions rather than the economic, social and environmental costs of supply infrastructure. Setting the criterion “too low” could result in restrictions of a severity and duration not acceptable by the community, i.e. the community would rather avoid these restrictions and bear the costs of infrastructure development.

The following issues and processes should be considered when reviewing the reliability criterion:

- As system characteristics change – for example, with increased diversification into non-rainfall dependent supply sources or with removal from the regime of very
deep restrictions – it could be expected that the acceptability of lowering the reliability requirement could increase.

- However, setting a reliability criterion as a single “expected frequency of restrictions” figure does not account for the varying costs of different levels of restrictions. Further assessment is warranted to determine whether reliability criteria reflecting different severities and durations could be incorporated into planning decisions, if indeed different severities and durations substantially influence costs.

- Community engagement should be undertaken to help inform the setting of any reliability criteria. These processes – deliberative processes, community forums and surveys – are briefly described in 18.4 below. However, systems are planned under weather and climate-change uncertainty, and reliability criteria reflect “expected” rather than actual restrictions frequency. Therefore consultative processes should also explore the community’s understanding of, and attitudes towards, risk and uncertainty.

- Alternative planning processes could be explored to incorporate restrictions frequency as a stochastic variable in supply planning (see Canberra case study). However, care should be taken when using specific cost estimates (see section 18.3 below). This is particularly the case if using the cost of restrictions estimated for a specific severity, duration and frequency, to estimate the cost of restrictions of another severity, duration and/or frequency. Assuming a linear relationship between cost of restrictions and severity, duration and/or frequency of restrictions is likely to result in decisions that do not accurately reflect community values.

20.3.3 Designing temporary restrictions for location-specific conditions

This review has identified that temporary restrictions rules, stages, triggers and reliability criterion vary between states, as well as within some states.

Consistency of triggers would not allow planners the flexibility to design the restrictions regime in a way which best reflects the water availability and scarcity situation in each location and point in time. Whether triggers are specified in terms of percentages, total volumes, or volumes per capita in storage, storage capacity varies significantly in different locations, as does expected demand per capita (in both drought- and non-drought conditions). Volumes of water in storage capacity, as noted in this review, is also not an appropriate indicator of the water availability in locations which have multiple other sources of water.

Consistency of restrictions rules and stages, whether across a state or between states and territories, would have the potential advantage of greater clarity both for water users and affected industries (eg. suppliers of garden products and watering technologies).
Box 21 Perspectives – local government on the variability of restrictions rules across a state

In NSW the Local Government and Shires Association (LGSA) noted that an emerging recognition of the range of types of restrictions and a preference for consistency across locations.

The Water Directorate (an association of some 95 NSW councils who are water utilities) introduced Drought Management Guidelines in 2003, recommending some consistency in restriction regimes of non-metropolitan, council run water utilities.

LGSA supports this policy position, citing the increased possibility for information exchange and sharing of case studies between regions, if their restrictions regimes were more similar (LGSA pers. comm. March 2007).

However, and despite the lack of detailed quantitative evidence on the precise savings and effectiveness due to specific restrictions rules, it is also apparent that both the effectiveness and costs of a restrictions rules and stages (including, importantly, the relative and marginal cost-effectiveness of restrictions compared to other drought response or long term water options) depends on many location-specific factors, including:

- **Availability and sources of water** (eg. surface water, groundwater, regulated rivers) From a system perspective, this affects what other options are available to manage water supply during droughts and longer-term. From an individual user perspective, the cost and availability of alternative sources of water (eg. private bores) affects what flexibility there is to adapt to restrictions.

- **System characteristics and types of options available**. Restrictions are a non-rainfall dependent option, which can be effective in slowing down depletion of storages during drought. However, there may be other non-rainfall dependent options available, such as recycled water, desalination, groundwater, or other transfers. The availability, costs and effectiveness of these options depends on location-specific characteristics.

- **Weather and climate**. The weather influences water demand, and in turn the potential savings from restrictions, as well as the costs. For example, in wetter climates (or times of the year), there may be less water used outdoors and less potential savings – however, there might also be fewer impacts (eg. if gardens, parks and sportgrounds do not require as much irrigation due to rainfall). Weather and climate also affects rainfall and runoff variability, and hence the likelihood of droughts and the costs of designing a water supply system to supply water through these droughts.

- **Demand management and other water efficiency measures**. Effective demand management programmes, which have improved water efficiency outdoors, may reduce the effectiveness of outdoor restrictions. However demand management measures also act to reduce long-term average demand, and hence the likelihood of water shortages during drought.

- **Types and patterns of mains water use**, and hence the potential for savings from restrictions, vary in different locations. Some of this variation is due to factors
listed above (e.g., availability of private bores, weather, and water efficiency programmes). Other location-specific factors that influence types and patterns of water use include block sizes and housing densities.

The appropriate reliability criterion (capturing expected frequency, duration and/or severity of restrictions) will also depend on community attitudes towards restrictions, as well as how these restrictions rules are specified – and both of these factors are likely to vary in different locations. The appropriate reliability criterion will also depend on what other non-rainfall dependent options are available to manage the system during drought.

In summary, as the cost-effectiveness of restrictions is dependent on many location-specific characteristics, any move towards greater restrictions consistency across locations should weigh up the potential benefits with the likely impacts of reduced flexibility to design the restrictions regime to best suite location-specific characteristics. As demonstrated in the case studies, the best “portfolio” of water management options – in terms of cost-effectiveness, sustainability, equity and/or social objectives - varies significantly with location.

Nevertheless, whether or not rules and stages are standardised across jurisdictions, these should be justified.

20.4 Expand the possibilities of drought response options

This chapter has outlined approaches to obtaining information to better inform the design of a restrictions, both permanent and temporary, in a way which takes into account the savings, costs and benefits of different types of restrictions rules, frequencies and durations.

In improving the understanding of the costs, benefits and effectiveness of temporary restrictions, an opportunity also exists to assess these restrictions within a broadened scope of possible drought response options. In some locations, a polarised “restrictions vs. supply infrastructure” debate has emerged. However, whilst both temporary restrictions and supply augmentation (during droughts, and in relation to the longer term supply-demand balance) could ensure water availability throughout droughts, an opportunity exists now to include consideration of other drought-response options, including:

- Demand management programmes, for example those which focus on reducing overall demand for water through promoting water-use efficiency.
- Designing non-rainfall dependent options, which (unlike demand management) traditionally have long lead-times and high capital expenditure, for “readiness to implement” during drought.
- Incentive-based approaches such as scarcity based pricing, rationing or trading.
Analysis of these approaches and their incorporation in planning could have significant implications for the cost-effectiveness of all other portfolio options – including both supply infrastructure and restrictions.

20.4.1 Promoting water-use efficiency through demand management

Long term demand management options, like large scale new supply augmentations (such as new storages) also have the potential to increase the buffer between available supply and projected demand and thereby decrease the frequency and severity of restrictions.

Opportunities exist to further promote water-use efficiency through demand management – and accelerating these programmes during drought can have the added advantage of reducing the rate of decline of storages in a relatively “no regrets” manner, since these options are often cost-effective when compared to supply options (Howe and White 2000). Measures might include distributing water-efficient shower heads to households, retrofitting a significant proportion of residential households in a short period, and auditing all large water uses. Broader demand management programmes can also be designed to promote innovation in water-efficient technologies – such as rebate schemes. Nevertheless, as noted in this review, in many locations temporary water restrictions that limit types or technologies of water use, limit the potential of demand management programmes which might promote technological innovation in outdoor water use (eg. rebates for water-efficient irrigation technologies).

20.4.2 Designing options for readiness during drought

Options that have the potential to alleviate pressures to water supplies during droughts are those that are not rainfall dependent, and have relatively short lead-times. These options are not limited to temporary restrictions, but also include temporary groundwater extractions and temporary water transfers (including through trading) that operate only during droughts. As discussed above, targeted large scale demand management programs that are implemented as a drought response may also be possible.

Conventionally, supply infrastructure options (even those that are not rainfall-dependent) have not been considered as possible measures that can be implemented during drought, especially during a drought that is worse than historically experienced. Due to relatively long lead-times (involving design, planning and construction), these options have been implemented during non-drought periods. However, an opportunity exists to examine whether these non-rainfall dependent supply options can be designed to be “ready” to implement during drought, but only if drought conditions require it (and all other more cost-effective options are implemented first). This means that part or all of the infrastructure is not built until trigger points are reached. Ideally all planning and approvals for infrastructure, some ground work and the regulatory mechanisms required would be in place before a drought.
While it is unlikely that readiness-options would completely eliminate restrictions these alternatives should be analysed as potential tools to avoid restrictions that have particularly high net costs to the community. Whether or not these readiness options would be preferable over implementing some or all types of temporary restrictions depends on the relative costs and savings (including consideration of distribution of costs and sustainability impacts).

### 20.4.3 Incentive mechanisms

Rationing is effectively a form of restriction – but one that places limits on the total water used by a household or individual rather than on specific types, technologies or timing of water use. By placing a penalty for usage exceeding specific levels, it is also effectively a form of price mechanism. The experience with rationing of urban water in Australia is limited, but where it has been undertaken (e.g. by Gladstone City Council in the 2002-03 drought), it could be regarded as very effective in terms of water savings and public support.

Both rationing and scarcity-based pricing do not require planners to make decisions about what water uses are discretionary or essential – but allow the water user the flexibility to make tradeoffs from within and outside the home to maximise the value they attain from water use. Water savings are achieved due to the price signal incentive mechanism. Their effectiveness would depend on price sensitivity (in the case of scarcity pricing) and to specific sensitivity to ‘illegal usage’ penalties (in the case of rationing).

Opening markets to water trading, a key objective of the National Water Initiative, is another mechanism that should be further considered when assessing the future role of water restrictions. Urban-rural trading, for example, may open up alternative supply or transfer options for managing water systems through drought and the longer term. More specifically, within the urban context, there have been recent proposals that there could be water trading between commercial, industrial and even household water users, for example by setting a “cap” on total water used (see, for example, The University of Adelaide 2006).

Further analysis of the potential of these incentive mechanisms is warranted, however with full consideration of likely costs, benefits, sustainability and distributional impacts, including on low-income households.
References


REFERENCES

DNRW – Department of Natural Resources and Water Queensland (2006). Water for South-East Queensland – A Long-Term Solution.


REFERENCES
REFERENCES


REVIEW OF WATER RESTRICTIONS

Volume 2 – Appendices

Final Report

For the National Water Commission

Authors:
Joanne Chong, Jade Herriman and Stuart White
from the Institute for Sustainable Futures

and

David Campbell from ACIL Tasman

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ACIL Tasman Pty Ltd

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Currency of this report

The research presented in this report was completed during December 2006 to August 2007. The research, including perspectives and evidence collected from personal communications, is current only for that period.

Since August 2007, there have been changes to drought situations, restrictions policies, and urban water systems and planning.

Changes which have occurred since August 2007, including further evidence or studies into the costs and benefits of restrictions, are not reflected in this report.

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We would also like to thank our many colleagues for their input, advice, ideas and support throughout this study.
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Appendix A: Organisations interviewed for this review

Comprehensive public consultation was not part of the terms of reference for this review.

The organisations listed below represent key stakeholder interests. As there was limited secondary information about the impacts of restrictions on the community, these organisations were interviewed. The number and scope of organisations contacted was limited by the time available for this review. Where possible, organisations which represented interests in case study locations were contacted.

<table>
<thead>
<tr>
<th>State</th>
<th>Metro Water Area*</th>
<th>Water providers and other organisations contacted</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Australia</td>
<td>Adelaide</td>
<td>SA Water</td>
</tr>
<tr>
<td></td>
<td>Eyre Peninsula</td>
<td>SA Water</td>
</tr>
<tr>
<td>Victoria</td>
<td>Melbourne</td>
<td>Department of Sustainability and the Environment (DSE), Melbourne Water, Drought Coordinating Committee (includes Melbourne Water, DSE, Yarra Valley Water, City West Water, South East Water, Western Water).</td>
</tr>
<tr>
<td></td>
<td>Ballarat</td>
<td>Central Highlands Water</td>
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<td></td>
<td>Bendigo</td>
<td>Coliban Water</td>
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<tr>
<td></td>
<td>Geelong</td>
<td>Barwon Water</td>
</tr>
<tr>
<td>New South Wales</td>
<td>Sydney</td>
<td>Sydney Water, Metropolitan Water Directorate</td>
</tr>
<tr>
<td></td>
<td>Hunter</td>
<td>Hunter Valley Water</td>
</tr>
<tr>
<td></td>
<td>Gosford-Wyong</td>
<td>Gosford-Wyong Water</td>
</tr>
<tr>
<td>Queensland</td>
<td>Brisbane/SEQ</td>
<td>Brisbane City Council, Queensland Water Commission, SEQ Water</td>
</tr>
<tr>
<td>ACT</td>
<td>ACT</td>
<td>ACTEW, ACTEWAGL</td>
</tr>
<tr>
<td>Western Australia</td>
<td>Perth</td>
<td>WA Water Corporation</td>
</tr>
<tr>
<td>Tasmania</td>
<td>Hobart</td>
<td>Hobart Water</td>
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<tr>
<td></td>
<td>Launceston</td>
<td>Esk Water</td>
</tr>
</tbody>
</table>

*Specified in Terms of Reference

### Organisations

#### Industry organisations

Swimming Pool & Spa Associations from various states
Australian Car Wash Association
Irrigation Association of Australia
Parks and Leisure Australia
Turf Producers’ Australia Ltd.
Turf Producers Australia Ltd – Victoria
Nursery and Garden Industry Australia (NGIA)

#### Community/consumer organisations

St Vincent de Paul Society Victoria Inc., VIC
Consumer Utilities Advocacy Centre (CUAC), VIC
Consumer Action Law Centre, VIC
Public Interest Advocacy Centre, NSW
ACT Council of Social Service
WA Council of Social Service

#### Local government associations (and related)

Western Australia Local Government Association
Municipal Association of Victoria (MAV)
NSW Local Government and Shires Association
International Council of Local Environment Initiatives

#### Other

CSIRO
Water Services Association of Australia (WSAA)
### Appendix B: Websites describing restrictions rules

<table>
<thead>
<tr>
<th>State</th>
<th>Metro Water Area*</th>
<th>Websites holding restrictions rules and regimes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasmania</td>
<td>Hobart</td>
<td>No current restrictions</td>
</tr>
<tr>
<td>Northern Territory</td>
<td>Darwin</td>
<td>No current restrictions</td>
</tr>
</tbody>
</table>

* As specified in terms of reference

These sites were accessed prior to 1 April 2007 and may have changed.
Appendix C: Legislation underpinning restrictions

New South Wales

A range of acts and regulations underpin the water restrictions in the metropolitan areas supplied by Sydney Water, Hunter Water and Gosford/Wyong Councils’ Water Authority.

Under clause 15 of Sydney Water Regulation 2000, during drought the Minister for Water Utilities may, by notice, restrict or regulate the purposes, times, quantities and means or methods of water use. The Minister may also, by notice, impose restrictions in the Hunter region under the Hunter Water (General) Regulation 2005. Gosford-Wyong Water Supply Authority is empowered to impose restrictions during drought under the Water Management (Water supply Authorities) Regulation 2004.

Victoria

In Victoria, Schedules of Restrictions (containing trigger levels, rules and stages) are documented in Drought Response Plans (DRPs).

In accordance with section 78B of the Water Industry Act 1994, metropolitan water businesses are required to prepare DRPs taking into account the written guidelines issued by the Minister for Water – “Guidelines for Developing and Implementing a Drought Response Plan” (1998). These guidelines also recommend period review and revision of restrictions, including after drought. The Schedule of Restrictions, as a part of a metropolitan water business DRP, must be approved by the Minister for Water.

Although there is no comparable legal requirement in the Water Act 1989 (under which regional businesses operate), the Minister has asked regional businesses to prepare DRPs in accordance with the same guidelines which apply to (Vic Uniform Guidelines). The Schedule of Restrictions, as part of a regional water business DRP can only be given legal effect by the relevant Water Authority by establishing a By-law, which must subsequently be approved by the Minister.

In Victoria, a 4-stage “Victorian Uniform Drought Water Restriction Guidelines for Drought Response” contain a Schedule of Restrictions which is intended to be the model for all future Schedules of Restrictions. This schedule was developed by a working group including representatives from the Department of Sustainability and Environment and Victorian water businesses (including bulk supplier Melbourne Water). This uniform schedule was developed as an initiative of the 2004 White Paper on Water, and has since been adopted (with some minor variations to allow for local conditions) by all water authorities across the State.

Queensland

In Queensland, responsibility to set and enforce water restrictions lies with the Queensland Water Commission (QWC), which was established in March 2006 as a statutory authority to implement the recommendations of the South East Queensland Regional Water Supply Strategy.
The QWC is governed by a legislative framework under Chapter 2A of the Water Act 2000. Under section 360ZD of the Water Act 2000, if the QWC considers it necessary because of a significant threat to sustainable and secure water supply, the QWC may impose restrictions on volumes of water, hours or water use, or the way in which water is used. The restriction takes effect one day after the Minister publishes a notice under section 22 of the Act, or makes a regulation under section 23 of the act. Section 360SE of the Water Act 2000 requires the QWC to consult with water service providers for water supply works in the region before it gives notice of a restriction.

South Australia

In south Australia, under section 33a of the Waterworks Act 1932, the SA Water Corporation may, with approval of the Minister by notice published in the Gazetter, prohibit, restrict or regulate the purposes for which water can be used, the manner or means by which water may be used, and the times at which water may be used.

Western Australia

In Western Australia, a seven-stage schedule of restrictions rules are contained within the water Agencies (Water Restrictions) By-laws 1998, which was made by the Minister under the Water Agencies (Powers) Act 1984. The water restrictions rules were designed by the WA Water Corporation.

Australian Capital Territory

In the ACT, under the Utilities (Water Conservation) Regulation 2006, the Minister may approve a scheme developed by ACTEW Corporation for temporary restrictions on the use of the water that ACTEW Corporation supplies. The Minister’s approval depends on satisfaction that the restrictions are necessary and desirable, that approved water conservation measures are not likely to ensure an efficient, reliable and sustainable supply of water, that the scheme adequately protects the interest of consumers, and that the utility developed the scheme in consultation with the environment protection authority.
## Appendix D: Recent restrictions stages in metropolitan locations across Australia

<table>
<thead>
<tr>
<th>State</th>
<th>Metro Water Area*</th>
<th>Recent restrictions (date of introduction)*</th>
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<tbody>
<tr>
<td>South Australia</td>
<td>Adelaide</td>
<td>Stage 2 23-Oct-06</td>
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<td></td>
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<td>Stage 3 1-Jan-07</td>
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<td>Eyre Peninsula</td>
<td>Stage 3 1-Dec-02</td>
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<td>Victoria</td>
<td>Melbourne</td>
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<td>Stage 2 1-Aug-03</td>
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<td></td>
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<td>PWSR 1-Mar-05</td>
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<td></td>
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<td>Stage 1 1-Sep-06</td>
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<td>Stage 3 1-Jan-07</td>
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<td>Ballarat</td>
<td>Stage 1 Aug-Nov-00</td>
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<td></td>
<td>Stage 2 Nov-02</td>
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<td>Stage 3 1-Sep-06</td>
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<td>Stage 4 1-Nov-06</td>
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<td>Level 2 3-Oct-05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Level 3 13-Jun-06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Level 4 1-Nov-06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Level 5 10-Apr-07</td>
</tr>
<tr>
<td>Australian Capital Territory</td>
<td></td>
<td>Stage 1 16-Dec-02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stage 2 1-May-03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stage 3 1-Oct-03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stage 2 1-Mar-04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stage 3 1-Sep-04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stage 2 1-Mar-05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stage 1 - trial of permanent PWSM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stage 2 1-Nov-06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stage 3 16-Dec-06</td>
</tr>
<tr>
<td>Western Australia</td>
<td>Perth</td>
<td>Stage 1 1-Nov-94</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stage 4 8-Sep-01</td>
</tr>
<tr>
<td>Tasmania</td>
<td>Hobart</td>
<td>Stage 1 see notes in appendix</td>
</tr>
<tr>
<td></td>
<td>Launceston</td>
<td>No current restrictions</td>
</tr>
<tr>
<td>Northern Territory</td>
<td>Darwin</td>
<td>No current restrictions</td>
</tr>
</tbody>
</table>

*As specified in the terms of reference

+ Note that restrictions rules may have changed during the periods specified above.
## Appendix E: Consumer attitudes surveys reviewed

<table>
<thead>
<tr>
<th>Survey – study citation</th>
<th>Study location(s)</th>
<th>Survey date(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSE, Responses to Drought Response Plan (MWC comment: “Retail Water Authorities involvement?”)</td>
<td>Victoria</td>
<td>2002 Not a formal survey, attitudes surmised from response to consultation</td>
</tr>
</tbody>
</table>
Appendix F: Review of currently available quantitative studies on the costs of water restrictions

Hensher, Shore and Train (2006)

HST studied Canberra households’ willingness to pay (WTP) to avoid different levels of water restrictions, using stated choice experiments. The choice experiments were designed to present different levels of water restrictions and various attributes that may be associated with the service options, including the water price, and the severity, frequency and length of restrictions.

In the survey conducted by NERA/AC Nielsen, 211 respondents indicated their choice of service options when presented with their descriptions in a series of six experiments. A standard binary logit form is used for choice modelling where the probability of the respondent’s choice between the two options is expressed as a function of the attributes associated with the options. Estimates of willingness to pay/accept have been derived as follows.

- Canberra householders are willing to pay $239 per household, on average, to move from a situation with continuous restrictions at Stage 3 or above, all year every year, to a situation with virtually no chance of restrictions. Note that at the time of the study, stage 1 restrictions were in place.

- The amount that households are willing to pay to reduce the frequency of restrictions that matters (ie, stage 3 and above every day) from, say, once every 10 years to once every 20 years is $11.95 on average.

- Similarly, the amount householders are willing to pay to reduce the frequency of restrictions that matter from once every 20 years to once every 30 years, say, is $3.98 on average.

- Customers need to be compensated by $227 on average to accept an increase in the frequency of restrictions that matter from once every 20 years to once every year.

The analysis also revealed that households were not willing to pay to avoid Stage 1 or 2 restrictions (equivalent to the current permanent water conservation measures – PWCM and Stage 1) nor were they willing to pay to avoid “browness” of public spaces under restrictions.

At the time of this report, the above estimates are the most up to date and relevant measures of willingness to pay to avoid water restrictions in the Australian context. As with all stated preference experiments, the applicability of WTP estimates in supply/demand planning should be viewed with the following qualifications:

- When the experiment was conducted in 2003, Canberra households were facing level 1 water restrictions and had never experienced water restrictions at level 3 or higher;

- The 95 percent confidence interval for the WTP estimate of $239 is from $90 to $420, a large range which reflect the sample size of 211;
• Whether stated preference reflects true behaviour, i.e. whether the respondents would have the same response to the experimental service options in real-life situations. (Discussed further in main report).

Centre for International Economics (2005)

To estimate the cost of restrictions on households in the study ‘Economic benefit cost analysis of new water supply options’ for the ACT (CIE 2005), CIE reviewed various estimates of willingness to pay to avoid restrictions (WTP) including those from the NERA/AC Nielsen study (REF) and those which they derive from ACTEW’s Future Water Options values meetings held in October 2004. CIE (2005) describe their approach as one which uses the WTP estimates from the former studies to calibrate a “demand curve” for water, then calculating the cost of water restrictions using this demand curve, i.e. the loss of consumer surplus resulting from the restriction on quantity consumed. In Table 1, the estimates of costs of water restrictions for various restriction levels, to a baseline of no restrictions, is presented. WTP estimates based on 2003 prices and incomes were indexed to 2005 figures. As described below, these estimates are significantly greater than those estimated by Hensher (2006), due to somewhat arbitrary selection of “upper bounds” to calibrate results.

Table 1 CIE estimates of restrictions costs based on WTP (2005 $)

<table>
<thead>
<tr>
<th>Restriction level</th>
<th>Low estimate ($)</th>
<th>High estimate ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>Stage 2</td>
<td>80</td>
<td>118</td>
</tr>
<tr>
<td>Stage 3</td>
<td>198</td>
<td>360</td>
</tr>
<tr>
<td>Stage 4</td>
<td>224</td>
<td>411</td>
</tr>
<tr>
<td>Stage 5</td>
<td>396</td>
<td>769</td>
</tr>
<tr>
<td>Average for stage 3 and above</td>
<td>273</td>
<td>513</td>
</tr>
</tbody>
</table>

The above estimates of water restriction costs (or rather the value of the benefit of avoided restrictions) are higher than those presented in the study by Hensher (2006), despite their use of the same choice experiment results to calibrate results.

There are a number of possible reasons why the CIE study overestimates the welfare loss to households (i.e. overestimates the benefit gain from avoided restrictions), including:

• Point choice elasticity of -0.39; the authors note that, during drought conditions, elasticity may be much greater.

• The use of the upper estimate from the NERA/AC Nielsen survey to calibrate the demand curve and report final aggregated costs. There is no basis for choosing the upper bound 95% confidence interval to calibrate results. CIE (2005) also refer to an ACT Future Water Options values meeting (of 60 to 80 people) to justify the choice of upper-bound costs, however in this meeting, participants were asked questions about the frequency of restrictions. CIE (2005) then assume a linear functional relationship to
“transform” these responses (about frequency) into welfare losses over a year, continuous as such:

- A WTP of $40 to reduce one year in six to one year in twelve is equivalent to the cost of restrictions of $480/year (using the formula 41/(1/6-1/12)).
- There is no theoretical or statistical justification behind this calibration, and is likely to result in erroneous results.

There are also a number of reasons why CIE (2005) analysis could represent an overestimate of costs – including:

- Recreation – CIE (2005) notes that much sporting time is undertaken by children and should not be valued at the full average wage rate. Furthermore, this study makes the arbitrary assumption that recreation time should be valued at the average wage rate, and also makes arbitrary assumptions about the “percentage of recreation time needed to be reallocated” under each stage of restrictions – implicitly to finding other recreation activities, although this study does not explain clearly. CIE (2005) also fails to justify their assumed costs for restoration. Therefore the costs of Stage 3 - $8m, Stage 4 - $13.7m, Stage 5 - $20.8 m, could be overstated.

- Tourism – Again, CIE (2005) does not provide analysis to determine the relationship, if any between water restrictions, and their impacts, and tourism activity – visitor numbers or expenditure. Indeed, the study notes that most tourism is related to places of national interest which are not likely to be affected by restrictions (e.g. the National Gallery). Furthermore, the suggestion that garden events such as Floriade would be lost does not take into account exemptions that are likely to apply for such events (as they would for botanic gardens, etc). The use of economy-wide I-O analysis also could magnify the original estimates. Therefore the $31m lost for stage 5 is likely to be overstated. There are also criticisms of IO analysis to be arbitrarily assuming the ‘multiplier’ effect. It is a useful method for indicating the regional impacts of changes in demand and supply, but not for estimating impacts of changes in resource supply.

- Reduced ACTEW profits and loss of revenue from abstraction charge – these are not an economic cost but transfers and hence should not be included in total costs.

- Commercial and industrial costs – again the analysis is not clearly explained, and is based on reduced water availability – however, there is no evidence provided by CIE (2005) about what assumed reductions in water use have been modelled. Indeed, significant evidence (see main report) suggests that costs to industry are not based on reductions in water use (by the industry’s customers), but on restrictions on their customers. Restrictions currently in place in ACT do not imposed “caps” on water use to industrial or commercial users.
Brennan, Tapsuwan and Ingram (2006)

BTI estimates the impact of outdoor water restrictions on consumer welfare in Perth by formulating a conceptual consumer model for the choice between lawn quality and leisure. Water restrictions are considered a restriction on technology, rather than on absolute quantity of water. Without the use of sprinklers, householders can choose to do nothing and accept lower lawn quality or to use hand-held hoses to maintain a higher level of ‘greenness’. The cost of restrictions is derived by calculating the value of the lost leisure time (measured by wage rates) for several representative groups with different incomes and preferences for greenness. The model was calibrated using empirical data on the relationship between water use and lawn quality and other characteristics of the ‘cost function’ for lawn quality.

At the baseline price for water of $0.91 per kL, the conceptual model estimated:

- For ‘high greenness preference’ consumers, the price elasticity of demand for water between successive price changes to range from -1.05 in low income consumers, to -0.37 for high income consumers.
- A sprinkler ban will cause low, middle, and high income households to experience a total welfare loss of $3,418, $7,964 and $16,057 under high greenness preferences, and $510, $1,761 and $3,390, under low greenness preferences.

This approach (lawn production cost) does not directly incorporate information on consumer preference with respect to water restrictions – as would studies eliciting willingness to pay. Furthermore, caution should be exercised when using these results, whether in Perth or other areas for the following reasons:

- This study, like CIE (2005), also makes the assumption of a linear relationship between “expected welfare loss” and probability of a sprinkler ban.
- The analysis focuses solely on the impact of sprinkler restrictions on watering of gardens and lawn and not other outdoor use of water such as car washing, pool filling etc.
- The model examined the choice between watering methods (sprinkler versus hand hose) in the short run whereas in the long run, consumers may consider other technologies (rainwater tank, recycling) and changes to low water use gardens and lawn area.
- Estimates of welfare loss for high levels of lawn quality are likely to be overstated because they are solely based on the costs of factor inputs. As production cost estimates, they represent the upper limits to the welfare loss faced by consumers and not the actual value they attach to greenness i.e. only when the former is exceeded by the latter, that consumers opt for hand held watering. For instance, because of the inconvenience and/or high imputed costs of achieving high levels of greenness during periods of water restrictions, consumers may be more prepared to accept lower levels of greenness. As the estimated marginal cost of lawn quality in the study is very low up until about 90% greenness, consumers’ acceptance of lower quality levels also means that their welfare loss is well below the model estimates derived for high preference of greenness.
- Estimates for the high income groups may be overstated as these consumers can pay workers to care for their lawn at a lower wage rate.
Appendix G: Basic consumer surplus analysis method used to determine costs of restrictions to households in case studies

As noted in volume 1 (main report), a basic consumer surplus method was used to estimate illustrative costs (welfare loss) of restrictions to households. The reason for using this very simplified method was to illustrate a consistent method across all three case studies.

Essentially, these estimates assume that the cost of restrictions is equivalent to the change in consumer surplus derived from estimating the demand for water. A linear demand curve was estimated rather than constant elasticity (for the ranges estimated, this assumption about functional form has negligible impact on magnitude of estimates).

![Diagram of consumer surplus](image)

The change in consumer surplus can be estimated as:

\[
\left(\frac{Q_{\text{restricted}} + Q_{\text{unrestricted}}}{2}\right) \cdot p \cdot \frac{Q_{\text{unrestricted}} - Q_{\text{restricted}}}{\eta}
\]

where \(\eta\) is the price elasticity of demand.

As also noted in chapter 5 of volume 1, there are a number of assumptions with any estimation – including this simplified method, or more “complicated” models – which have implications for results (see below).

Basic consumer surplus method – some assumptions and their implications for cost estimates

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price elasticity of demand</td>
<td>Price elasticities during drought conditions or for outside water use are largely unknown. Depending on choice of elasticity, could over- or under-estimate costs to households.</td>
</tr>
<tr>
<td>Price of water</td>
<td>Top tier prices of water $/kL have been used. However not all households would pay this top marginal rate (either with or without restrictions). This assumption results in an over-estimation of costs to households.</td>
</tr>
<tr>
<td>Total or outdoor water use</td>
<td>Water restrictions almost exclusively target outdoor water use (water management plan offsets are an exception). Therefore estimating welfare loss from reductions in total water use is likely to over-estimate costs to households. However, estimating welfare loss from reduction in outdoor water use only is likely to under-estimate costs to households, because of attributing all reductions in water during restrictions to outdoor use. Both methods have been used in this study.</td>
</tr>
<tr>
<td>Assumption that actual restrictions are equivalent to quantity restrictions, and</td>
<td>Water restrictions target types, method and timing of water use, but not the total water of volume used. This method assumes that the loss of welfare under restrictions is equivalent to that under rationing, which could result in costs being</td>
</tr>
</tbody>
</table>
that welfare losses are independent of frequency and duration | underestimated (for more severe restrictions) or overestimated (for less severe restrictions). This method also does not account for the effect of frequency and duration of restrictions, which could also result in over- or under-estimate of costs.

| Aggregation | This method aggregates water use over time and across households, which could result in over- or under-estimation of costs.

| Accuracy of water use data | In many locations, savings are calculated based on reported volumes of bulk water supply, and were adjusted for actual residential use, and outdoor use (where applicable). Attributing all savings under restrictions to the household sector is likely to have resulted in an over-estimate of welfare costs.

For the case studies, to illustrate the sensitivity of the estimations to some of these assumptions, the following ranges were used:

- Modelling total residential water use (higher estimate of consumer welfare loss) or outdoor residential water use only (lower estimate of consumer welfare loss).

- Price elasticities of demand between -0.3 (greater estimate of consumer welfare loss) and -- 1.7 (lesser estimate of consumer welfares loss). This range of estimates appears greater than those commonly used – indeed in many Australian studies elasticity estimates of between -0.25 and -0.35 are employed. Whilst there is some evidence that the average (eg. over time) price responsiveness of demand is in this range, it is likely (although fewer studies exist) that demand for outdoor water use, which is generally regarded as more “discretionary”, and during drought periods, is significantly more elastic. Indeed, a meta-analysis of residential water demand periods (not specifically during drought periods)1 has indicated that outdoor elasticities in the range -0.7 to -1.6.

The following parameter values were fixed in the estimations:

- Prices – the top-tiered prices were used, although some consumers will not pay this rate. This is Sydney $1.17/kL, Perth $1.12/kL, ACT $1.11/kL (higher estimate of consumer welfare loss).

- Indoor use – this was estimated to be constant at 160L/p/day throughout, in all cities. This figure was derived from a domestic water use study conducted in Perth from 1998-20012 and data from end-use model used in the review of the Metropolitan Water Plan 20043, commissioned by the NSW Cabinet Office.

- Non-residential use – Total supply/consumption volumes were adjusted using non-residential supply figures from WSAA Facts (2005).

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Appendix H: Least cost planning and levelised costs

Least cost planning

Least cost planning (LCP) (also known as integrated resource planning - IRP) is an economic assessment method applied widely to utility planning (energy and water) to determine the most cost effective program for implementation. Options for water service provision include the augmentation of water supply and water efficiency programs. The LCP principle examines the ability of water utilities to influence future demand in recognition of scarce resources and often highlights that source development through supply augmentation alone may not be the most cost effective solution because of constraints such as reliability, risk, and environmental impact. By focussing on the services that water provides (sanitation, showers, landscape), rather than the product provided, efficiency outcomes often mean that demand is satisfied with lower resource use, leading to a welfare improvement through greater producer and consumer surplus.

In the US, the National Association of Regulatory Utility Commissioners recognises LCP as a method that:

... will ensure reliable service for the customers, economic stability and a reasonable return on investment for the utility, environmental protection, equity among ratepayers, and the lowest costs to the utility and the consumer.

LCP has evolved based upon methods used in the energy economics field where the cost of conserving energy without altering the level of service experienced by the end user was investigated. LCP identifies the optimal mix of supply-side and demand-side management practices while balancing system reliability and affordability, thereby producing planning alternatives with the lowest costs to the utility and customers. It is for these reasons that LCP is widely recommended as a framework for determining the potential for water efficiency and other conservation measures to delay or avoid the need for expensive augmentation of bulk supply.

Levelised cost

The costing methods used in LCP are known as “levelised cost.” Levelised cost is viewed as an accepted method for economic evaluation because it includes all costs and benefits of an option, including environmental and social costs and the level of customer satisfaction, assessed from the combined perspective of the utility, customers and community. This method is known as levelised cost because it provides an equivalent metric enabling both demand and supply side options to be compared in terms of unit cost ($/ML). The levelised

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cost is a net cost of the present value sum of the capital, operating, and avoidable costs (or benefits). It is defined here as:

\[
L = \frac{PV(\text{costs to WSP}) + PV(\text{costs to customers})}{PV(\text{water saved or supplied})}
\]

where:

- \(L\) = levelised cost in $/kL.
- \(WSP\) = water service provider.
- \(PV(\text{costs})\) = present value of costs ($) over a given period and at a given real discount rate.
- \(PV(\text{water saved or supplied})\) = present value of the water actually supplied by a source or saved by a demand side or water efficiency option over the same period and using the same discount rate (kL).

The values included in the levelised cost are determined by the type of ‘cost test’ employed. The ‘cost tests’ include:

- Utility cost (i.e. the cost borne by the utility).
- Customer cost (i.e. the cost borne by the customer).
- Total resource cost (i.e. the cost of each option borne by the utility, customers and government – comprising of capital and operating costs).
- Societal cost (i.e. the cost of each option imposed directly on the community).

The total resource cost and societal cost tests are employed to evaluate the cost effectiveness of a supply or demand side option from a whole of community perspective. The total resource cost and societal cost differ in that the societal cost includes externalities.

The use of economic values rather than market prices reflects the occasional failure of market prices to adequately reflect scarcity value. This is particularly the case where there is imperfect competition, government intervention in the market, and the absence of a market – three scenarios commonplace in water service provision. Adjustment of market prices in these situations will more adequately reflect the marginal social costs and benefits and consequently social welfare. In an ideal world, the societal cost would always be employed to include the economic value of externalities. As valuations are not always possible, the total resource cost method is the next best, and commonly used, alternative.

Applied to water service provision options, the levelised cost is the net present value of the costs borne and avoided by the utility, customers and government. This analysis allows simple comparison of options based upon the unit cost of alternatives, for example, in dollars spent to obtain an additional kL of physical water supply. Since each water efficiency

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option is an alternative to new or expanded water supply, water efficiency options are considered cost effective when their unit cost is less than the unit cost of the lowest-cost option for new or expanded water supply. Because the utility can select the lower cost efficiency options in a water provision program, it satisfies consumer needs at a reduced water bill, thereby increasing consumer surplus.

The total resource cost and societal cost aim to reflect the costs and benefits imposed directly on the community, thereby indicating cost effectiveness from the societal perspective. These benefits and costs include avoided benefits and costs from delaying alternative projects. For example, in the case of options which provide savings in hot water use, such as labelling or standards for showerheads, the benefit of avoiding greenhouse gas emissions should be included in the NPV of that option. This benefit represents an avoided cost. In the case of showerhead standards the avoided cost of greenhouse gas emissions is such that the option has a negative societal ‘cost’. This means that the option has a net benefit even before the water conservation potential is considered.

In summary, the financial cost tests in LCP – from utility and customer perspectives – are used to analyse cash flow and to decide on the most suitable format to roll out programs and apportion costs fairly among stakeholders. The results of this form of economic assessment are used to address equity considerations between customer groups and ensure the financial viability of the water service provider.
Appendix I: Summary of water restrictions across Australia

In this appendix, the restrictions rules which applied across metropolitan water areas at the time of this report are described. The relevant restrictions frameworks (regimes) are also described, noting different trigger levels and target water use savings for different restrictions stages, as well as system supply objectives where available (security and reliability). The material presented below is from interviews with utilities, various websites describing restrictions, 2004-05 figures from WSSA Facts (2005), and other sources as noted. Where sources are not noted, the information was obtained from pers. comm.s with utilities.

Note that information presented in this Appendix is a sample of some of the information obtained, and is not intended to be comprehensive across locations.

South Australia

Adelaide

SA Water introduced water restrictions in Adelaide for the first time in July 2003, at level 2 for almost four months. Permanent water conservation measures (restricting sprinkler use to mornings and evenings) were introduced on 2 October 2003. In October 2006, level 2 restrictions were re-introduced, and increased to level 3 on 1 January 2007. It was announced in June 2007 that a further ban on domestic outdoor watering will be in place for the months of July and August, due to record low flows. These restrictions applied to all SA Water customers supplied with River Murray water – the greater Adelaide area comprising Northern Adelaide & Barossa, Torrens, Patwalonga and Onkaparinga.

Other measures adopted have included the increase of emergency storage levels at Mt Lofty, and the purchase or lease of additional temporary or permanent water licenses to increase SA Water’s River Murray allocation.

At 8 Jan 2006, SA Water has 20 dedicated water conservation officers and more than 40 ‘authorised’ officers undertaking monitoring and enforcement. Since level 2 restrictions were introduced in late 2006, SA Water has issued 2022 friendly reminders, 474 warning notices and 3 expiation notices ($315).

Due to the mixed nature of water supply sources, the restrictions framework for Adelaide does not prescribe established “trigger levels” based on amount of water in storage.

SA Government aims to reduce annual mains water demand so that by 2025 consumption would be lower than what it would otherwise have been by about 35 GL (target savings 30 GL households, commercial/industrial 2GL, community 3GL).12

---

Current Restrictions – Adelaide

<table>
<thead>
<tr>
<th>Current level</th>
<th>Recent levels</th>
<th>Population</th>
<th>Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 3 since 1 January 2007</td>
<td>Level 2 since October 2006</td>
<td>1,100,000 (2003/04)</td>
<td>406 099 residential</td>
</tr>
</tbody>
</table>

Brief summary of key rules
- Sprinkler systems may be used to water domestic gardens and lawns once a week for three hours in the morning (5-8am) or evening (8-11pm) on Saturdays (evens) or Sundays (odds). Trigger hoses and drip systems can be used 8pm-8am. Buckets and cans may be used anytime. These rules apply except for the months of July and August (2007), during which a ban on the use of household sprinklers, hoses and irrigation systems apply. Sports grounds and recreational facilities face similar restrictions as domestic gardens.
- Existing pools and spas must not be refilled from empty. New pools or spas require pool cover and permit to fill. Vehicles may be washed using bucket or commercial car wash.
- Nurseries and garden centres may use sprinkler systems 8pm-8am, or trigger hoses, cans, buckets and drip systems anytime.

Penalties
$315 expiation notice if non-compliance continues after warning notice. Serious and ongoing breaches could result in court action and fines of up to $5000 for individuals or $10 000 for businesses.

Restrictions framework – Adelaide

<table>
<thead>
<tr>
<th>Storage capacity</th>
<th>Annual demand</th>
<th>Annual supply sources (Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>197GL (10 reservoirs)</td>
<td>310GL average year, 326 GL dry year, unrestricted</td>
<td></td>
</tr>
</tbody>
</table>

System objectives
“Difficult to quantify overall [security] standard of yield due to mixed nature of sources of water... [security] standards equate to approximately four weeks of demand held in storage.”

<table>
<thead>
<tr>
<th>Restrictions level</th>
<th>Illustrative example of rules on outside watering</th>
<th>Trigger - storage level</th>
<th>Target water use savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWCM</td>
<td>Sprinklers 5pm-10am.</td>
<td>Due to the mixed nature of Adelaide’s water supply, trigger levels based on storages have not been established.</td>
<td>3.5% 11% 18% 22% 27%</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Sprinklers evens/odds (3 days per week) 8pm to 8am.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 3</td>
<td>Sprinklers once a week for 3 hours 5-8am or 8-11pm.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 4</td>
<td>Stage 4 and 5 rules will be developed as needed according to the desired water savings at the time. Pers comm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Eyre Peninsula

Eyre Peninsula, which is not supplied by River Murray water, has been under customised stage 3 restrictions since 1 December 2002 which continues to apply at the time of this report.

SA Water (pers. comm. January 2007) reported that there has been limited enforcement of the Eyre Peninsula restrictions, with dedicated compliance officers making only a few targeted visits. After the River Murray connection to the Eyre region is completed (commissioned in 2007), it is expected that they will fall under the restrictions framework applicable in the rest of the SA Water region.

<table>
<thead>
<tr>
<th>Current Restrictions – Eyre Peninsula</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current level</strong></td>
</tr>
<tr>
<td><strong>Connections</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Brief summary of key rules**

- Sprinkler systems for domestic gardens, irrigation purposes, public gardens or sporting grounds may only be used 6pm-8am (8pm-8am during daylight saving). Hand-held hoses, buckets and watering cans may be used at any time. Empty new or existing pools, spas of ponds require approval for filling. Vehicles may only be cleaned using automatic washing systems that recycle water, commercial car washing facilities using trigger hoses, or on domestic premises using trigger hoses, buckets or watering cans.
- Restrictions on washing of food transport or motor vehicle dealer vehicles to trigger hoses, buckets or means that recycle water.
- Farm dams or tanks require approval for filled or topping up except for fire fighting, domestic purposes or stock watering.

<sup>18</sup> SA Water pers. comm, January 2007.
Victoria

In Victoria, a statewide drought response planning is coordinated through the Department of Sustainability and the Environment. Each metropolitan and non-metropolitan urban water authorities is required to prepare a Drought Response Plan according to the guidelines provided for under The Water Industry Act 1994. The Guidelines outline actions which should occur in pre-drought, drought and post-drought phases – including:

- Reviewing past experience during drought - including the impacts on consumers, the authority itself, environment and water quality
- Identify and evaluate demand reduction and supply enhancement measures, including evaluation of the financial, social and environmental impacts.19

There are four stages of urban water restrictions applicable across the whole of Victoria.

The Victorian Government has set short-term water conservation targets for the Central Region (includes Melbourne, Geelong and Ballarat). Reductions from 1990 average per capita drinking water consumption 25% by 2015, 30% by 2030; at least 1% annual reduction in current water consumption in the non-residential sector.20

Melbourne

Melbourne comprises the Port Phillip and Westernport regions (7665 square kilometres).

<table>
<thead>
<tr>
<th>Current Restrictions – Melbourne</th>
<th>Population Connections (2004-05)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current level</strong></td>
<td>3,600,000</td>
</tr>
<tr>
<td><strong>Stage 3a</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Recent levels</strong></td>
<td>1,404,000 residential</td>
</tr>
<tr>
<td>Permanent water savings rules were introduced on 1 March 2005, stage 1 water restrictions on 1 September 2006 and stage 2 water restrictions on 1 November 2006, Stage 3 water restrictions on 01 January 2007, Stage 3A water restrictions on 1 April 2007</td>
<td>129,000 non-residential²¹</td>
</tr>
</tbody>
</table>

**Brief summary of key rules**

- Lawns may not be watered at anytime. Sprinklers must not be used. Dripper systems and trigger hoses may be used for garden two days per week with restricted hours. New pools must not be filled. Households may use bucket filled directly from tap for safety and corrosion, spot-cleaning vehicles, or commercial car washes which use less than 70L per car allowed.
- Sportsgrounds and public gardens may water under restricted hours, or under approved Water Conservation Plan.
- Commercial nurseries, garden centres and market gardens may use watering systems up to 3 hours/day with approval. Trigger hoses, buckets and cans filled from tap may be used anytime.
- Following a warning notice, if restrictions are still breached, customers may have water supply restricted.

---

## Restrictions framework – Melbourne

<table>
<thead>
<tr>
<th>System objectives</th>
<th>Storage capacity 1773 GL (^{22})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water restriction</td>
<td>Annual demand 484 GL/annum (unrestricted) (^{23})</td>
</tr>
<tr>
<td>Stage 1 – Lawns cannot be watered. Sprinklers not allowed. Drippers and trigger hoses 2 days per week restricted hours for gardens.</td>
<td>Annual inflows 555 GL/annum (long-term average) 395 GL/annum (low inflows) (^{24})</td>
</tr>
</tbody>
</table>

### Restrictions level

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Simplified example of rules on outside watering</th>
<th>Trigger - storage level (depends on month)</th>
<th>Target water use savings (annual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>Watering systems evens/odds restricted hours. Trigger hoses anytime.</td>
<td>795GL Jun to 955GL Nov</td>
<td>2.5%</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Lawns cannot be watered. Gardens as for stage 1.</td>
<td>703GL Jun to 810 GL Nov</td>
<td>8%</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Lawns cannot be watered. Sprinklers not allowed. Drippers and trigger hoses 2 days per week restricted hours for gardens.</td>
<td>611GL Jun to 665GL Nov</td>
<td>12%</td>
</tr>
<tr>
<td>Stage 4</td>
<td>No watering.</td>
<td>520 GL</td>
<td>17.5%</td>
</tr>
</tbody>
</table>

## Bendigo

Bendigo urban supply system is part of the Coliban System (Campaspe Catchment) which also supplies Castlemaine, Kyneton, Heathcoate, and rural areas. Coliban Water is entitled to divert 45 654 ML/year as part of long-term average (the Campaspe River is a tributary of the River Murray).

Coliban held a series of workshops in August/September 2004 (200 people attending 7 workshops) to raise public awareness of water planning options. At these workshops, participants were in favour of the community adopting water restrictions during times of drought, and also generally supported permanent water conservation measures. \(^{25}\)

Coliban employed three teams of two officers to undertake enforcement (Coliban Water pers. comm. December 2006).


\(^{24}\) Department of Sustainability and Environment (2006). Central Region Sustainable Water Strategy 2055.

Current Restrictions – Bendigo

<table>
<thead>
<tr>
<th>Current level</th>
<th>Stage 4 since 1 July 2006.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent levels</td>
<td>Mandatory restrictions since November 2002, stage 3 or higher since April 2003.</td>
</tr>
<tr>
<td>Population (2004-05)</td>
<td>74,000²⁶</td>
</tr>
<tr>
<td>Connections (2004-05)</td>
<td>37,163 (total)²⁷</td>
</tr>
</tbody>
</table>

Brief summary of key rules
- No outside watering of household gardens or lawns, sportsgrounds or public lawns.
- New pools cannot be filled.
- Vehicle cleaning may only occur with bucket for windows, mirrors, lights and spot-cleaning corrosive substances (households, motor vehicle dealers, or commercial car washes).
- Commercial nurseries, gardens and market gardens can apply for approval to use watering systems for 2 hours a day, or use trigger hoses, buckets and cans anytime.

Restrictions framework – Bendigo

<table>
<thead>
<tr>
<th>System objectives</th>
<th>Storage capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability – 95%²⁸</td>
<td>57GL + share of Lake Eppalock²⁹</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annual demand (2004-05)</th>
<th>27.3GL (entire Coliban system, including but not only Bendigo)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12.1GL (residential from entire Coliban system)³⁰</td>
</tr>
</tbody>
</table>

| Average annual yield | 45GL at 90% reliability, 39 GL at 95% reliability (system incl rural.)³¹ |

<table>
<thead>
<tr>
<th>Restrictions level</th>
<th>Simplified example of rules on outside watering³²</th>
<th>Trigger - storage level</th>
<th>Target water use savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>Watering systems evens/odds restricted hours. Trigger hoses anytime.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Lawns cannot be watered. Gardens as for stage 1.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Lawns cannot be watered. Sprinklers not allowed. Drippers and trigger hoses evens/odds restricted hours.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Stage 4</td>
<td>No watering.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

n/a Information not available.

²⁹ http://www.chw.net.au/fact_2005.htm (to be confirmed)
Ballarat

Ballarat is supplied by Central Highlands Regional Water Authority.

In Ballarat, Stage 4 restrictions have been in place since 1 November 2006.

Penalties for any person found guilty of an offence against the By-Law include a maximum fine of 40 penalty units (each $107), or 3 months imprisonment for a first offence, and 80 penalty units or 6 months for a subsequent offence. An on-the-spot fine system has been developed of 5 penalty units. There is also the option to restrict supply to 2L/minute for a breach of the Water Act 1989. Central Highlands Water has not yet enforced restrictions, however if to do so would prefer to restrict supply.

<table>
<thead>
<tr>
<th>Current Restrictions – Ballarat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current level</strong></td>
</tr>
<tr>
<td><strong>Recent levels</strong></td>
</tr>
<tr>
<td><strong>Population</strong></td>
</tr>
<tr>
<td><strong>Connections</strong></td>
</tr>
<tr>
<td><strong>(2004-05)</strong></td>
</tr>
</tbody>
</table>

**Brief summary of key rules**

- No outside watering of household gardens or lawns, sportgrounds or public lawns.
- New pools cannot be filled.
- Vehicle cleaning may only occur with bucket for windows, mirrors, lights and spot-cleaning corrosive substances (households, motor vehicle dealers, or commercial car washes).
- Commercial nurseries, gardens and market gardens can apply for approval to use watering systems for 2 hours a day, or use trigger hoses, buckets and cans anytime.

<table>
<thead>
<tr>
<th>Restrictions framework – Ballarat and district</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System objectives</strong></td>
</tr>
<tr>
<td>Reliability – 95%</td>
</tr>
<tr>
<td><strong>Annual demand</strong></td>
</tr>
<tr>
<td>(2004-05)</td>
</tr>
<tr>
<td>18.5 GL</td>
</tr>
<tr>
<td><strong>Average annual yield</strong></td>
</tr>
<tr>
<td><strong>Restrictions level</strong></td>
</tr>
<tr>
<td>Stage 1</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Stage 2</td>
</tr>
<tr>
<td>Stage 3</td>
</tr>
<tr>
<td>Stage 4</td>
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<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
</tr>
</tbody>
</table>

n/a Information not available.

Geelong

Geelong has been under Stage 4 restrictions since December 2006. Barwon Water (pers. comm. February 2007) reports that Community Consultation for the Water restrictions By-law 187 was undertaken in early 2006 for a period of 3 weeks. The consultation was widely advertised on the website and in local papers. There was not a great deal of take up, and comments received were generally supportive of the by-law.

Since the introduction of Stage 3 & stage 4 water restrictions there appeared to be a shift in attitudes and a great deal of angst within the community. However, there have been no surveys or research into the communities’ attitudes toward stage 3 & 4 water restrictions due to resources being allocated to managing the queries and complaints that are received.

<table>
<thead>
<tr>
<th>Current Restrictions – Geelong</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current level</strong></td>
</tr>
<tr>
<td><strong>Recent levels</strong></td>
</tr>
<tr>
<td><strong>Population</strong></td>
</tr>
<tr>
<td><strong>Connections</strong></td>
</tr>
<tr>
<td><strong>Connections</strong></td>
</tr>
</tbody>
</table>

**Brief summary of key rules**
- No outside watering of household gardens or lawns, sportsgrounds or public lawns.
- New pools cannot be filled.
- Vehicle cleaning may only occur with bucket for windows, mirrors, lights and spot-cleaning corrosive substances (households, motor vehicle dealers, or commercial car washes).
- Commercial nurseries, gardens and market gardens can apply for approval to use watering systems for 2 hours a day, or use trigger hoses, buckets and cans anytime.

<table>
<thead>
<tr>
<th>Restrictions framework – Geelong</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System objectives</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Stage 1</strong></td>
</tr>
<tr>
<td><strong>Stage 2</strong></td>
</tr>
<tr>
<td><strong>Stage 3</strong></td>
</tr>
<tr>
<td><strong>Stage 4</strong></td>
</tr>
<tr>
<td><strong>Trigger - storage level</strong></td>
</tr>
<tr>
<td><strong>Target water use savings</strong></td>
</tr>
</tbody>
</table>

New South Wales

Sydney

The demand reduction levels and targeted demand reductions described in the table below are based on advice from Sydney Water. Sydney Water notes that the decision to introduce water restrictions is made by the Portfolio Minister, having regard for storage levels, depletion rates, weather forecasts etc. It notes that the trigger levels used in the current drought differ slightly from the scheduled trigger levels, and that the precise rules for each restrictions level are determined during each drought.

Since the introduction of mandatory water restrictions on 1 October 2003, total usage (until 14 December 2006) was 12.5 per cent below the ten-year average.42 Further information on savings is found in Volume 1.

Sydney Water’s 2005-06 Water Conservation and Recycling Implementation Report evaluates progress towards water conservation targets for 2005-06. From the figure presented, water consumption can be estimated to be 65 L/p/day higher if stage 3 restrictions were not in place.

This report also observes that the margin of climate correction has been in a relatively narrow band of around +/- 5 L/capita/day since December 2003, suggesting that “restrictions remove much of the variation in demand that is due to climatic circumstances”.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current level</strong></td>
<td>Level 3 since June 2005</td>
<td>4,228,000</td>
</tr>
<tr>
<td><strong>Recent levels</strong></td>
<td>Level 1 since 1 October 2003, level 2 since 2 June 2004.</td>
<td>Residential 1 593 157</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other 180 766</td>
</tr>
</tbody>
</table>

Brief summary of key rules
- Hand-held hosing and drip systems allowed on Wednesdays and Sundays from 4pm to 10am.
- Permits required to fill new pools greater than 10 000L.
- Businesses, organisations and in some circumstances households, can apply for exemptions.

---

44 Metro Water Directorate, pers. comm., 2007.
### Restrictions framework – Sydney

<table>
<thead>
<tr>
<th>System objectives</th>
<th>Storage capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Security</strong></td>
<td><strong>Annual demand</strong></td>
</tr>
<tr>
<td>Dams must not approach emptiness (&lt;5% storage) more than 0.01% of the time.</td>
<td>2,584 GL&lt;sup&gt;45&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Reliability</strong></td>
<td><strong>Annual yield</strong></td>
</tr>
<tr>
<td>97%</td>
<td>526.4 GL&lt;sup&gt;46&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Robustness</strong></td>
<td><strong>Trigger - storage level of Warragamba Dam</strong></td>
</tr>
<tr>
<td>90% (not more than 10 restrictions episodes in any 100-year period.)</td>
<td>47</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Restrictions level</th>
<th>Illustrative example of rules on outside watering</th>
<th>Target water use savings (tracked monthly)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>No sprinklers or watering systems.</td>
<td>55%</td>
</tr>
<tr>
<td>Level 2</td>
<td>No sprinklers or watering systems. Hosing allowed 4pm-10am 3 days/week.</td>
<td>45%</td>
</tr>
<tr>
<td>Level 3</td>
<td>No sprinklers or watering systems. Drip systems and hosing allowed 4pm-10am 2 days/week.</td>
<td>40%</td>
</tr>
</tbody>
</table>

*Note that the target savings in this table are measured relative to a baseline of 600 GL pa, whereas the effectiveness of restrictions in practice is measured relative to modelled demand. (see Report Volume 1).

### Gosford/Wyong

The area supplied by Gosford and Wyong Council’s Joint Water Authority (the Gosford and Wyong LGAs) has been under restrictions since February 2002. Level 3 restrictions were introduced on June 2006 and Level 4 restrictions introduced on 1 October 2006, which remained in place as at August 2007.

Early in 2006, Gosford Council employed 2 full time water rangers to drive through the municipality looking for breaches of the restrictions and responding to reports of suspected breaches. Council also has Exemptions Assessment Officers – who assess applications for commercial exemptions to the restrictions on outdoor use (eg. brick layers, dog washers, pubs). They conduct site visits as necessary in assessing the applications, and if exemption is granted will conduct follow up visits to ensure the conditions of the exemption are being complied with.

There is a $200 penalty for individual breaches of restrictions and a maximum possible penalty of $2,200 for corporations. There is no ‘first warning’ system, with all breaches resulting in a fine if there is adequate evidence; only if there is not sufficient evidence will a warning be issued. Between January 2006 and June 2006, 55 fines were issued; between July 2006 and January 2007, 60 fines were issued.<sup>48</sup>

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<sup>47</sup> To be confirmed.

Education has included weekly advertising in local papers, and regular advertising on radio – addressing the restrictions regime, dam levels and specific campaigns. Other education initiatives include signage placed on the back of toilet doors in public toilets and within hotels and motels to target visitors to the area, signs and banners in public spaces, notices in rates mail outs and water notices, and presentations to industry groups such as Hotel Association and the Nursery Association. A Water Forum was held in September 2006, and information has been provided at stalls at other festival events.

WaterPlan 2050 (draft, currently on exhibition) was developed in consultation with the ‘purpose-built’ Community Liaison Group between July 2004 and July 2005. The CLG recommended that there be a ‘tough line taken when water restrictions are ignored’

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<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current level</strong></td>
<td>Level 4 since 1 October 2006</td>
<td>153,000³⁰</td>
</tr>
<tr>
<td><strong>Recent levels</strong></td>
<td>Level 3 introduced June 2006</td>
<td>62,000 residential</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,000 non-residential²¹</td>
</tr>
</tbody>
</table>

**Brief summary of key rules**

No watering of gardens or lawns using town water. No private pools filled or topped up. No car washing except windows with bucket.

Nurseries and commercial gardens may use watering systems for a total of 1 hour per day 6-8am or 6-8pm.

Bowling and gold greens and cricket pitches may use watering systems for a total of 1 hour per day Monday, Wednesday or Friday 6-9am or 6-8pm. Sporting fields, schooled ovals and other lawns may not be watered.

Water cartage from town water supply permitted for domestic internal use only.

Customers with an annual demand greater than 3500kL and all accommodation and public pools must prepare and implement a Water Management Plan.

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### Restrictions framework – Gosford-Wyong

<table>
<thead>
<tr>
<th>System objectives</th>
<th>Storage capacity</th>
<th>Average annual demand</th>
<th>Average annual yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security</td>
<td>202.7GL</td>
<td>33GL 52</td>
<td></td>
</tr>
<tr>
<td>Reliability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robustness</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Illustrative example of rules on outside watering

<table>
<thead>
<tr>
<th>Restrictions level</th>
<th>Trigger - storage level (initiate/remove)</th>
<th>Target water use savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>40% (remove at 47%)</td>
<td>8%</td>
</tr>
<tr>
<td>Level 2</td>
<td>30%</td>
<td>16%</td>
</tr>
<tr>
<td>Level 2a/2b</td>
<td>22%</td>
<td>24%</td>
</tr>
<tr>
<td>Level 3</td>
<td>18%</td>
<td>30%</td>
</tr>
<tr>
<td>Level 4</td>
<td>14%</td>
<td>32%</td>
</tr>
<tr>
<td>Level 5</td>
<td>12% (remove at 15%)</td>
<td>38%</td>
</tr>
</tbody>
</table>

Increased environmental flows may be required in future – the DNR Water Sharing Plan currently being prepared (Draft Waterplan 2050) in accordance with the Water Management Act 2000. Approx 68% of demand is residential; and when unrestricted, around 30% is used outdoor, principally for garden watering.54

There are proposed permanent limitations on the hours for garden watering, restrictions on the washing down of hard surfaces and the use of trigger hoses for car washing.55

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Hunter

### Restrictions framework – Hunter

<table>
<thead>
<tr>
<th>System objectives</th>
<th>Storage capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability – 95%</td>
<td>172GL surface (60GL aquifer)</td>
</tr>
<tr>
<td>Robustness – restrictions not entered into more than once every 10 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average annual demand: 71 GL</td>
</tr>
<tr>
<td></td>
<td>Average annual yield: 73.5 GL scheduled for increase to 79</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Restrictions level</th>
<th>Illustrative example of rules on outside watering</th>
<th>Trigger - storage level</th>
<th>Expected demand reductions below average</th>
<th>Assumed demand ML/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informal</td>
<td>Publicity campaign</td>
<td>70%</td>
<td></td>
<td>225</td>
</tr>
<tr>
<td>Stage 1</td>
<td>Ban fixed sprinklers; hoses 5pm-10am 3 days/week, internally connected rainwater tanks may also water on Friday.</td>
<td>60%</td>
<td>5%</td>
<td>205</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Ban on fixed sprinklers, hoses 5pm-10am 2 days/week</td>
<td>50%</td>
<td>10%</td>
<td>195</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Ban on outdoor use of potable water except internally connected rainwater tanks may also use water on Friday.</td>
<td>40%</td>
<td>15%</td>
<td>185</td>
</tr>
<tr>
<td>Stage 4</td>
<td>Total outdoor water ban.</td>
<td>30%</td>
<td>30%</td>
<td>150</td>
</tr>
</tbody>
</table>

The restrictions policy is designed to allow at least 2 months between implementing successively more severe restriction levels. The Policy features:

- Advertising that targets voluntary water use reduction when storage drops below 70%, and continues throughout the entire drought sequence.
- Ban on fixed sprinklers when storage drops below 60%.
- Limitation on when hand held hoses may be used when storage drops below 50%.

Annual supply is 31% of maximum stored volume – Hunter has relatively less storage than most other large urban water authorities. In 2004-05 also began Gosford Wyong Water Authority with water.

- Grahamstown Stage 2 works when complete, the yield of the combined headworks system (Grahamstown, Chichester, Tomago and Anna Bay) will be increased from around 73.5GL/year to around 79GL/year.56
- Various water conservation programs for residential and business, use of recycled water for industry (3000 ML in 2003-04) and use of effluent in irrigation.

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Australian Capital Territory

Current Restrictions – Canberra

<table>
<thead>
<tr>
<th>Current level</th>
<th>Stage 3 from 16 December 06.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent levels</td>
<td>Some form of mandatory restrictions since 16 December 2002. Stage 1 restrictions made permanent on 1 November 2005.</td>
</tr>
<tr>
<td>Population (2004-05)</td>
<td>361,000(^{57})</td>
</tr>
<tr>
<td>Connections (2004-05)</td>
<td>129,000 residential 7,000 non-residential(^{58})</td>
</tr>
</tbody>
</table>

Brief summary of key rules
- No sprinkler or irrigation systems allowed. Watering of lawns is not allowed.
- Trigger hoses, dripper systems, buckets or cans may be used 7-10am or 7-10pm odds/evens.
- Across the board exemptions are occasionally applied, allowing sprinklers.
- Pools require exemptions for filling or topping up.
- Cars may only be washed at commercial car washes that recycle water and hold exemptions.
- Water storage tanks, dams and lakes must not be filled or topped up unless with non-potable water

On 1 April 2006, ACTEW introduced permanent water conservation measures (PWCM) and moved from a 5-stage restriction scheme to a simplified 4-stage restriction scheme. In effect, stage 1 from the old scheme became PWCM.

ACTEW (2006, Review of Supply Planning Variables) notes that there was insufficient information to calculate how much consumption is reduced by water restrictions, and that observed values of reduction during each restriction level were lower (less effective) than previously thought. New target water use savings have been estimated, including the effects of demand hardening (estimated at 8% ongoing savings from PWCM).

Restrictions framework – Canberra

<table>
<thead>
<tr>
<th>Restrictions level</th>
<th>Storage capacity 215 GL(^{59})</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Annual demand 82.5GL(^{60})</td>
</tr>
<tr>
<td></td>
<td>Average annual yield</td>
</tr>
<tr>
<td>PWCM</td>
<td>Trigger - storage level (averages below — triggers vary by month)</td>
</tr>
<tr>
<td>Stage 1</td>
<td>Target water use savings</td>
</tr>
<tr>
<td>Stage 2</td>
<td>50%</td>
</tr>
<tr>
<td>Stage 3</td>
<td>40%</td>
</tr>
<tr>
<td>Stage 4</td>
<td>35%</td>
</tr>
<tr>
<td></td>
<td>31%</td>
</tr>
</tbody>
</table>

---

\(^{59}\) To be confirmed
Queensland

South-east Queensland (including Brisbane)

The Queensland Water Commission (QWC) was established in March 2006 as a statutory authority. One of its roles, legislated under chapter 2A of the Water Act 2000, is to set and enforce water restrictions. Previously, SEQWater, the major supplier of untreated bulk water in the region, was responsible for designing restrictions.

As at 2007, 12 local councils in the south-east Queensland area (including Brisbane) are covered by restrictions implemented by QWC. Level 5 restrictions were introduced on 10 April 2007, and incorporate the “Target 140” plan, which aims to reduce per capita water consumption to 140 L per day.

<table>
<thead>
<tr>
<th>Current Restrictions – Brisbane and SEQ</th>
<th>Population</th>
<th>Restrictions framework – south east Queensland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current level</td>
<td>SEQ: 1.2 million consumers and businesses(^61)</td>
<td>Storage capacity 1760 GL(^63)</td>
</tr>
<tr>
<td>Recent levels</td>
<td>Brisbane: 975,000 (2004-05)(^62)</td>
<td>Annual supply 2004-05 285GL(^64)</td>
</tr>
<tr>
<td>Stage 5 since 10 April 2007.</td>
<td>Connections 1 million (includes 6 neighbouring water authorities)</td>
<td>450GL(^65)</td>
</tr>
<tr>
<td>Level 4 since 1 November 2006.</td>
<td></td>
<td>Annual yield 630 GL or 450 GL(^66)</td>
</tr>
<tr>
<td>Level 3 restrictions commenced 13 June 2006.</td>
<td></td>
<td>Restriction level</td>
</tr>
<tr>
<td>Level 2 restrictions commenced 3 October 2005.</td>
<td></td>
<td>Stage 1 Voluntary</td>
</tr>
<tr>
<td>Level 1 restrictions (voluntary) 13 May 2005.</td>
<td></td>
<td>Stage 2 No sprinklers. Hoses odds/evens 7am-7pm 3 days a week. Buckets anytime.</td>
</tr>
<tr>
<td>Only water existing gardens with buckets or watering cans on three allocated days between 4pm–7pm.</td>
<td></td>
<td>Stage 3 No sprinklers, no outdoor hosing</td>
</tr>
<tr>
<td>High water users (greater than 800L/day) must submit to council a water use assessment form on their water use, and identify savings opportunities.</td>
<td></td>
<td>Stage 4 No sprinklers, no hoses. Buckets or cans allowed odds/evens 3 days a week 4-8am and 4-8pm.</td>
</tr>
</tbody>
</table>

66 HNFY and derated yields respectively. South East Queensland Regional Water Supply Strategy, Stage 2 Interim Report.
In Western Australia (WA), the WA Water Corporation administers restrictions on water sourced from mains (town water). Separate licensing conditions exist for water sourced from private bores.

Water Agencies (Water Restrictions) by-laws specify seven stages of restrictions for Western Australia. In Perth, a daytime sprinkler ban has operated since November 2004 and stage 4 restrictions have been in place since 8 September 2001. To the time of this report, the restrictions have been estimated to save 44.2GL/year. 68

Education and awareness campaign activities have included newspaper and television campaigns, sprinkler days fridge magnet distribution, and a number of community and industry Waterwise Programs. Water Corporation of WA estimates that $1.2million is spent statewide on marketing and education for water conservation activities, about one-third directly related to water restrictions. 69 Spent over what period of time?

The penalties for non-compliance are a warning followed by $1000 fine for second and subsequent offences. Up to 16 staff carry out enforcement activities, which are estimated to cost approximately $600 000 per year.

Water Corporation of WA suggests that the additional savings to be made through moving from a 1-day-a-week sprinkler rule to a sprinkler ban are not significant, but are likely to be less acceptable by the community (due to inconvenience). 70 The corporation was considering incorporating a 1-in-200-year reliability rule (regarding total sprinkler ban) into future planning at the time of this report.

The Water Corporation of Western Australia has also undertaken the following emergency responses at this time:

- Initially emergency response included new groundwater bores (9 superficial aquifer bores at Mirrabooka and 3 deep Yarragadee artesian bores), 2 new pipehead dams (Samson and Wokalup). These projects were delivered during 2002 and 2003.

- Planning and investigations were also advanced for
  - a seawater desalination plant (subsequently delivered in 2006);
  - development of the South West Yarragadee groundwater source (project awaiting regulatory and funding approval as at August 2007);
  - catchment thinning trial to improve runoff from surface water (commenced in 2006);

• water trading with irrigators (initial temporary trade in 2003/04 has now progressed to include permanent trades from 2005/06); and

• water recycling opportunities advanced (Kwinana Water Reclamation Plant commenced in 2004 and an aquifer replenishment trial using highly treated wastewater is being planned awaiting Federal funding support from the National Water initiative.

- 2006 emergency response to prevent increase in restriction level:

  • additional 2 Leederville bores to allow increase in abstraction from 165 to 175GL/yr in extreme circumstances;
  
  • maximising groundwater usage and minimising production down-time;
  
  • maximising dam capacity (i.e. minimum useable level).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current level</strong></td>
<td>Level 4 introduced 8 September 2001, estimated savings 15% of 45 GL per year.</td>
<td>1,484,000</td>
</tr>
<tr>
<td><strong>Recent levels</strong></td>
<td>Daytime sprinkler ban permanent from November 2004.</td>
<td>741321</td>
</tr>
<tr>
<td><strong>Population</strong></td>
<td>1,484,000</td>
<td></td>
</tr>
<tr>
<td><strong>Connections</strong></td>
<td>741321 connections, 652362 residential</td>
<td></td>
</tr>
</tbody>
</table>

**Brief summary of key rules**
- Watering by sprinklers may occur only once per day on two designated watering days per week (based on house number) between the hours of 6pm and 9am.
- No restriction on hose watering of gardens but hosing of paved surfaces not permitted.
- Self-supplied groundwater only subject to daytime sprinkler ban.

**Restrictions framework – Perth**

<table>
<thead>
<tr>
<th>System objectives</th>
<th>Storage capacity</th>
<th>Annual demand (2004-05)</th>
<th>Average annual yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>No reliability standards have been set from a regulatory point of view. However, the Corporation intends to move from a reliability standard (for total sprinkler bans) of 3% of years to one year in 200. This standard is currently being reviewed in response to concerns from the Economic Regulation Authority.</td>
<td>188 GL</td>
<td>228.6GL</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Restrictions level</th>
<th>Illustrative example of rules on outside watering</th>
<th>Trigger - storage level</th>
<th>Target water use savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>Daytime sprinkler ban</td>
<td>Trigger levels not fixed but assessed annually based on sources available including groundwater allocation and water trade opportunities.</td>
<td>20 GL/year</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Odds &amp; Evens sprinkler watering</td>
<td></td>
<td>30 GL/year</td>
</tr>
<tr>
<td>Stage 3</td>
<td>3 days a week sprinkler watering</td>
<td></td>
<td>35 GL/year</td>
</tr>
<tr>
<td>Stage 4</td>
<td>2 days a week sprinkler watering</td>
<td></td>
<td>45 GL/year</td>
</tr>
<tr>
<td>Stage 5</td>
<td>1 day a week sprinkler water</td>
<td></td>
<td>60 GL/year</td>
</tr>
<tr>
<td>Stage 6</td>
<td>Sprinkler watering ban</td>
<td></td>
<td>70 GL/year</td>
</tr>
<tr>
<td>Stage 7</td>
<td>Total sprinkler and hose watering ban</td>
<td></td>
<td>100 GL/year</td>
</tr>
</tbody>
</table>

Tasmania

Hobart Water

Stage 1 water restrictions came into force for Hobart, Glenorchy, Clarence, Kingborough and Derwent Valley Councils on 17th December 2006. The ‘odds and evens’ watering system under State 1 restrictions were implemented primarily as a precaution for the hotter summer weather and for fire fighting.

The Water, Sewer & Drains By-law 1998 has provisions for on-the-spot fines to be issued for third offence against restrictions rules.

Relaxation Permits for restrictions are available in some circumstances on written request to address issues of safety and financial hardship.

<table>
<thead>
<tr>
<th>Current Restrictions – Hobart</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current level</strong></td>
</tr>
<tr>
<td><strong>Recent levels</strong></td>
</tr>
<tr>
<td><strong>Population</strong></td>
</tr>
<tr>
<td><strong>Connections</strong></td>
</tr>
</tbody>
</table>

**Brief summary of key rules**

- Residential - odds/evens can water using fixed, moveable and non-automatically timed sprinklers (including microspray and drip systems) - Tues/Thurs/Sat, Wed, Fri, Sun - no sprinkler watering Mondays. Hand held hoses may be used at anytime on any day. On Total Fire Ban days declared by the State Fire Commission, watering by fixed, moveable or automatically times sprinklers is totally prohibited. Window washing by bucket and hand held hose. Washing of paths and driveways not permitted. Cars by bucket and hand held hose.

- No restriction on any outdoor water use which is part of the incoming earning process of the business.

- Water use for non-income earning purposes of businesses such as landscape irrigation and pavement washing activities are restricted as per domestic use. Discretion: Councils may exercise discretion in applying restrictions for special circumstances such as filling public or commercial swimming pools, dams and like structures; filling tankers for other than non-potable water use; and water use on cultural and tourist areas considered to have cultural or significant tourist value.


Restrictions framework – Hobart

<table>
<thead>
<tr>
<th>Restrictions level</th>
<th>Illustrative example of rules on outside watering</th>
<th>Trigger - storage level</th>
<th>Target water use savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>Odds and evens use of outdoor water system, hand-watering at all times. Cars by bucket and hand held hose. No hard surfaces.</td>
<td>60%*</td>
<td></td>
</tr>
<tr>
<td>Stage 2</td>
<td></td>
<td>50%**</td>
<td></td>
</tr>
<tr>
<td>Stage 3</td>
<td></td>
<td>40%*</td>
<td></td>
</tr>
</tbody>
</table>

Sources:

*Stage 1 – implemented when Weather conditions are or are predicted to be such that demand may increase to a level where it may prevent the refilling of Council reticulation reservoirs overnight, or Hobart Water is unable to sustain at least 60% of normally useable storage in the bulk system.

** Water restrictions may be increased to the next stage where the current Stage of restrictions are not having the desired effect and / or where there are difficulties regarding overnight recovery of reticulation storage, or Hobart water is unable to sustain at least the trigger level (%) of normally useable storage in the bulk system storages.

Launceston

There are currently no restrictions in place in any of the areas supplied by Esk Water, and have not been since Esk water was formed in 1997. Some of the individual Councils serviced by Esk Water may have had restrictions in place prior to 1997, but there has been a 30% reduction in demand since 1997 – attributed to a combination of pricing regime change, metering, demand management programs and general growing community awareness about water conservation due to national drought issues.

Within the City of Launceston, the township of Lilydale (a small bush town with 190 houses and unmetered supply) has been subject to restrictions between December 2006 and April 2007, to protect pressures of supply (this is not supplied by Esk Water). These applied only to the township and were triggered by resident feedback and after liaison with the water committee.

There is currently no restrictions policy or regime for Esk Water, and systems objectives such as reliability and robustness do not have numerical targets. It is believed that there will be no need for restrictions at any time in the near future.77

Most of the supply is from run of river rather than storage. A recent report (unpublished) reviewed the last 30 years of streamflow data and concluded that they would need another 40% reduction in streamflow to require restrictions.78

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**Northern Territory**

There are no current water restrictions in place in the Northern Territory. This study has not included a review of water restrictions for the Northern Territory.